,

Energy Sector Development and Carbon Abatement Challenges in Saudi Arabia, the United Arab Emirates, and Qatar

Justin Dargin
St. Hilda's College
School of Geography and the Environment
University of Oxford

Thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Oxford

Supervisors: Professors Jonathan Stern and Dariusz Wojcik

Abstract

The issue of climate change is high on the global agenda, and the hydrocarbon-rich countries of the Gulf region are no exception. While the Gulf countries initially resisted the drafting of an international climate agreement for many years, they have now finally realized that decarbonization is not only necessary for their continued existence due to the threat of climate change, but that it would assist in reducing their hydrocarbon demand and meeting their economic diversification goals.

This research focuses on how Saudi Arabia, the United Arab Emirates, and Qatar could achieve the decarbonization goals of their Paris Agreement (COP 21) pledges by analyzing the potential impact that various carbon reduction frameworks, such as carbon trading, carbon taxation, and command and control regulations, would have on their economic development. The key questions posed in this paper are whether carbon reduction mechanisms could be a viable way to reduce domestic hydrocarbon demand, and if so, which carbon reduction model would be preferable, and how it should be optimally designed to meet the Paris Agreement commitments?

These questions are answered by examining the contours of the energy sectors of the three selected countries, the evolution of their negotiating positions during the various international climate negotiations, and an analysis of the various carbon reduction frameworks and how they might best be designed to optimally decarbonize their macro-economies.

My principal findings are that Saudi Arabia and the UAE would be best placed to implement national carbon markets in their respective jurisdictions, due to their large industrial bases and downstream sectors, as well as their relatively mature economies and growing populations. In Qatar's case, my research discovered that a command-and-control carbon reduction framework would work optimally because Qatar's small size, both in population and industrial base, would more efficiently allow direct regulation. This research is an important contribution because as it showed that the Gulf countries may have taken a

circuitous route to recognize the importance of combatting climate change, but now they are investing billions of dollars in alternative (nuclear+renewable) projects, implementing robust energy efficiency codes, and announcing, in the case of the UAE and Saudi Arabia, ambitious net-zero goals. As a result, understanding how they may arrive at their Paris Agreement pledges is critical for understanding the potential evolution of the region's development and the contours of the future global energy market.

Acknowledgments

There are many people for whom I am incredibly grateful who have selflessly supported me during the pursuit of my doctorate. Without them, it is doubtful I would have been able to complete this present thesis. Firstly, I would like to thank my supervisors sincerely, Professors Jonathan Stern and Dariusz Wojcik, for their unwavering support, encouragement, and generosity. They have pushed me to apply my critical thinking to every step of my work. This thesis was the culmination of many years of study of energy and climate issues in the Middle East, during which Professor Jonathan Stern generously granted me access to the deep well of experience he has from working and researching in the region. Dr. Wojcik allowed me to benefit significantly from his boundless knowledge of economic geography and its application to understanding the contours of economic development in energy-rich producing countries.

I sincerely thank both of them for their meticulous guidance and friendship on this journey. I am also deeply indebted to my loving parents, whose patient support truly allowed me to reach the finish line. And I would not have been able to finish a project of this scope without the abundant love and support of Kasia Szczepanik, who relentlessly urged me to pour more of my spirit into this work. I would also like to thank the Dubai Initiative at Harvard Kennedy School, where I served as an energy-climate research fellow during the early stages of my research. With access to on-the-ground resources in the Middle East from Harvard, I broadened my research scope significantly. The comments I received during the transfer of status and confirmation of status were invaluable in the ultimate direction of my research; therefore, I would like to thank Drs. Gordan Clark, Jim Krane, and Nick Eyre for their in-depth critical analysis of my work. I would also like to thank Dr. Lorraine Wild for her excellent assistance during my time at Oxford.
Along a journey like this, there are many people who I may not have mentioned, but they are not forgotten. They still figure prominently in the formation and development of this research, and I would like to thank everyone along the way who was a positive influence during my studies.

Table of Contents

Chapter One: Creating the Case: Carbon and Energy Assessments in Saudi Arabia, the UAE, and Qatar 13
1.1 Background 13
1.2 Objectives 21
1.3 Conceptual Framework 22
1.4 Data and Methods 28
1.5 Structure of the Thesis 33
Chapter Two: Literature Review 36
2.1: Tracing the Intellectual Contours 36
2.1.1 Gulf-related climate literature 36
2.1.2 Theoretical and Conceptual Climate Literature 42
2.2 The Taxonomy of Carbon Abatement Instruments 45
Chapter Three: Crossing the Rubicon: Qatar's Journey to Natural Gas Dominance 52
3.1 Introduction: Overview of Qatar 52
3.2 Qatar's Gas Reserves 54
3.2.1 North Field Development and Characteristics 55
3.3 The Development of the Qatari Gas Industry 58
3.3.1 The Birth of Qatari Gas Development 58
3.4 Domestic Demand: Petrochemicals and Power Generation 65
3.4.1 Qatar's Petrochemical Sector 67
3.4.2 Power Sector 68
3.5 Conclusion: The Transformative Gambit: Challenges and Opportunities 70
Chapter Four: Background and Outlook of the Emirati Energy Sector 73
4.1 Brief History of the UAE 73
4.2 Overview of the UAE Natural Gas Sector 74
4.2.1 Domestic Natural Gas Reserves 76
4.2.2 UAE Natural Gas Production and Imports 79
4.2.3 Natural Gas Demand and Drivers 80
4.3 Supply and Demand projections 83
4.4 Conclusion 85
Chapter Five: Saudi Gas Production: Strategy and Challenges 86

5.1 Introduction: The Growth of the Oil Titan 86
5.2 The Saudi Oil Sector 89
5.3 Saudi Natural Gas Sector 91
5.3.1 Incremental Gas Production 92
5.3.2. Gas Production Challenges 96
5.4 Rising Energy Demand 100
5.4.1 Sectoral Gas Demand 100
5.4.2 Power Sector 102
5.4.3 Industry and Petrochemicals 105
5.5 Conclusion 108
Chapter Six: Combatting Rising Energy Demand: Decarbonization Efforts 110
6.1 Introduction: Background of the Arab Social Contract and Regional Energy Pricing 110
6.2 Energy Sector-Based Industrialization in the Gulf Region 113
6.3 The Development of Gulf Energy Pricing 117
6.4 Energy and Power Pricing Reform in Saudi Arabia, the UAE, and Qatar 122
6.4.1 The Gulf Social Contract 122
6.4.2 Saudi Arabia and Energy Price Reform 126
6.4.3 Emirati Energy Price Reform 130
6.4.4 Qatar and its Energy Pricing Framework 133
6.5 Gulf Alternative Energy Deployment 134
6.5.1 Saudi Arabia: Moving Ahead with Solar Investments 138
6.5.2 Investing in the Atom: Saudi Nuclear Energy Development 142
6.5.3 UAE: Ahead of the Pack with Renewable Energy Deployment 144
6.5.4 Qatar's Renewable Energy Goals 151
6.6 Conclusion 153
Chapter Seven: The Pathway to Gulf Carbon Emissions Reductions Plans 156
7.1 Introduction: Climate Change and the Gulf Region 156
Introduction: Climate Change and the Gulf Region 156
7.2 The Evolution of the Negotiating Positions of Saudi Arabia, Qatar, and the UAE in the Global Climate Accords 159
7.2.1 The Gulf and the Development of a Carbon Consensus 159
7.2.2 Copenhagen Accord: The Gulf Countries Agree to Disagree 168
7.2.3 The Road from Cancun to Durban 171
7.2.4 Qatar Takes the Driver's Seat: The Doha Negotiations 173
7.2.5 The Paris Agreement: The Gulf Agrees to Carbon Emissions Reductions 176

7.2.5 COP 26: The Establishment of Enhanced Frameworks 183
7.3 Analysis of the Nationally Determined Contributions of Saudi Arabia, the UAE, and Qatar 187
7.3.1 The Saudi Arabian NDCs 188
7.3.2 United Arab Emirates NDC 195
7.3.3 The Qatari NDC 200
7.4 Conclusion 205
Chapter Eight: Carbon Abatement Lessons from the EU and China 206
8.1 Introduction 206
8.2 How to Quantify Success and Failure: Lessons from the EU 208
8.3 Carbon Trading with Chinese Characteristics 217
8.3.1 Structure of the Pilot Schemes 220
8.3.2 The Creation of a National ETS 222
8.3.3 Challenges to the National ETS 227
8.4 Conclusion 229
Chapter Nine: Carbon Abatement Strategies in Saudi Arabia, the UAE, and Qatar 232
9.1 Introduction 232
9.2 Requirements for Designing an Effective Carbon Trading Platform 236
2.1 An Initial Allowance Disbursement in a Cap-and-Trade System 237
9.2.2 Developing the Base: Development of MERV, Certification, and the Construction of a Baseline 241
9.2.3 National Carbon Scheme Integrity 242
9.3 Could a Cap-and-Trade Regime be Realistically Implemented in the Three Selected Gulf Countries? 244
9.3.1 The Rationale for the Implementation of a Domestic Carbon Abatement Schemes in the UAE, Saudi Arabia, and Qatar 245
9.4 Current and Potential Progress of the Development of Carbon Abatement Mechanisms in the Three Selected Gulf Countries 250
9.4.1 The Potential Development of a Carbon Abatement Mechanism in the UAE 250
9.4.2 Carbon Reduction Initiatives 252
9.4.3 Gas Flaring and Methane Leakage 255
9.4.4 Current Status of Emirati Environmental and Carbon Regulatory Agencies 257
9.4.5 How the UAE Could Implement a Carbon Market 262
9.5 The Potential Development of a Carbon Abatement Mechanism in Saudi Arabia 265
9.5.1 Carbon Reduction Initiatives 266
9.5.2 Gas Flaring and Methane Leakage 272
9.5.3 Current Status of Saudi Arabian Environmental and Carbon Regulatory Agencies 275

9.5.4 How Saudi Arabia Could Implement a Carbon Market 277
9.6 The Potential Development of a Carbon Abatement Mechanism in Qatar 280
9.6.1 Gas Flaring and Methane Leakage Initiatives 282
9.6.2 Other Carbon Reduction Initiatives 285
9.6.3 Current Status of Qatari Environmental Legal Frameworks and Carbon Regulatory Agencies 287
9.6.4 How Qatar Could Implement a Carbon Emissions Abatement Framework 291
Chapter Ten: Conclusions and Implications: Carbon Abatement Strategies in Saudi Arabia, Qatar, and the UAE 293
10.1 Introduction: Key Findings 293
10.2 Contributions to Research 305
10.3 Contributions to Policy 309
10.4 Limitations and Suggestions for Future Research 312
Bibliography 317
Appendix A: Detailed Additions to Chapter Seven 365
Appendix B: Total Listing of GHG Regional and Global Accounting 375
Appendix C: Interviews, Conferences, Consultations and Lectures 384
Appendix D: Arabic Language Documents and Resources 389

List of Boxes. Figures and Tables

Figures

1.1 New Institutional Economics Model...24

3.1 Map of the North-West Dome Reservoir and Qatari Energy Infrastructure 54

3.2 Qatar Gas and Oil Fields...56

3.3 Qatari Dry Natural Gas Demand 1980-2020 66

4.1 Map of the UAE..74

4.2 Emirati Natural Gas Demand 1980-2020 75

4.3 Location of Abu Dhabi Gas and Oil Fields...77

4.4 Total Primary Energy Consumption in UAE by Fuel Type, 2018.................................81

4.5 Emirati Gas Demand Footprint..82

5.1 Saudi Gas Production 1970-2020... 92

5.2 Map of Major Saudi Arabia Oil/Gas Fields...95

5.3 Saudi Gas Demand from 1980-2020...102

5.4 Saudi Electricity Demand...105

5.5 Saudi Domestic Power Generation Fuel Mix...106

5.6 Upcoming Oil and Gas Projects in Saudi Arabia, 2021-2025.......................................107

6.1 Middle East Project Regional Gas Demand by Sector Source.......................................115

6.2 Middle East Historical and Projected Power Generation by Method............................137

6.3 Power Generation Costs (LCOE) Under Typical Middle Eastern Conditions................138

7.1 Representation of Circular Carbon Economy..193

8.1 Verified Emissions Under the EU ETS, Excluding Aviation...216

8.2 European Carbon Prices 2017-2021...217 ‘

8.3 Pilot Trading Schemes in China..219

8.4 Chinese Energy Use Emissions...226

9.1 UAE Annual Carbon Dioxide Emissions (MMtonnes)..252

9.2 UAE Methane Emissions (2020) 257

9.3 Saudi Arabian Annual Carbon Dioxide Emissions..266

9.4 Saudi Arabian Methane Emissions (2020) 274

9.5 Carbon Intensity of Global Crude Oil Production...275

9.6 Map of Saudi Arabia...280

9.7 Qatar Annual Carbon Dioxide Emissions...282

9.8 Qatar Methane Emissions (2020) 285

Tables

1.1 Table of Source Material...32

1.2 Interviews..33
6.1 Saudi Arabia Price Reform...128

6.2 Saudi Power Tariffs Reform...129
7.1 Gulf Hydrocarbon Producers' Core Positions During Climate Negotiations (From Kyoto to Glasgow)
....366
7.2 Table 7.2: Equity Principles and Burden Sharing Rules 367
7.3 Foundation for an NDC...368

7.4 Main Elements of Saudi Arabia's First NDC (2016)..369

7.5 Main Elements of Saudi Arabia's Updated NDC (2021)..370

7.6 Main Elements of UAE's First NDC (2015)...371

7.7 Main Elements of UAE's Second NDC (2020)..372

7.8 Comparison of UAE NDC Targets...373

7.9 Main Elements of First Qatar's NDC (2015)...374

7.10 Main Elements of Qatar's Second NDC (2021)..375

8.1 The EU ETS Phases.. 211

List of Abbreviations and Acronyms

MCM	Million Cubic Meters
BBL	Barrel of Crude Oil
BCM	Billion Cubic Meters
BCF	Billion Cubic Feet
BPD	Barrels per Day
CCS	Carbon Capture and Storage
CoP	Conference of Parties
TCM	Trillion Cubic Meters
MBPD	Million Barrels Per Day
MMtonnes	Million Ton
KGOE	Kg of Oil Equivalent
kWh	Kilowatt-hour
GCC	Gulf Cooperation Council
GWe	Gigawatt Electrical
LCOE	Levelized Cost of Electricity
MMBTU	Metric Million British Thermal Unit
Mn t/yr	Million Ton Per Year
MW	Megawatt
IPCC	Intergovernmental Panel on Climate Change
MERV	Monitoring, Evaluation, Reporting, and Verification
COP	Conference of Parties United Nations Climate Change Conference
MGS	Master Gas System
TWh	Terawatt-hour

Chapter One: Creating the Case: Carbon and Energy Assessments in Saudi Arabia, the UAE, and Qatar

1.1 Background

The Gulf region has faced a host of challenges for decades, comprising a range of internal and external threats.[1] The Gulf countries now recognize that climate change potentially gave birth to a new host of systemic threats, such as desertification, food insecurity, internal conflict, extreme heat waves, domestic population displacement, and a host of other destabilizing forces.[2] The Middle East as a region arrived at the awareness that climate change offers unparalleled threats to its way of life and potential opportunities to transform their economies into dynamic growth engines as they engage in macroeconomic diversification.[3]

The significant multibillion-dollar investments in renewable energy production are positioned as a pathway to allow the countries to meet their rising power demand and preserve more of their hydrocarbon inputs for downstream expansion, such as in

[1] Some of the external threats emanated from the 'revolutionary' Middle Eastern countries of Libya, Syria Iraq, and to a lesser extent, Algeria, that attempted to spread pan-Arab nationalism in the more conservative monarchical states in the Gulf. Iraq, for instance, posed a significant threat to the region with its invasion of Kuwait in 1991. Iran as well posed, and still poses, both an external military threat and an internal threat by its promotion of external Shiite political sectarianism throughout the region. Additionally, Arab nationalist parties and cells during the 1950s-60s caused bouts of instability, while the advent of domestic Shiite political agitation in the 1970s, and then the rise of various Islamist organizations during the 1990s until the present, are still issues of concern for the Gulf monarchies. See, generally, Justin Dargin, *Desert Dreams: The Quest for Arab Integration from the Arab Revolt to the Gulf Cooperation Council* (Republic of Letters, 2012).

[2] According to a 2013 study by John Waterbury, decreased rainfall that occurred prior to 2011 led to desertification in agricultural areas in eastern Syria, which resulted in the death of at least 85% of the livestock. This stimulated a mass internal migration of villagers to the larger cities where they formed communities of underpaid workers. The large internal migration is not thought to have cause the Syrian civil war. But it is thought to have been a major contributing factor in overall disenfranchisement and the initial outbreak of violence. It is also considered that the vast increase in food prices in the Middle East during the mid-to-late 2000s was exacerbated by climate changes and was, again, a major contributing factor in the Arab Spring in 2011. John Waterbury, *The Political Economy of Climate Change in the Arab Region*, Arab Human Development Report: United Nations Development Programme (2013).

[3] The Arab Forum for Environment and Development conducted a pan-Arab survey in 2009 that discovered 98% of respondents believed that the climate had changed. And 89% believed that this was anthropogenic in origin. See, (ed) Mostafa K. Tolba and Najib W. Saab, *Arab Environment: Climate Change: Impact of Climate Change on Arab Countries* Report of the Arab Forum for Environment and Development (2009). The leaders of Saudi Arabia and the UAE have sought to position themselves as taking advantage of economic opportunities associated with decarbonization. As representative of the region's changing outlook, Sheikh Mohammed bin Rashid Al Maktoum, vice president and prime minister of the United Arab Emirates and Ruler of Dubai, announced that, 'We are committed to seize the opportunity to cement our leadership on climate change within our region and take this key economic opportunity to drive development, growth and new jobs as we pivot our economy and nation to net zero.' *The UAE Launches Plan to Achieve Net-Zero Emissions by 2050* Reuters (October 7, 2021).

petrochemicals, fertilizers, and the energy-intensive industries. The region, indeed, has come a long way from believing that climate change did not exist and was merely a means for Western countries to obstruct their economic development to becoming major participants in multilateral climate conferences.[4] In a significant departure from its earlier stances, the Saudi Crown Prince, Mohammed Bin Salman, announced in 2021 an unequivocal link between climate change and the health of the Saudi citizenry.[5]

The Arabian Gulf region has the most prodigious fossil fuel reserves in the world. In 2021, the region contained 486.8 billion barrels of proven oil reserves, totaling approximately 30% of the world's reserves.[6] The Kingdom of Saudi Arabia holds the lion's share, accounting for 20% of the worldwide total.[7] The Gulf region accounts for nearly a quarter of global oil production. With the advantage of enormous oil reserves and small, albeit growing, populations, the region exports most of its oil production.

As of 2021, the Gulf region had approximately 42 trillion cubic meters (TCM) of natural gas, equating to nearly 23 % of global natural gas reserves. Yet, it only produces about 8 % of the total global output. Various reputable studies assert that the region's current proven oil reserves will endure until approximately 2100 at current production rates, and natural gas reserves will likely persist until the mid-2100s.

The hydrocarbon production and consumption dynamics in the three Gulf countries of Saudi Arabia, the UAE, and Qatar offer distinct contrasts. This is because these countries rank at various positions on the continuum of carbon emissions, deployment of renewable energy, the political will to embrace energy sector reconfiguration, domestic demographics, and structural hydrocarbon production/ consumption dynamics. This thesis reviews Qatar, Saudi Arabia, and the UAE because these three countries offer a viable comparison and

[4] This belief was not limited to the Gulf energy-rich countries, China and India at various times promulgated the same theory. The so-called 'Climategate,' which involved hacked emails from the University of East Anglia prior to the 2009 climate negotiations in Copenhagen, was hailed as irrefutable evidence by the Saudi negotiating team and other developing countries that there was, 'No relationship whatsoever between human activities and climate change.' Mohammad Al-Sabban, the lead Saudi climate negotiator, stated that, 'The volume and the size of those sacrifices must be predicated on a sound scientific basis and must be built on a secure foundation of information, which is what we found now is not true and that our high level of trust had suffered,' Richard Black, *Climate E-Mail Hack 'Will Impact on Copenhagen Summit'* BBC News (2009); *Saudi Arabia Tries to Stall Global Emissions Limits*, NPR (Dec. 10, 2009).
[5] Michael Safi et al, *So What Has the Rest of the World Decided to Do about Climate Change?* The Guardian (London April 19, 2021).
[6] *Statistical Review of World Energy*, BP (2021)
[7] Ibid.

contrast as they represent the largest economies in the region, and each is a global leader in the hydrocarbon sector.

Additionally, Saudi Arabia's stance in international climate negotiations must be understood as it boasts the largest economy in the Gulf Cooperation Council (GCC), is one of the world's largest oil producers, and is the world's largest oil exporter.[8] Qatar, for its part, is one of the world's largest Liquified Natural Gas (LNG) producers and exporters, and has increasingly forged a more proactive geopolitical stance, and as the world begins the arduous process of decarbonization, its global role will be ever more critical. The UAE represents a Gulf country that is steadily engaging in substantive macroeconomic diversification and serves as a template for how other Gulf countries could transform themselves from being mono-exporters to a more diversified economic base. Therefore, an analysis of the three selected countries' positions toward climate change and their decarbonization efforts should be assessed in-depth to critically understand how the Gulf region, and the broader Middle East by extension, intended to manage the complexities of climate change on a national and global scale.

Therefore, these three countries have diverse requirements for energy conservation and economic sustainability. In addition, complex social, political, and economic factors may constitute structural forces that could blunt the deployment of these countries' immense energy reserves and thereby erode their ability to foster future economic growth. The pressures of economic development, population growth, global competition, job creation, and industrial diversification may negatively impact the comparative energy advantage that the Gulf countries have enjoyed since the 1970s. This comparative advantage allowed these countries to expand their domestic downstream and heavy industries with extremely low-priced associated natural gas. The rapidly increasing natural gas demand in the Gulf region was and is driven, in large part, by administrative pricing. These prices tend to be much lower than the various international prices of natural gas as the price formation is not based upon market forces, but rather governmental policy.

Qatar, Saudi Arabia, and the UAE are currently implementing policies designed to limit their hydrocarbon consumption, mostly of natural gas, to meet their respective energy-related

[8] The Cooperation Council of the States of the Arabian Gulf, informally known as the Gulf Cooperation Council or GCC, was officially established in 1981. It is a regional, intergovernmental, political and economic organization composed of Saudi Arabia, the UAE, Qatar, Oman, Bahrain and Kuwait.

challenges. These countries are also taking steps to limit their carbon dioxide emissions as the reduction of carbon emissions also leads to a decline in hydrocarbon consumption. Among these steps are (1) the introduction of energy efficiency measures, (2) the incremental reconfiguration of their respective domestic energy and electricity pricing regimes, (3) the introduction of policies that require fuel switchovers from more carbon-intensive oil to natural gas and renewable/alternative energy, and (4) signing international agreements to reduce carbon emissions.

The three Gulf countries had long resisted global climate negotiations as they feared that international decarbonization efforts would hobble hydrocarbon export potential, and hence, their economic growth. The thesis will illustrate how in the wake of the global financial crisis of 2008 and the 2011 Arab Spring revolutions, the Gulf countries realized that if they did not sufficiently reorganize their respective macroeconomies with broad-based energy pricing reconfiguration to reduce domestic energy demand and stimulate natural gas production, as well as allowing the private sector to play a more prominent role in the economy, then broad-based socio-political dislocation would likely result. In short, they viewed the task of adequately managing their hydrocarbon consumption through the prism of a national security issue. And, in the beginning of the 2020s, the Gulf countries are also beginning to recognize that climate change itself-not just hydrocarbon allocation deficiencies-would likely give rise to many internal and external security risks as well.

The national security prism of Saudi Arabia, the UAE and Qatar comprise several different (and somewhat opposing) factors that are interlocking and are mutually reinforcing. For instance, in the short term, a radical restructuring of the social contract by the removal of subsidies and a hasty increase in energy prices could spark violent protests to the social order and challenges to the government's legitimacy, as has happened previously and continues to occur in the region.[9] Additionally, of no small consideration is how the role of the millions

[9] Some analyses of the birth of the Arab Spring revolts trace it to the embracing of neo-liberal economic reform in many of the afflicted countries that steadily eroded the standard of living over since the 1970s. Moreover, often protests that begin with limited aims, such as against burdensome taxation or governmental overreach morph into broader anti-government agitation and even revolutions. This phenomenon has been seen with the anti-Covid vaccine and mask mandates in 2020 and 2021, which initially begun as limited in scope to encompass more extensive anti-government activities. See, generally, Amirah El-Haddad, "Redefining the Social Contract in the Wake of the Arab Spring: The Experiences of Egypt, Morocco and Tunisia," *World Development*, Volume 127 (2020); L. Achy, "Breakdown of the Authoritarian "Social Contract" and Emergence of New Social Actors: An Ongoing Process?" in L. Sadiki (Ed.), *Routledge handbook of the Arab*

of expatriates and guest workers that reside in the region will evolve with any modification of the traditional social contract. Secondly, if comprehensive and sustainable economic reform is not implemented, which includes energy pricing and subsidy reconfiguration, then as the world continues to decarbonize and their main foreign revenue generation tools evaporate, the lack of economic growth and opportunity could cause severe disruptions to the social order, as has been shown numerous times throughout history.

Lastly, if a business-as-usual cycle continues and carbon emissions mitigation is not firmly implemented, then global climate change and the repercussions of extreme climatic events would also bear the seeds of social and geopolitical turmoil.[10] The region is one of the most vulnerable areas in the world to climatic change, regional tension and potential unrest, and could potentially become uninhabitable by the end of this century due to temperature increases, thereby exacerbating the other stressors.[11] If the Gulf countries do not develop a sustainable future economic base, and as their hydrocarbon foreign revenue decreases in tandem, then that would not only impact their ability to continue their subsidization programs, but also their ability to adequately adapt to climate change, which would likely add further stressors upon an already fragile regional nation state framework and geopolitical balance of power.

There is already evidence that extreme weather events are taking place in the Gulf region, from hostile summer temperatures to extraordinary tropical storms.[12] Additionally, even though there are broad similarities between the Gulf countries, there are significant differences between them, how they pursue their foreign policy objectives, and how their rivalries impact any potential collaboration. Disputes between the Gulf countries are not a

---

Spring. Rethinking Democratization, Routledge, London (2015), pp. 303-318; Vera Burgengruen, *How the Anti-Vax Movement is Taking Over the Right*, Time (Jan. 26, 2022).

[10] The Pentagon considers climate change as perhaps one of the largest geostrategic threats to world stability. For a broad rendition of the multivariate security threats that have arisen and will likely arise due to global warming, See, generally, *Department of Defense Climate Risk Analysis*, Report Submitted to National Security Council (October 2021).
[11] Climate change is thought to be the cause behind a generational drought in Syria that was one of the impetuses behind the initial uprising that launched the civil war. And the drying of the regional aquifers and rivers also heralds a harbinger of extreme socio-political disruption. Water scarcity is already beginning to exacerbate regional and domestic tensions between Jordan and Israel, Egypt and Ethiopia, and Turkey and Iraq, while Iran has had increasingly violent protests over water access. Several extremist groups, such as ISIS and its affiliates, have taken advantage of the mounting frustration. Sagatom Saha, *How Climate Change Could Exacerbate Conflict in the Middle East*, MENA Source: Atlantic Council (May 14, 2019); Linda Givetash, *Water Scarcity Fuels Tension Across the Middle East*, NBC (Nov. 1, 2018).
[12] For a detailed analysis on the various impacts of climate change in the Gulf region, ranging from the economic to the social-political, see Mai Mahmoud, *Weathering Climate Change in the Gulf*, The Arab Gulf States Institute in Washington (Nov. 14, 2017).

recent invention, they hark back to the early 19th century as the countries gradually extricated themselves from the sway of the Ottoman and British Empires. Since the period they gained their independence, various border clashes, maritime boundary quarrels, geopolitical tension and disputes over hydrocarbon deposits have erupted.[13] While it is unlikely that any geopolitical rivalry between the Saudi Arabia, the UAE and Qatar would impact their respective domestic decarbonization strategies-as the Saudi-led embargo from 2017-2021 did not disrupt energy trade between these neighbors- but these flareups could negatively influence any incipient regional carbon abatement cooperation either in the form of a regional carbon market or collaboration in international climate negotiations.

All of the aforementioned concerns are also taking place in the context of Gulf countries delicately and incrementally reforming the social contract by both extending the citizenship franchise to select groups of expatriates and the gradual reworking of their extensive subsidization frameworks.

Therefore, the Gulf governments have taken notice of both carbon emissions mitigation and adaptation. But as the research illustrates, the latter has often been at the expense of the countries' hydrocarbon production and consumption policies, with adaptation only recently beginning to come to the fore as climate-change effects become more apparent.

However, the Gulf countries also recognized that decarbonization did not just represent an existential threat, but that they could use the process as a catalyst to reach their goals of comprehensively reducing the fiscal burden on their governmental budgets by domestic energy-based subsidies, create new technological hubs associated with renewable energy production and carbon emissions abatement, maintain-or increase-foreign revenue generation through an expansion of hydrocarbon exports (rent preservation), and substantively diversify their economies by funneling the hydrocarbon demand savings into more profitable uses in the downstream industries. In fact, the region has become somewhat of a global template for renewable energy production with solar power generation prices reaching record lows becoming much more competitive with fossil-fuel power generation.

These considerations played a distinct role in the international climate negotiations that

[13] For a detailed discussion of the rivalries and disputes between the Gulf states, see, generally, Justin Dargin *Desert Dreams: The Quest for Arab Integration from the Arab Revolt to the Gulf Cooperation Council* (Republic of Letters, 2012).

were ongoing during that period. Before the Durban Platform in 2011, the energy-rich Gulf countries, along with China, India and other rapidly developing countries viewed climate change as a hoax and that global decarbonization would negatively impact their economic growth. The Gulf countries, alongside China and India and other rapidly developing countries, considered that international decarbonization efforts were merely a stratagem perpetrated by the developed countries to forestall the economic development of the Global South. Additionally, the Gulf countries argued that even if climate change were anthropogenic in origin, it was the Western countries that bore the principal historical responsibility. Therefore, according to the Gulf perspective, the onus was on the Western countries to financially support the developed countries in clean energy financing and the loss and damage resulting from climate change, as well as to undertake the burden of economic restructuring to mitigate the threat.

However, as with the widespread gas allocation shortages that developed after 2007 and the socio-political repercussions after the Arab spring, Saudi Arabia, Qatar, and the UAE reassessed their climate postures and accepted that decarbonization, instead of harming their economic growth, could improve their overall macroeconomic health by compelling them to engage in comprehensive economic diversification while at the same time evolving their mono-exporting postures. As the research will illustrate, the Gulf countries recognized that it would be more advantageous if they participated and “joined in” the international climate negotiations in order to help craft future global decarbonation in ways that would be more conducive to their continued economic development. As a result, Qatar hosted COP 18 in 2012 and the UAE will host COP 28 in 2023. The Gulf countries hope to use the hosting of these climate negotiations to influence the proceedings in ways that would be amenable to their economic goals.

In the beginning of the global climate negotiations in the late 1990s, the Gulf countries attempted to confront the basic theory of climate change to argue that mankind’s impact on the climate was minimal at best. However, subsequently, when the Gulf countries accepted the foundational tenets of global warming post-Copenhagen, their resistance from the 2010s onward-especially in CoP 26- took the form of more procedural elements to allow the continued utilization of hydrocarbons with carbon capture and storage technology. The Gulf countries, led by Saudi Arabia, are actively working to halt the transition in international climate negotiations from targeting aggregate carbon emissions from all fuel sources to that of focusing on the hydrocarbons as being the main generator of carbon emissions. As a corollary, there has been increased pressure on oil and gas companies to moderate their Scope 3 GHG emissions to reach net-zero goals. As a result, the Gulf countries sense that their main economic mainstay, i.e. oil, is under siege and that their further economic development is at risk.[14]

The Saudi Energy Minister, Prince Abdulaziz bin Salman, voiced his fears at a World Economic Conference in 2022, saying that, "We are all trying to congregate around the idea of reducing emissions of all greenhouse gases, but we have to be honest about; are we really trying to achieve that goal or are we trying to take that hope as a pretext to … get rid of hydrocarbons … I really would like to see the true colors of everybody."[15] The Saudis and the Emiratis reinforced their pleas with the warning that if there were an abrupt cessation in spending on oil and gas development to keep pace with rising global demand, then in this decade the world could face a severe energy crisis the likes of which have not been seen previously.[16]

Additionally, as this research argues, emerging from the Durban Platform in 2011, the Gulf countries viewed decarbonization as a means to reduce their domestic hydrocarbon demand which would allow them to meet their own domestic demand, diversify their economies, expand their downstream hydrocarbon industries and export more oil and gas to the international market.[17] It seems that the Gulf countries' diversification efforts have been to bear fruit as in 2022, the region began to post a strong economic recovery led by the non-oil sectors in the wake of the crash in global oil prices in 2020 and the pandemic.[18]

And while the three selected countries have engaged somewhat haltingly in hydrocarbon and power pricing reformation in the mid-2010s, the forward momentum has stalled, and this research argues that the development of carbon pricing acts could operate as a type of proxy

[14] Amena Saiyid, *Oil, Gas Companies Under Pressure to Manage Scope 3 Emissions to Reach Net-Zero Goals, Analysts*, HIS Markit (June 22, 2021).
[15] *Saudi Energy Minister Hones Plea to Target Carbon Emission; Not Oil and Gas*, SP Global (Jan. 19, 2022).
[16] Ibid.
[17] This was exemplified when a senior Emirati energy official declared that, "If you want to really reduce carbon you have to really work on efficiency, you have to reduce your own consumption," said Ali. "This is really low hanging fruit." *UAE Expects 20% of its Power Generation to Come From Clean Energy in Three Years: Official*, S&P Global Platts (My 17, 2021).
[18] There has already begun a decoupling from oil price movement and governmental spending in the region. Previously, with high oil prices, the regional governments would begin to increase state-led expenditures. However, there is increasing activity from the corporate sector, such as the property and financial sectors and domestic demand which are driving growth. Natasha Turak, *Saudi Arabia, UAE, Could be Slowly "De-Anchoring" from Oil Price Movements*, Data Suggests, CNBC (Nov. 3, 2021).

to allow more expansive energy pricing reconfiguration without incurring the widescale resistance-from the business and industrial sectors and the wrath from the citizenry-that afflicted other countries in their attempts to increase energy prices and reduce subsidies.[19]

1.2 Objectives

In this context, the objective of this research is to assess how Saudi Arabia, the United Arab Emirates, and Qatar could create an effective carbon emissions reduction framework in their respective countries that would reduce their natural gas demand commensurate with their Nationally Determined Contributions (NDRs) as outlined in COP 21.

This overarching objective can be broken down into two groups of research questions:

A) The reduction of natural gas consumption is the centerpiece of the Gulf countries' efforts to achieve macroeconomic diversification. In order to reduce domestic natural gas consumption to foster macroeconomic diversification and growth, what role could carbon pricing (taxation, trading, or hybrid) or command-and-control frameworks play in the policy mix of Saudi Arabia, Qatar, and the UAE? What alternatives are there, and why would these be more or less desirable?

B) If Saudi Arabia, Qatar, and the UAE implement carbon pricing or command-and-control frameworks, how would they be best designed for political feasibility and economic efficiency to meet their COP 21 climate pledges? What lessons are available

[19] The reason why engaging in energy pricing reform and subsidy removal is so contentious is because it strikes at the heart of a country's social contract, the foundational elements which form the legitimacy of the government and the public's acquiescence to its authority. Numerous countries in the Middle East and elsewhere have witnessed socio-political discord upon the advent of abrupt energy price increases. In 2012, when the Nigerian government began to remove fuel subsidies, riots and protests spontaneously broke out in many major cities. When Ecuador's government announced the removal of fuel subsidies in late 2019, a wave of violent protests swept the country. As a result, the government halted the subsidy removal policy. India, Kazakhstan, Iran, Egypt, Mexico, Sudan, France, Indonesia, Yemen, Jordan and many other countries have also been struck by popular mobilization tied to the rollback of fuel subsidies since the late 2000s. Julia Horowitz*, Ditching Fossil Fuel Subsidies Can Trigger Unrest, Keeping them Will Kill the Climate*, CNN (Jan. 20, 2022).

and relevant from experience with carbon and energy pricing from other parts of the world?

1.3 Conceptual Framework

This study will focus on three countries, Qatar, the UAE, and Saudi Arabia. It will identify the main intrinsic drivers in the increase in energy demand and carbon emissions in the three selected countries and seek to determine the most efficacious carbon abatement regime to implement to fulfill their Paris Agreement pledges. This approach focuses on the respective governments as the principal influencing stakeholders and recognizing that the government can adopt a restrictive or catalytic role in enabling or regulating companies operating within its jurisdiction to incorporate carbon reduction policies.

Researchers and scholars have expounded upon the influences of governments in promoting environmental sustainability by the Complex Adaptive Systems (CAS) concept and the Infrastructures of Provision approach. The study of CAS focused on emergent, complex, and macroscopic properties of the system, and as John Holland stated, "[CAS] are systems that have large numbers of components, often called agents, that interact and adapt and learn (Holland 2006, 1-8)."[20]

The CAS has three principal characteristics; firstly, a given system (such as a country) has many heterogeneous agents, and each agent decides how to operate (Sullivan 2011).[21] And, it is essential to recognize that these decisions will evolve over a period.[22] Secondly, as Sullivan indicated, all these agents interact with each other in a dynamic process.

Thirdly, Sullivan maintained that this leads to what is termed "emergence."[23] This is applied to the carbon mitigation frameworks being developed in the three selected countries, in that interaction between renewable energy development, international treaties (e.g., the Paris Agreement), and domestic regulations and the establishment of climate change agencies create a model of how these groups relate to each other towards the goal of carbon emissions

[20] John Holland, "Studying Complex Adaptive Systems" *(PDF). Journal of Systems Science and Complexity. 19 (1): 1–8* (2006).
[21] Tim Sullivan, *Embracing Complexity*, Harvard Business Review (September 2011).
[22] Ibid.
[23] Ibid.

reductions.

CAS can be implemented as part of the conceptual framework due to how international and academic organizations approach environmental sustainability research. Furthermore, it is helpful due to its overarching classification of external factors allows the framing of the research for the grouping and categorization of the policy-related elements.

New Institutional Economics (NIE) also provides a robust model (Figure 1.1) to utilize its contention that not all transactions are undertaken in market institutions and are ubiquitous throughout all macroeconomic levels. NIE allows my research to properly incorporate the role of governmental organizations in creating an operational carbon abatement regime.[24]

---

[24] Barry Soloman "New Directions in Emissions Trading: The Potential Contribution of New Institutional Economics *"Ecological Economics*. 30. 371-387. 10.1016/S0921-8009(99)00021-X. (1999); A. Vatn *Institutions and the Environment* (Edward Elgar, Cheltenham: 2005)

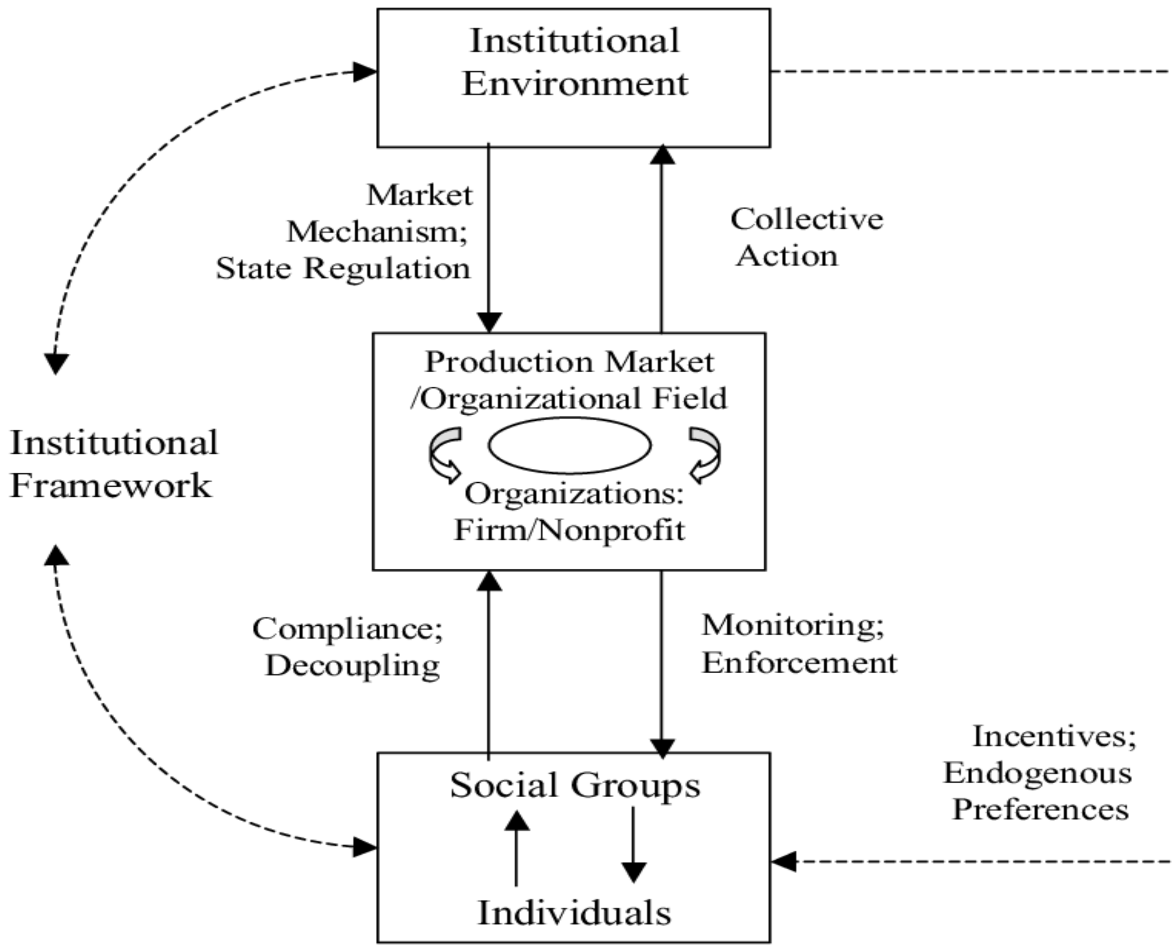


Figure 1.1 New Institutional Economics Model: Source: C. Menard and M. Shirley, Handbook of New Institutional Economics (Springer 2005)

Both NIE and CAS allow for a non-equilibrist approach to understanding the macroeconomy. Each institution is a complex adaptive system, even though it is embedded within the broader institutional system and the larger macroeconomy. It is understood that economic relations are nestled within various complex adaptive systems, both larger and smaller. As a result, as Hartwell stated, complexity theory maintains that these systems generally do not tend towards equilibrium (Hartwell 2017).[25] However, these two theories meld into and mutually reinforce each other in the sense that institutions are necessary for the development and operation of any macroeconomy (as well as in the formation of a carbon market). These institutions themselves are also complex adaptive systems.

Scholars such as Foster (2000), Joskow (2008), and Ruhl (2009) maintained that complexity theory is foundational to understanding how institutions interact and develop

[25] Hartwell, C.A. Understanding "Development": Insights from Some Aspects of Complexity Theory. *Homo Oecon* 34, 165–190 (2017)

within a macroeconomy. They posited the idea that a macroeconomy is composed of multiple equilibria, in which the entities act based on local, bounded rationality. However, Colander (1996) initially illustrated that institutions crucially underpin economic stability, the principal component of complex systems. And, in summary, that it was institutions that mediated the economic relationships between the economic actors and regulated and placed limits upon them.

NIE seeks to assess the emergence and persistence of institutions based on their efficiency.[26] One of the principal concepts of NIE is the notion of transaction costs, in that institutions appear or are established when the benefits that they grant are more significant than the transaction costs that were incurred with their creation and continued operation. These transaction costs comprise those *ex-ante* costs present before the exchange, such as preliminary negotiations and *ex-post* costs of monitoring and enforcement that appear after the exchange. If a thorough understanding of the transaction costs is not present, it may not be possible to conceptualize how any given economic system or market operates adequately. Institutions that are constructed haphazardly often result in having much higher transaction costs while operating inefficiently. And, what distinguishes NIE from neoclassical economics is its contention that real markets are not frictionless and don't exist in a utopic bubble. Or, to paraphrase North (1993), the neoclassical result of efficient markets is only realized when there are no (or few) transaction costs; however, when costs do arise during transactions, then institutions matter.

Tripp and Dudek (1989) created a set of institutional guidelines for an efficient and successful transferable rights program.[27] Utilizing the NIE framework, these guidelines managed issues that were neglected or assumed away in emissions trading, such as transactions costs and principle-agent problems. As a result, there were only partial understandings of the mechanics of market failure in emissions trading. As stated above, this relates to CAS as it can identify and define the market deficiencies and obstacles that result from a complex system.

Even though these guidelines were developed in 1989, they are still relevant and utilized

[26] Shinji Teraji, *The Cognitive Basis of Institutions: A Synthesis of Behavioral and Institutional Economics* (Academic Press, 2018) p. 5
[27] See, generally, J.T.D. Tripp. D.J Dudek, "Institutional Guidelines for Designing Successful Transferable Rights Programs" *Yale J. Regul.* 6 (1), 369 – 391. (1989)

today as they detail that the most critical design aspects of any carbon abatement framework are that: the administrative agency should be granted a clearly defined legal/regulatory framework and technical ability to deploy an evasion proof system that has specified objectives while reducing transaction costs to a minimum. In subsequent work, this last guideline and the necessity to ensure an economic value for the traded commodities have been primarily focused upon.[28] Tripp and Dudek's model has been the gold standard in NIE literature related to emissions trading frameworks.

However, in developing their institutional guidelines, a critique was subsequently leveled that Tripp and Dudek did not list security of property rights as a specified guideline to ensure a successful emissions trading platform. Even though the earlier articulations of pollution trading, such as the Acid Rain Program and the lead trading program, were successful, analysts still pointed out that the government could still confiscate these emissions "rights" at any time (Bouckaert 2010).[29] However, overall, the lack of secure and perpetual property rights in emissions has not been figured as a significant impediment in developing pollution markets. The EPA treats emissions allowances as property rights in most cases and only very rarely decides otherwise (Bennett 2010).[30]

With these theoretical considerations and literature in mind, the conceptual model for the thesis consists of three building blocks.

Hydrocarbon Infrastructure and Renewable Energy Investment: This is an essential factor as per the model as it is a foundational condition for any carbon reduction framework to be implemented. Kollmuss and Agyeman argued that "many pro-environmental behaviors can only occur if the necessary infrastructure is provided."[31] In this study, I grouped the infrastructure based on the policy category comprised of hydrocarbon demand/ production and renewable energy investments. Additionally, a detailed review of the three countries' energy sectors (reserves/demand/production/exports) will be implemented to highlight these nations' challenges in meeting domestic natural gas/ power demand.

---

[28] Ibid.

[29] (ed) Boudewijn Bouckaert, Property Law and Economics (Edward Elgar, 2010). p. 249

[30] L. Bennett, "Are Tradable Carbon Emissions Credits Investments? Characterization and Ramifications Under International Investment Law" *New York University Law Review, 85*, 1581–1617 (2010)

[31] A. Kollmuss, J. Agyeman, Mind the Gap: Why Do People Act Environmentally and What Are the Barriers to Pro-Environmental Behavior?" *Environ. Educ. Res*. 2002 8, 239–260

Political and Governmental Agencies: When assessing the context of a government's ability to sway pro-environmental behavior, one can determine the political drivers that encourage certain behaviors. These comprise governmental agencies that have been established to monitor carbon emissions and other environmental issues related to the hydrocarbon sector. These agencies are tasked with creating a foundation for future carbon reductions and rectifying the existing institutional weaknesses in the three selected countries pertaining to data acquisition.

Laws and Regulations: The research will also assess the role of domestic legislation and international treaties. For example, the Paris Agreement stipulates that signatories establish regulatory agencies to monitor and account for carbon emissions for submission. Utilization of the legal/regulatory code creates the framework that determines the contours of an organization's future investments. In this research, I chose legislation geared explicitly towards climate change and decarbonization of the respective country's macroeconomy. Moreover, an assessment of the energy pricing reformation policies of the three countries will be analyzed. And this portion of the research will also examine the three principal carbon emissions reduction platforms (carbon taxation, cap, and trade, and command-and-control) will be reviewed in detail as to whether they could be successfully implemented in line with their commitments undertaken at COP-21.

I utilized the World Resources Institute (WRI) methodology to analyze and assess the NDCs that the three countries submitted under the auspices of the Paris Agreement. The WRI methodology reviews and judges the regulations posited by the three countries to reduce their carbon emissions, as relates to the above building block, and assesses the overall viability of their NDCs to achieve the goals of the Paris Agreement.

The WRI utilizes a three-part methodology to review NDCs. The components of the WRI methodology are whether an NDC is ambitious, transparent, and equitable.[32] An ambitious NDC would make certain that the goal of maintaining global warming below 2 degrees Celsius is achievable. Transparency relates that the NDC has an efficient mechanism to monitor progress toward the pledged targets. Moreover, the NDC must be equitable in that each party is undertaking its fair share of climate mitigation and adaptation. The WRI

[32] See, Kelly Levin, *et al*, *Designing and Preparing Intended Nationally Determined Contributions*, World Resource Institute (May 2015).

methodology incorporates Tripp and Dudek's institutional guidelines for an emissions trading framework but also undertakes a discrete analysis to assess the relative robustness of a country's NDC.[33]

1.4 Data and Methods

This research project will primarily employ the NIE methodology. The NIE differs from the standard neoclassical theory in that transaction costs are widespread, and not all transactions are limited to markets. While some subbranches, such as the property rights school and the transaction costs framework, the foundational theory is that institutions matter in all economic analyses.

The NIE has extended the focus of economics beyond neoclassical and institutional economics by looking at the institutions, e.g., social norms and legal and regulatory frameworks that form the bedrock of economic activity. As a result, it includes crucial issues not covered in neoclassical economics and interacts with the political economy. The NIE model assumes that individuals (or organizations) are rational and seek to maximize their respective preferences but that there are cognitive limitations, a deficiency of information, and complexities in monitoring and enforcing agreements. As per the NIE model, institutions are developed to be an effective method to manage transaction costs.[34]

Douglass North created the basic methodological principles of NIE, which explain the distinction between organizations and institutions.[35] According to North, institutions may be considered the "rules of the game," which are composed of the formal legal structure, i.e., the legal rules or regulations, and the informal social norms that govern and influence individual behavior and construct the social interactions, which are known as institutional frameworks.[36]

The NIE methodology is anchored to a large degree in the Coasian bargaining system. Coase forged the interconnection between neoclassical theory, transaction costs, and institutions.

[33] *Enhancing NDCs: A Guide to Strengthening National Climate Plans by 2020*, World Resources Institute (Sept. 2019).
[34] Walter W. Powell Paul J. DiMaggio, *The New Institutionalism in Organizational Analysis*. (University of Chicago Press 1991)
[35] Rita Yi Man Li "The Institutional Analysis of Fittings in Residential Units*" Law, Economics and Finance of the Real Estate Market* 2014, pp 45-61
[36] Ibid.

And NIE was able to build on Coase's basic premise that the neoclassical assertion of efficient markets does not exist. Therefore, as North argued, "When it is costly to transact, institutions matter."[37]

Governments have been relatively reticent to assign unrestricted property rights in allocating carbon emissions credits in previous emissions trading systems. This may be understood when reviewed in the context of the public interest in pollution mitigation. However, this does beg the question of creating the optimal design models for carbon abatement frameworks. I will utilize the methodology of NIE to answer the questions of what should be the role of the governments of the three selected countries concerning the creation of carbon abatement regulations and a climate-oriented administrative apparatus versus the scope of the role for the private sector? What should be the level of flexibility and stringency of the carbon mitigation regulations and transaction costs? How should the institutional design be made more efficient under the various carbon abatement models? How may an effective carbon abatement program be constructed commensurate with the selected country's respective obligations as set forth on the Paris Agreement (COP 21)?

The overarching question that this research seeks to answer is to determine which carbon abatement mechanism would be best suited for implementation in the Gulf countries to fulfill their COP 21 pledges, and NIE can play a significant role in granting answers to be these questions. NIE answers economic organization, governance, and transaction costs from the Coasian perspective that economic efficiency is a reasonable public policy goal.[38]

As Solomon indicated, NIE can often focus on areas that neoclassical economics typically "minimizes, assumes away or ignores."[39] NIE can render an analysis on issues unique to carbon abatement frameworks, such as principal-agent issues and transaction costs. NIE also explains the uneven performance of carbon markets and provides an instrumental assessment of embedding property rights into a carbon abatement regime and non-rational behavioral assumptions. [40]

---

[37] Douglass C. North. "The New Institutional Economics." *Journal of Institutional and Theoretical Economics (JITE) / Zeitschrift Für Die Gesamte Staatswissenschaft* 142, no. 1 (1986): 230-37

[38] Barry Solomon, *New Directions in Emissions Trading: The Potential Contribution of New Institutional* Economics, Ecological Economics (Sept. 1999). p. 383; R.H. Coase, "The New Institutional Economics" J. *Inst.Theor. Econ*. (1984) 140 (1), 229 – 231

[39] Ibid. *New Directions in Emissions Trading*

[40] Ibid.

NIE can rectify the inherent neoclassical bias towards private property regimes. A market can only be thought of in relation to a set of conventions and entitlements that can produce a predictable framework for resource ownership. As with the neoclassical model, the definition of rights is critical. And with the utilization of the NIE model, the transaction costs of deploying a carbon abatement mechanism, whether that of cap-and-trade, a carbon tax, or command and control, can be accurately assessed.

Suppose a country decides to construct a new carbon abatement regime, in that case, it is necessary to take account of the program implementation costs, such as that with the initial design of the system, the acquiring the essential baseline data, and monitoring and enforcement while negotiating the carbon abatement contours with the involved parties. Therefore, after assessing the various carbon abatement regimes, NIE would be beneficial in that being able to assist with the design parameters of an efficient system.

There are certain constraints upon the usefulness of current primary data since many Gulf countries do not always accurately report their energy consumption and production. And, very often, there are no statistics at all, especially concerning sectoral demand and domestic pricing.[41] Comprehensive, precise, national, and regional historical and projected energy data from primary sources are almost entirely lacking on any consistent basis. Due to the OPEC quota system and other issues, basic energy data reporting tends to be politicized and not always entirely transparent.

Hydrocarbon data in the Gulf region (and much of the non-OECD world) tend to be opaque statistics disclosed for political purposes. Much of the data related to domestic hydrocarbon issued from non-OECD countries tend to be coveted as though they were, in fact, state secrets. With a focus on the above data considerations, the analysis will rely primarily on data from BP, which I will apply to data provided by OPEC, the EIA, IEA, various government and media sources, national figures, along with my analysis. I will cross-reference the energy data from BP, OPEC, the EIA, IEA, and national statistics. If the divergence amongst the figures exceeds more than 5%, such will be highlighted in the text.

Consequently, there will be some reliance on well-respected energy sector media and

[41] However, in preparation for its planned initial public offering, Saudi Aramco hired two U.S. firms to audit its reserves in late 2017/early 2018. Rania El Gamal and Alex Lawler, *Audit Finds Aramco Oil Reserves Slightly Higher Than Reported: Sources*, Reuters (April 29, 2018).

periodicals, such as the Oil and Gas Journal, the Petroleum Economist, etc., due to the rapid temporal mutations in the regional energy sector. These publications are also highly regarded source-material in energy literature.

Additionally, I can fluently speak, read, and write Arabic, and I participated in various Arabic language international conferences involving Gulf policymakers and have granted interviews regarding my views on energy sector development in Arabic for Middle Eastern TV and radio stations[42] To a large degree, this gave me insight into how the regional policymakers view decarbonization and energy issues. There were also a wide variety of Arabic language sources that were consulted in Appendix D that added significant contextual flavor to my research. These resources were quite beneficial to the overall thesis as they granted me the ability to understand how the discourse surrounding climate change issues is structured in the Arab world. While there are points of similarity which broadly overlaps with English language research, Arabic language text on climate change from governmental ministries diverges slightly in that it often takes into account the primacy of energy trade and the potential economic harm that could result if global decarbonization is not managed delicately, i.e., taking into consideration the macroeconomic postures of the hydrocarbon producing countries.

As discussed within the text, energy demand/production projections and carbon emissions will be based on extrapolated historical trends, primarily utilizing BP data, cross-referenced by the sources mentioned above. Where such data is unavailable, then informed assessments will be utilized. In accessing and interpreting carbon emissions data, a researcher

---

[42] A detailed list of my Arabic and English language conferences, lectures, and presentations may be found in iin Appendix C. I have also given numerous Arabic language interviews on major Middle Eastern media platforms commenting on decarbonization developments and geopolitical and energy issues in the MENA region. See, أسعار النفط ستستمر بالتقلّب في المستقبل القريب (*-Arabic: The price of oil in the MENA region*), AME Info (Oct. 27, 2011); (قطاع الطاقة والربيع العربي *The Energy Sector and the Arabic Spring*, RT News (Oct. 14, 2011);
احتجاجات منطقة الشرق الأوسط وشمال إفريقيا وموقف الغرب *Protests in the MENA Region and the Position of the West*, RT News (July 24, 2011); صعوبات اقتصادية في أعقاب الربيع العرب
Economic Difficulties in the Wake of the Arab Spring , Al Hura TV News (June 27, 2011);
الاستثمار وعدم الاستقرار في الشرق الأوسط, Al Hura TV News (April 23, 2011)

encounters obstacles similar to those discussed above. However, most issues with data collection of carbon emissions relate to the region's relative lack of measurement mechanisms. Nonetheless, to redress that deficiency, I would utilize the most commonly accepted data from the EIA, the IEA, and the Global Gas Flaring Reduction department from the World Bank. And will utilize national greenhouse gas inventories where available. These sources are generally regarded as being the most accurate in terms of measurement of carbon emissions data.

Table 1.1: Table of Source Material

Saudi Arabia BP Annual Statistical Review of World Energy, OPEC Data, Oil and Gas Journal, Energy Information Administration, International Energy Agency, National government statistics, U.S. Geological Survey, EDGAR, OPEC Annual Review, World Bank-Global Gas Flaring Initiative
Qatar BP Annual Statistical Review of World Energy, OPEC Data, Oil and Gas Journal, Energy Information Administration, EDGAR, International Energy Agency, National government statistics, U.S. Geological Survey, OPEC Annual Review, World Bank-Global Gas Flaring Initiative
United Arab Emirates BP Annual Statistical Review of World Energy, EDGAR, OPEC Data, Oil and Gas Journal, Energy Information Administration, International Energy Agency, National government statistics, U.S. Geological Survey, OPEC Annual Review, World Bank-Global Gas Flaring Initiative

Table 1.2 Interviews

Mhamed Biygautane Lecturer in Public Policy, The University of Melbourne **Subject:** GCC and Climate Change Negotiations **Date:** 4/06/2018	**King Abdullah Petroleum Studies and Research (KAPSARC):** Anonymous **Subject:** Saudi Arabian Energy Strategy **Date:** 07/03/2013	**QatarEnergy:** Anonymous **Subject:** QatarEnergy's LNG Strategy **Date:** 09/06/2017
International Renewable Energy Agency (IRENA): Anonymous **Subject:** Renewable Energy Investment in GCC **Date:** 20/06/2017	**Abu Dhabi National Oil Company (ADNOC):** Anonymous **Subject:** Natural Gas Investment **Date:** 15/05/2017	**ARAMCO:** Anonymous **Subject:** Carbon Reduction Plans **Date:**19/02/18

In addition to the interviews, I also participated in numerous conferences and gave lectures in the region that Gulf academic institutions and senior level governmental agencies/ministries hosted concerning the region's energy and carbon emissions dynamics(See Appendix C for a detailed listing of my conferences, thesis interviews, invited lectures, high-level consultations and moderatorships given in Arabic and English).[43]

1.5 Structure of the Thesis

The thesis will be constituted as follows: Chapter One, the Introduction, provides the background of the research detailing the structure, conceptual framework, and methodology of the dissertation.

Chapter Two reviews the academic literature on energy and carbon emissions reduction efforts in the selected countries.

[43] Some of the interviewees requested anonymity because the discussions concerned energy matters about which they had not been given official permission to speak on record.

Chapters Three through Five will use comprehensive national-level data and analysis detailing the three selected countries' natural gas reserves, demand, production, and export policies. These chapters will also illustrate the challenges that the selected countries face in natural gas production and demand, and discuss how these dynamics affect each country's domestic policies (e.g., energy prices, industrialization, etc.) and demographics. As the Covid 19 pandemic began to spread worldwide in February 2020, my research could not consider the myriad dimensions of its impact. However, where possible, specific instances of how Covid-19 would affect certain aspects of the analysis were discussed.

Chapter Six discusses in detail the steps that the selected countries have already taken to reduce their energy intensity/carbon emissions. It will include a cross-sectoral analysis of renewable and nuclear energy development, energy efficiency, pricing reform, and efforts to reduce carbon emissions.

Chapter Seven will describe the contours of the multilateral emissions trading negotiations to illustrate how the three selected Gulf countries have approached the discussions and how their respective positions have evolved. This chapter also analyzes the various Nationally Determined Contributions (NDCs) submitted by the selected countries using the three-point matrix methodology developed by the World Resource Institute to determine these documents' relative equitableness, transparency, and ambition.[44]

Chapter Eight analyzes the historical development of EU ETS and China's carbon market and examines its successes and failures to draw valuable lessons that can potentially be applied to the three selected Gulf countries as they shape their carbon reduction policies to meet their commitments under the Paris Agreement.

Chapter Nine outlines the specific regulatory and legal frameworks that would need to be implemented to create a viable carbon reduction regime in the selected countries. The chapter also provides an in-depth analysis of the three selected countries' current and past efforts to reduce carbon emissions, comparing their announced actions with the relative strength of their environmental authorities. It also provides a framework for how the three

[44] See, Kelly Levin, *et al*, *Designing and Preparing Intended Nationally Determined Contributions*, World Resource Institute (May 2015).

selected countries might proceed in establishing a carbon reduction mechanism in their respective jurisdictions.

Chapter Ten, i.e., Conclusions and Implications, will discuss the research findings and review the thesis. It will also highlight the social, economic, and cultural adjustments required to implement national carbon reduction models in the Gulf region. In addition, this chapter will discuss what metrics or milestones the selected Gulf countries should use to measure progress in decarbonization. Finally, this chapter outlines how the research will contribute to the academic literature on the region's socio-political aspects of energy efficiency and carbon reduction efforts. It also discusses how the publication of the research findings can support current policies in the selected countries.

Chapter Two: Literature Review

2.1: Tracing the Intellectual Contours

This study examines the intersection between hydrocarbon demand/production, renewable energy investment, and carbon reduction efforts in the United Arab Emirates, Qatar, and Saudi Arabia. This topic is critical to the research as the selected countries are three of the world's most significant oil and gas producers/exporters. To date, there has been no comprehensive research on the policies of the three selected Gulf countries in reducing their carbon emissions under their Paris Agreement commitments. There are several deficiencies in the literature regarding the Gulf states and climate change/decarbonization policies. While there is a wealth of literature on the Gulf States and their energy sectors (both hydrocarbons and renewables), there are still critical gaps in the research regarding the role of the Gulf States in multilateral climate change negotiations, the development (and design metrics) of carbon reduction frameworks, and the intersection between hydrocarbon demand reduction and carbon intensity. Understanding how these countries - which provide the fuel for the global economy - will approach their climate commitments and how they are likely to create and deploy optimal carbon reduction frameworks is critical.

2.1.1 Gulf-related climate literature

Even though the Gulf region is universally linked with hydrocarbon production in most studies, it has only been recently where research has focused on how the Gulf countries are attempting to reduce domestic hydrocarbon production and the overall efforts to transform their energy sectors. One of the most recent research studies was undertaken by Goldthau and Westphal, where they pointedly disputed the contention that global decarbonization would inextricably lead to economic decline in the Gulf.[45] Instead, they argue that global decarbonization may assist the Gulf states in modernizing and expanding their macroeconomy as they move up the hydrocarbon value chain, such as has already been occurring.

Likely, the two scholars assert, climate change policies will ultimately lead to macroeconomic diversification. And, it could be the impetus to assist the countries in

[45] A. Goldthau and K. Westphal, *Why the Global Energy Transition Does Not Mean the End of the Petrostate*. Global Policy, Policy Insights (2019)

modifying their state-led enterprises and unleashing private sector-led development. However, it is without a doubt that the Gulf countries would experience some economic turbulence in the interim as they restructure their economies to adapt to a decarbonized world. This is especially so as Ansari researched when assessing the value of the stranded assets (the hydrocarbon reserves left in the ground), which would decline to zero.[46]

However, in a bid to counteract the strong possibility that their hydrocarbon reserves would decline in value, Saudi Arabia, the UAE, and Qatar have begun to invest significantly in their downstream sectors (petrochemicals, refineries, fertilizers) while buttressing their industrial sectors. Goldthau and Westphal stated that a decarbonized global economy could conceivably lead to the formation of new oligopolies and higher market concentration spread out amongst fewer oil suppliers. However, they cautioned that the Gulf states would face a dual-pronged challenge ahead of them: managing a rapidly evolving global energy market to acquire the benefits that the transformation would bring for their citizenry and economic development while balancing the emergent geopolitical order that would arise in the post-oil world.[47] This is an important point as the global geopolitical order is still in flux as China (and Russia to a lesser extent) expands its influence in the region. Therefore, more research would have to be conducted on whether the Gulf countries would take a more proactive role in geopolitical diplomacy in an increasingly multipolar world.

The perceived reordering of the global economic and political system could be seen as a significant impetus that led the UAE to be more proactive in its external posture. Weatherby *et al*. described how the UAE leverages its strategic diplomacy, terming it "clean energy diplomacy," while investing in renewable energy projects across the developing world. This study delineated three areas where the UAE could extend its soft power via renewable energy development abroad to help reduce carbon emissions outside of its jurisdiction: decarbonization capacity building, strategically targeted foreign aid, and expanding commercial ties in the renewable energy sector in developing countries.[48]

Weatherby *et al*. maintain that there is a significant growth opportunity to buttress Emirati soft power and accrue financial and commercial benefits by assisting countries in the Global

[46] Dawud Ansari and Franziska Holz*, Between Stranded Assets and Green Transformation: Fossil Fuel Producing Developing Countries Towards 2055*, World Development Vol. 130 (June 2020).
[47] Ibid.
[48] C. Weatherby B. Eyler, R. Burchill, *UAE Energy Diplomacy: Exporting Renewable Energy to the Global South*. Trends Report, Trends Research and Advisory & the Stimson Centre (2018).

South with renewable energy project implementation. I applied these concepts to note how the UAE's response to carbon mitigation efforts internationally illustrated how the government viewed its ability to benefit from global decarbonization in ways that its neighbors had not. Weatherby *et al*. accurately assessed how the UAE saw an opportunity to realize strategic openings to secure its influence. Weatherby's study could have benefited from determining whether the UAE would take on an additional role in forging carbon market development in the MENA region. The growth of a domestic carbon market would also significantly impact Emirati hydrocarbon demand, which it had been trying to tame for nearly a decade.

Jim Krane, in *Stability Versus Sustainability: Energy Policy in the Gulf Monarchies*, covered the issue when he assessed how the domestic industrial and subsidization policies in the Gulf countries were diverting ever-increasing shares of their hydrocarbon production to the domestic market, which then threatens their ability to maintain robust export levels, and thereby their ability to generate foreign revenue. Krane argued that the increasing pressure on exports due to domestic demand could threaten not only the future macroeconomic growth of these countries but even their political stability over the long run.[49]

Krane's research was especially fruitful during my analysis as it exemplified one of my dissertation's primary contentions, i.e., that the three selected countries had recognized that by incorporating the central tenets of decarbonization, they would be able to reduce their domestic hydrocarbon demand and thereby preserve their export margins while also progressing with their diversification goals. And, at the same time, I applied Krane's insight that the Gulf governments view macroeconomic diversification through a national security prism as well, and not merely as essential supply and demand issues. However, as the Gulf countries seek to preserve their export margins, they also understand significant benefits may arise from expanding into the global carbon market.

Luomi examined the Gulf countries' foray into the global decarbonization effort in *The International Relations of the Green Economy in the Gulf.* Luomi assessed how the hydrocarbon-rich Gulf countries are transforming themselves to become key players in

[49] Jim Krane, 2015. "Stability versus Sustainability: Energy Policy in the Gulf Monarchies," *The Energy Journal, International Association for Energy Economics*, Vol. 0 (Number 4).

global decarbonization efforts.[50] The study looked at how the UAE is working to become a first mover in the MENA region to decarbonize its macroeconomy. Loumi argues convincingly that, unlike its neighbors, early on, the UAE perceived the benefits of a "green economy," and in the process, invested significant amounts in fostering partnerships and renewable energy programs.

Luomi pointed out that UAE illustrates a path forward for resource-rich countries in leveraging international partnerships to gain invaluable technical and political support that came nearly without cost. And, of importance to this dissertation, this UAE case shows the necessity of having a clear political will from the highest echelons of the government for any decarbonization program to be successful. I found Luomi's analysis useful in assessing how the three selected countries could construct the initial parameters of a carbon abatement framework and how international collaboration would enable them to potentially avoid many missteps that plagued carbon reduction frameworks in other jurisdictions.

Luomi expanded this research and outlined in a 2018 study, *The Foreign Relations of Energy Transitions-Framing the Issue for the UAE*, the overall challenges that the UAE and other Gulf hydrocarbon exporters (in particular Saudi Arabia and Qatar) face in attempting to adjust to a post-oil world.[51] And that because of their structural similarities, they encounter many of the same difficulties. Saudi Arabia, Qatar, and the UAE have three strategic interests that must be met to ensure a smooth transition to a diversified economy: maintaining their roles as global energy suppliers, ensuring that domestic energy targets can be achieved, and making certain that net gains will accrue from diversifying economies.

I agreed with Luomi's findings that the UAE, and the other Gulf countries, by extension, need to create outward-oriented and "energy diplomacy strategies" that would synergistically interact with their domestic energy policies.[52] This is especially important as the Gulf countries begin to decarbonize their economies and search for external assistance and collaboration. This is especially important as the Gulf countries are either maintaining and expanding their natural gas production or reducing their respective domestic gas

[50] M. Luomi, *The International Relations of the Green Economy in the Gulf: Lessons From the UAE's State-Led Energy Transition*, Oxford Institute for Energy Studies (OIES), OIES paper: MEP 12, (May 2015)
[51] M. Luomi, "The Foreign Relations of Energy Transitions – Framing the Issue for the UAE" Emirates Diplomatic Academy (EDA), EDA Insight (December 2018).
[52] Ibid. M. Hafner and S. Tagliapietra "The Global Energy Transition: A Review of the Existing Literature" In: Hafner M., Tagliapietra S. (eds) *The Geopolitics of the Global Energy Transition*. Lecture Notes in Energy, vol 73 (Springer, Cham. 2020) p.13.

consumption/production rates.

Stern *et al.*, in *The Future of Gas in the Gulf: Continuity and Change*, analyzed the changes in gas production, demand, and trade developments in the 2010s within the Gulf region and whether we would be able to extrapolate from these the likely pathway dependencies of future overall energy demand and production.[53] This collection of articles illustrated the degree of progress, or lack thereof, that the Gulf countries have taken in the reconfiguration of their natural gas pricing structures. Of salience to this crucial research was whether the regional governments would bridge the gap between the cost of domestically produced (mostly non-associated and complex) natural gas/imported LNG and the price from domestic gas sales. Additionally, this study played a significant role in the literature as it was one of the only comprehensive studies to assess how the regional role of the gas balance in the Gulf national economies is evolving.

To date, there have not been critical analyses of the participation of the Gulf States in multilateral climate negotiations leading up to the Paris Agreement of 2016. The most notable contributions have not focused on the Gulf states individually or collectively during multilateral climate negotiations. Instead, most research reviewed OPEC and its role in the G-77 related to global climate negotiations. Furthermore, most of the research was published over a decade ago. For instance, a 2004 report for the World Wildlife Foundation (WWF) entitled, *An Analysis of the Role of OPEC as a G77 Member at the UNFCCC*.[54] This report assessed the geopolitical fault lines in the G-77 organization and the sometimes-conflicting positions of its members.

Barnett *et al.* published a study entitled, *Will OPEC Lose from the Kyoto Protocol?*[55] in 2004, which reviewed the OPEC economies and the potential impact that the implementation of the Kyoto Protocol would have upon them. While this study was timely when it was published and went into depth crafting energy-economy models, it was still hampered by a lack of analysis on the potential benefits that carbon mitigation policies could have when deployed domestically in the Gulf states and the internal challenges that could exist for them to create a carbon abatement platform.

---

[53] (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES 2018)
[54] *An Analysis of the Role of OPEC as a G77 Member at the UNFCCC,* World Wildlife Foundation (2004).
[55] Jon Barnett, *et al*, "Will OPEC Lose from the Kyoto Protocol?" *Energy Policy* 32 (2004) pp. 2077–2088

Meanwhile, Barnett detailed the perceived obstructionist policies of many OPEC member states in multilateral negotiations in *The Worst of Friends: OPEC and the G-77 in the Climate Regime*.[56] Barnett also noted the divergence of OPEC's core interests with those of the other G-77 member states. However, Barnett's analysis concluded in 2008, which, as discussed in Chapter Seven, was when the negotiating positions of the Gulf countries began to evolve, and the initial waves of the global financial crisis began to coalesce. Moreover, 2008 was when the Gulf countries began to experience natural gas allocation shortages that were the principal cause for them to embrace carbon intensity reductions to lower domestic energy consumption. Barnett's analysis reflected upon the overall cohesion, or lack thereof, of the G-77 and failed to assess the potential benefits that OPEC member states later realized could be had by moderating their respective positions in global climate change negotiations.

Krane has produced perhaps the only significant research I discovered about how many Gulf countries viewed global climate change policies. In, *Climate Strategy for Producing Countries: The Case of Saudi Arabia*, Krane outlined the three core strategies that oil-exporting countries often utilize in the near term to protect their oil revenue in the environment of global decarbonization, such as a defensive strategy to shield domestic upstream and downstream industries from climate risk, what he termed a "dig in" policy.

Secondly, Krane analyzed the "join in" strategy where the governments develop policies to reduce domestic hydrocarbon demand that would provide the secondary benefits of decreasing greenhouse gas emissions. And thirdly, he outlined the "throw in" strategy, whereby oil-rich countries seek to convince their populations that greenhouse gas emissions reduction policies are more harmful than the potential, although increasingly likely, injury that would result from climate change.[57] Krane's succinct analysis provided a framework whereby I weighed the evolution of the Gulf states' position during the multilateral climate negotiations.

As Krane pointed out, many Gulf countries began to invest in renewable energy to reduce their hydrocarbon demand. But, at the same time, they became conscious of the threat that climate change held for their countries. Meltzer, Hultman, and Langley, in *Low-Carbon Energy Transitions in Qatar and the Gulf Cooperation Council*, assessed the impact of

[56] Jon Barnett, "The Worst of Friends: OPEC and the G-77 in the Climate Regime" *Global Environmental Politics* 8(4):1-8 · (Nov. 2008).
[57] Jim Krane, *Climate Strategy for Producer Countries: The Case of Saudi Arabia* (2020)

climate change in the Gulf and how it could offer opportunities for Qatar and its neighbors in fostering investment into renewable energy development to lower its energy intensity.[58] While this study did analyze Qatar's steps towards decarbonization, it was oriented towards policy prescriptions rather than academic research. Additionally, as the authors published the paper in 2014, it does not consider the various multilateral climate negotiations and renewable energy investment strategies that had taken place since the paper's publication. Therefore, the article lacked an analysis of how the Gulf countries view the advantages and disadvantages of national decarbonization.

Except for Krane's research, the lapses addressed above are significant. Governments often cannot create and deploy carbon mitigation instruments without accounting for certain institutional realities despite the theoretical literature on carbon abatement instrument designs. And, while there is a wealth of literature on the EU ETS and on how a national carbon market would potentially succeed in North America, there is a significant gap in the literature on the applicability of carbon trading to the Gulf States. Even though the region has the highest per capita carbon emissions globally, very few researchers have focused on this region in that regard.

2.1.2 Theoretical and Conceptual Climate Literature

During the 1980s and 1990s, a new awareness of the growing risks of climate change and the necessity to reduce greenhouse gas emissions to manage the problem adequately took hold in the global discourse. The genesis of this intellectual shift may be traced to the first World Climate Conference in 1979, which the World Meteorological Organization (WMO) organized in Geneva. This was the first global conference of import that discussed global warming as one of its core themes. The efforts of the World Climate Conference led to the subsequent development of the Intergovernmental Panel on Climate Change (IPCC) by the WMO and the United Nations Environment Programme (UNEP) in 1988.

However, despite its many detractors, climate change mitigation became part and parcel of many countries' agendas with the United Nations Framework Convention on Climate

[58] Joshua Meltzer, *et al*, *Low-Carbon Energy Transitions in Qatar and the Gulf Cooperation Council,* Brookings Institution (Feb. 2014).

Change (UNFCCC) at the 1992 Earth Summit in Rio de Janeiro. During the UNFCCC negotiations, the initial 166 nations (currently 194) that signed the agreement accepted the necessity of curtailing the accumulation of greenhouse gases in the atmosphere to a level that would "prevent dangerous anthropogenic interference with the climate system."[59]

As policy debates intensified around carbon abatement initiatives, a whole host of literature arose, which qualitatively and quantitatively created conceptual models and assessed the development of carbon markets globally. Furthermore, since the establishment of the European Union Emissions Trading Scheme (EU ETS) in 2005, carbon markets have been increasing rapidly across the world. As will be discussed subsequently, there is a fair amount of debate on which carbon mitigation framework is more viable, i.e., carbon taxation, carbon trading, or even other carbon abatement platforms. However, as carbon taxation has not yet been deployed significantly, and carbon markets (outside of the EU ETS) are still very much in their infancy, much of the debate is theoretical in scope.

The current literature on carbon trading expands upon the formative research that Ronald Coase conducted in the 1960s that centered upon the development of well-defined property rights to control externalities, such as pollution. Furthermore, economic geography has been playing an increasingly important role in the discourse of carbon markets. Scholars, such as Clark, Wojcik, Bradshaw, Knight, Howarth, Leichenko, and Knox-Hayes, defined the contours of the nascent field of how carbon trading fits into economic geography and connected the growth of carbon markets to that of the broader understanding of how capital markets function across jurisdictions. [60]

In *The Cultures of Markets: The Political Economy of Climate Governance*, Janelle Knox-Hayes discusses the critical distinction between free-market capitalism and constructed local markets.[61] Her study was impressive in scope by assessing the discrete details of how

---

[59] *The UN Framework Convention on Climate Change*, Art. 2.
[60] Gordan Clark, *et al*, "Geographically Dispersed Ownership and Inter-Market Stock Price Arbitrage: Ahold's Crisis of Corporate Governance and its Implications for Global Standards." *Journal of Economic Geography*, 6 (2006): 303-322; Janelle Knox-Hayes. "Constructing Carbon Market Space-Time: Implications for Neomodernity." Oxford University Centre for the Environment Working Paper Series (2008); Dariusz Wójcik, "Geography and the Future of Stock Exchanges: Between Virtual and Real Spaces." *Growth and Change*, 38, No.2 (2007): 200-223; Eric Knight, "The Economic Geography of European Carbon Market Trading" *Journal of Economic Geography* 11, no. 5 (2011): 817-841.
[61] Janelle Knox-Hayes, *The Culture of Markets: The Political Economy of Climate Governance* (OUP, 2016)

various emissions markets function and the role of local cultural practices that can create a particular pathway dependency of how a country addresses climate change. Knox-Hayes was able to utilize her understanding of how different emissions markets could impact local market operations. While Knox-Hayes did apply a critical approach to using markets to combat climate change, she accepted that markets are most likely going to be the most productive method in managing climate change. However, Know-Hayes did somewhat overlook the critical role of politics in the formation of the market ideology. For instance, the research would have benefited from an in-depth analysis of how specific vested political interests can intertwine (and interfere) with the formation of market-based climate solutions.

Additionally, as Knox-Hayes undertook an in-depth analysis of the theoretical application of carbon markets, Leichenko (2011) analyzed the physical impacts of climate change on metropolises. In Climate Change and Urban Resilience, he argued that urban habitats must become more resilient to manage a wider variety of shocks and stressors that are likely to come because of climate change. However, Leichenko cautioned that any climate adaptation should be undertaken in conjunction with urban development and sustainability.

However, to adequately manage the stressors that would result from climate change, and undertake significant adaptation, Hepburn (2014), postulated that "green growth" is necessary for global welfare to continue to rise.[62] While economic growth is possible without regard for environmental sustainability, an actual increase in human welfare by undermining the ecological basis of human existence is not. Through my research, I found Hepburn's contention to be accurate. Once most developing countries reach a certain level of economic growth, they tend to focus much more on environmental principles. China is illustrative of this phenomenon.

In a continuation of the analysis that postulates that global capital flows are forged by time and space, in a sense, dimensional, economic geographers such as Eyre, Bradshaw, Bridge, and Bouzarovski argued that when we consider the decarbonization process in the global

[62] Alex Bowen and Cameron Hepburn, "Green Growth: An Assessment," *Oxford Review of Economic Policy*, Volume 30, Number 3, 2014, pp. 407–422

economy, it is necessary to recognize that this is principally a *geographical* process.[63] This geographical process is centered upon the reconfiguration of spatial patterns of economic and social activity. It grants a set of foundational concepts which map the geographies of a transition to a low-carbon energy system and influence the various choices among different potential energy futures.[64] Also, as Jiusto argued, the transition to a low-carbon economy is likely to be as significant a shift as the transition from biomass to fossil fuels in the 19th and 20th centuries. Nonetheless, economic geographers have developed a robust critique of contemporary scholarship on the low-carbon energy transition; they argue that its primary limitation is that the modern scholarship views it as a temporal phenomenon and minimally analyzes issues of space and scale. [65]

2.2 The Taxonomy of Carbon Abatement Instruments

Nearly every carbon emissions abatement platform can be classified into one of three overarching categories—whether cap-and-trade (CaT), carbon taxation, or command-and-control regulations (including energy efficiency standards, building regulations, automobile fuel efficiency standards, and feed-in tariffs).[66] While the mechanics differ for each program, the fundamental praxis is that all carbon abatement schemes seek to limit the quantity of greenhouse gases in the atmosphere by either financial incentives, fiscal penalties, or governmental regulation

There has been a perennial debate about whether market-based frameworks of government-mandated regimes are the most effective in mitigating environmental externalities. As this chapter discusses, it is never a simple process to manage externalities that negatively impact the commons. And, to understand the various advantages and disadvantages of the various

---

[63] Michael Bradshaw, "Global Energy Dilemmas: A Geographical Perspective," *The Geographical Journal* 176, no. 4 (2010): 275–290; Gavin Bridge, "Resource Geographies I: Carbon Economies Old and New," *Progress in Human Geography* 35 (2011) 820–834; Nick Eyre, *et al*, "The Way We Live From Now On: Lifestyle and Energy Consumption," Eds. Jim Skea, Paul Ekins, Mark Winskel, *Energy 2050: The Transition to a Secure Low Carbon Energy System for the UK* (London: Earthscan, 2010)

[64] Gavin Bridge, *et al*, "Geographies of Energy Transition: Space, Place and the Low-Carbon Economy," *Energy Policy* 53 (2013): 333

[65] Ibid. at 333; Scott Jiusto, "Energy transformations and geographic research," In *A Companion to Environmental Geography*, eds. Noel Castree, David Demeritt, Diana Liverman, Bruce Rhoads, (Oxford: Wiley-Blackwell, 2009) 533–551.

[66] There are others, such a smart system for buildings and industrial complexes.

carbon abatement mechanisms, this chapter grants an overview of the historical development of these instruments and their promoters.

The notion of utilizing environmental taxes to control pollution (known generally as Pigouvian taxes) originated with Professor Arthur Pigou of the University of Cambridge. Pigou's basic notion was that applying a tax upon a market activity that creates negative externalities would correct an inefficient market outcome, such as pollution. [67] As structured in *The Economics of Welfare* (1920), Pigou argued that industrialists are motivated only by their marginal private interest. When the marginal social interest deviates from marginal private interest, an externality arises as the industrialist would have no incentive to internalize the marginal social cost.[68]

In *Wealth and Welfare*, Pigou introduced the term "market failure," which bracketed certain problems (externalities) as being either public or social that would justify government intervention. In a similar vein, Fourcade explained that from the late 19th century, the dilemma of the British Reform Movement gave birth to welfare economics, which was concerned with how to foster individual liberty and freedom alongside that of social welfare.[69] In that regard, governmental intervention in the market was seen as justified to combat inevitable "market failure" issues as they were inherently "social," "public," or "normative" problems.[70] This policy justification is still used today.

Pigou emphasized that externalities disturb the efficient operation of markets, and government intervention was needed to balance market failures. Pigou created the intellectual contours for the subsequent system of environmental taxes, which supporters of a carbon tax consider to be the most efficient means to reduce greenhouse gas emissions. However, certain scholars, such as Baumol, Coase, Boettke, and Buchanan, among others, pointed out that one of the critical deficiencies of the Pigouvian tax is the calculation of the tax level that would be needed to counterbalance the negative externality.

---

[67] William Baumol, "On Taxation and the Control of Externalities", *American Economic Review,* 62, no 3 (1972): 307-322.
[68] Arthur Pigou, *The Economics of Welfare* (New Brunswick: Transaction Publishers, 1924).
[69] Marion Fourcade, *Economists and Societies: Discipline and Profession in the United States, Britain, and France, 1890s to 1990s* (Princeton: Princeton University Press, 2009)
[70] Ibid.

Both Pigou and F.A. Hayek acknowledged that the central deficiency of the Pigouvian tax was how to accurately create a taxation regime that would bring about the desired reduction in the externality at hand. Pigou termed this information deficit the "knowledge problem," as he suggested in his essay, *Some Aspects of the Welfare State* (1954). [71] In the *Welfare State*, Pigou indicated that economists' models often depend upon many assumptions that may not exist in the "real world." Therefore, the use of such a model could cause the proposed government intervention to either fail or exacerbate other hitherto unconsidered externalities.[72]

Additionally, Hayek expanded his inquiry and delved into the cognitive limitations of the human mind. Hayek argued that a single human or even an institution could not have all the information necessary to plan and direct efficient resource allocation in society rationally. Another way to view this is by the term coined by Herbert A. Simon in *Models of Men*. Simon adhered to the belief that individuals and governmental agencies suffer from "bounded rationality" in which ostensibly rational agents, due to the cognitive confines of their minds, the restricted amount of time to assess and make a decision, and the dearth of available information, cannot make an entirely rational or optimal choice.[73]

However, Simon's central thesis could also critique both individual bureaucrats attempting to direct the market or individual market agents prone to overreaction, which would lead to extreme market fluctuation. Behavioral finance scholars have extensively analyzed this herding behavior, such as Robert Shiller and Nobel laureates Vernon L. Smith, Amos Tversky, and Daniel Kahneman. They identified bounded rationality as the principal cause of the collective irrationality of investors, which often leads to herding and outbursts of market panic.[74]

---

[71] Arthur Pigou, *The Economics of Welfare,* (London: Macmillan, 1920); See, generally, William D. Nordhaus, "To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming," *Review of Environmental Economics and Policy* 1, no. 1 (2007): 26-44.

[72] Pigou wrote that, "It must be confessed, however, that we seldom know enough to decide in what fields and to what extent the State, on account of [the gaps between private and public costs] could interfere with individual choice." Arthur Pigou, "Some Aspects of the Welfare State," *Diogenes* 2, no. 7 (1954): 6.

p.57 Simon wrote that, "boundedly rational agents experience limits in formulating and solving complex problems and in processing (receiving, storing, retrieving, transmitting) information." See, Herbert A. Simon, *Models of Man*, (Wiley: 1966); See, generally, Daniel Kahneman, "Maps of bounded rationality: psychology for behavioral economics," *The American Economic Review* 93, no. 5 (2003): 1449–75.

[74] Shiller, Robert J. (2000). *Irrational Exuberance*. Princeton University Press. pp. 149–153. Retrieved 4 March 2013.; (ed) Daniel Kahneman, Paul Slovic, Amos Tversky, *Judgment under Uncertainty: Heuristics and Biases* (Cambridge

Therefore, according to Hayek, decentralization of economic decision making, or the formation of a market-based social order (what he termed, *catallaxy*) is necessary to form the incentives and opportunities to allow various entities to interact and exchange the knowledge gained through their discrete activities.[75] The accumulated and aggregate understanding of many individual actors would serve as a type of "collective intelligence," developed by Douglas Hofstadter, Peter Russell, Tom Atlee, and Pierre Levy.[76]

Regarding the application of the Pigouvian tax on carbon emissions, a carbon tax is a price instrument that is generally imposed on the carbon content of fuel inputs, or in other words, the carbon intensity. The theoretical impetus behind the carbon tax is that it would encourage emitters to transition to a reduced carbon footprint or use their fuel inputs more efficiently.

Yet, a close analysis of most externalities can reveal that they are essentially an ownership problem. In short, an externality is principally a failure to specify ownership rights over a particular asset class. For example, a power plant purchases coal and has ownership rights over that commodity but does not have property rights over the emitted carbon from the combustion of that coal. From the University of Chicago, Ronald Coase first explored this problem in-depth in his famous article, which he published in 1960, *The Problem of Social Cost*. This article greatly influenced the future carbon trading literature by creating the conceptual foundation for the cap-and-trade system.

Coase vigorously opposed the administrative method of Pigouvian taxes and instead chose

---

University Press:1982)

[7575] While Hayek first coined catallaxy, von Mises first discussed it. Hayek developed this term from the Greek word ‘katallasso’ (καταλλάσσω) which not only signified making a change or exchange, but also reconciliation. The term catallaxy implies that the foundational market characteristics, such as prices and division of labor, are the results of the diverse and disparate individual goal of the economic actors in a community. This contrasts with the term, “economy,” which implies that the economic actors in a particular community possess a common set of values. See, Thayer and Smith. "Greek Lexicon entry for Katallasso". "The NAS New Testament Greek Lexicon". 1999; Friedrich Hayek*, Law, Legislation, and Liberty, Volume 2: The Mirage of Social Justice*, (Chicago: University of Chicago Press, 1976) 108–9.

[76] Douglas Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid* (New York: Basic Books: 1979); Tom Atlee and Karen Mercer, *The First Little Book on Co-Intelligence,* (The Co-Intelligence Institute: 1996); Pierre Levy, *Toward a Self-referential Collective Intelligence: Some Philosophical Background of the IEML Research Program*, Computational Collective Intelligence. Semantic Web, Social Networks and Multiagent Systems Lecture Notes in Computer Science, Volume 5796, 2009, pp 22-35

to leverage existing property law (e.g., common law) as the most efficacious method to control unwanted externalities. [77] Coase based his theories on the notion of a Lockean framework of property rights. And, as stated previously, in his critique of the notion of "externalities," Coase merely redefined the problem of externalities as simply being a problem of unclear or unallocated property rights.[78]

While Pigou and his supporters viewed market failure as the principal cause for externalities, Coase and other economists from the Chicago School regarded the market as the cure for externalities such as carbon emissions. More precisely, for these scholars, the price mechanism promotes exactitude, quantification, and transparency. For example, Stigler expounded that the market-based price mechanism "lays the cards face-up on the table."[79]

The New Institutional Economics (NIE) field was developed to rectify the perceived deficiencies of neoclassical economics as it relates to carbon markets. Neoclassical economics would typically neglect issues of transaction costs and principal-agent problems in a carbon market. As a result, it did not allow a comprehensive assessment of why carbon markets could experience uneven performance. The NIE has created a robust methodology to analyze property rights and non-rational behavioral assumptions to uncover problems in economic regulation, global markets, contracting, and trade issues.[80]

Building off Coase's work, 1969, Kenneth Arrow, a Nobel Laureate in economics, wrote that: "The identification of transaction costs in different contexts and under other systems of resource allocation should be a significant item on the research agenda of the theory of public goods and indeed of the theory of resource allocation in general.[81] Thereby, a new sub-discipline of institutional economic research arose, which was termed transaction costs economics. However, a period had passed before research on economic instruments for environmental protection began to recognize its value which started in earnest in the 1990s

---

[77] Ronald Coase, "The Problem of Social Cost," *The Journal of Law and Economics* 3 (1960): 1-44.

[78] Ibid. p.1

[79] George Stigler, *The Organization of Industry* (Chicago: University of Chicago Press, 1983) 36.

[80] Barry Solomon, *New Directions in Emissions Trading: The Potential Contribution of New Institutional Economics*, Ecological Economics (Sept. 1999). p.382

[81] Kenneth Arrow, "The Organization of Economic Activity: Issues Pertinent to the Choice of Market Versus Nonmarket Allocation." In *The Analysis and Evaluation of Public Expenditures: the PBB System*, Joint Economic Committee Compendium, 91st Congress, 1st Section, Vol. 1. Government Printing Office: Washington, D.C.

with the seminal study of Bressers and Huitema, which illustrated the difficulties economists had noticed for the acceptance and in the start-up phase of emissions trading.[82] Moreover, Dudek and Wiener argued that market transaction costs are composed of approval costs, monitoring costs, enforcement costs, insurance costs, and search costs. The government usually bears the transaction costs of regulating the carbon-emitting sectors and monitoring emissions.[83]

As discussed in Chapter Six, Section 6.1, historically, the notion of taxation ran counter to the Arab social contract that held firm for many decades whereby in the most basic sense, the rulers promised a broad welfare state while the populace acquiesced to limited popular representation. Regressive taxation frameworks were thought to upset that delicate balance. These could potentially lead to calls for popular enfranchisement, such as throughout various periods in history, perhaps the American revolution being one of the starkest examples. However, due to the decline in over revenue over the past several years, several Gulf states are experimenting in the implementation of various taxation regimes, such as Saudi Arabia, Bahrain, and the UAE have implemented and Oman plans to do in April 2021, alongside an income tax on wealthy individuals.[84] If the Gulf countries were to institute a carbon tax, the national governments would likely nullify its impact by promptly exempting most energy-intensive industries.

Command-and-Control (CAC) methods also have a reasonably extensive pedigree in the Gulf region. CAC refers to a regulatory body authorized by the government to "command" the reduction of certain pollutants, such as by setting carbon emissions levels. And it also refers to "control," which decides how the designated emissions level is achieved, such as by mandating the installation of specific technology. Generally, these two methods are referred to as emissions and technology standards. These two standards are often utilized together to achieve the desired result. CAC differs from other forms of environmental regulation, such as carbon taxation, as the regulatory body sets the standards or targets to which an entity must adhere. In the case of non-compliance, the regulatory body may

[82] Edwin Woerdman, "The Institutional Economics of Market-Based Climate Policy, Developments" in *Environmental Economics* (2004).
[83] Ibid; D.J Dudek and J.B. Wiener *Joint Implementation and Transaction Costs Under the Climate Change Convention*, Restricted Discussion Document ENV/EPOC/GEEI (96)1 (Paris: OECD 1996)
[84] *Vat in the Gulf: Oman Becomes the 4th State to Introduce a VAT Systems*, Taxamo (Oct. 20, 2020).

impose penalties such as prosecution or fines.[85]

CAC-type regulations have successfully mitigated pollution in the U.S. Due to the many CAC regulations promulgated in the 1970s, the air and water quality in the U.S has markedly improved.[86] CAC was a prevalent pollution control method during the latter half of the twentieth century due to increased environmental awareness and activism at the local and national levels.[87] But it subsequently fell out of favor as it was generally viewed as merely being remedial and reactive, rather than being proactive and focused on pollution prevention. Despite utilizing other environmental pollution control techniques, CAC regulations are still a standard part of many countries' environmental policy toolbox.[88]

Supporters of the CAC approach to reduce carbon emissions generally maintain that CAC regulations are desirable. As the set standards are implemented with legal force, it typically has a relatively rapid response time for compliance.[89] Yet, as with carbon taxation, during the 1980s, CAC regulation was roundly criticized as being ineffective and symptomatic of an overly broad approach to complex problems that the market could more readily solve.[90] Most of the criticism directed towards the CAC approach was aligned with the overall growth of neoliberal and deregulation movements during the Reagan-Thatcher terms in the U.S. and UK during the 1980s.

---

[85] Robert Baldwin, *et al*, *Understanding Regulation: Theory, Strategy and Practice.* (2nd ed. Oxford University Press 2011)

[86] See, generally, Clifford Rechtschaffen and Denise Antolini, *Creative Common Law Strategies for Protecting the Environment* (Environmental Law Institute, 2007).

[87] For instance, Earth Day, established on April 22, 1970, typically marks the birth of the modern American environmental movement. Furthermore, books such as Rachel Carson's 1962 *Silent Spring* did much to impact and encourage the environmental discourse. See, generally, Rachel Carson, *Silent Spring* (Houghton Mifflin Company:1962).

[88] See, generally, M. Bocher, *A Theoretical Framework for Explaining the Choice of Instruments in Environmental Policy. "Forest Policy and Economics* (Elsevier: 2011)

[89] Winston Harrington and Richard Morgenstern, *Economic Incentives Versus Command and Control: What's the Best Approach for Solving Environmental Problems*, Resources (Fall/Winter 2004).

[90] Ibid.

Chapter Three: Crossing the Rubicon: Qatar's Journey to Natural Gas Dominance

3.1 Introduction: Overview of Qatar

Qatar has been a world leader in the export of liquefied natural gas production (LNG) for the past decade and has adroitly positioned itself to take advantage of the rise in global LNG demand. The small nation is strategically placed in the Gulf at the tip of the Arabian Peninsula, where it straddles Bahrain and the UAE. And is governed by a well-educated, ambitious, and tolerant elite, promoting a robust pro-market philosophy.[91]

However, Qatar arrived relatively late in the LNG market, in part, because of its small population of approximately 2.881 million (Jan. 2020), only 20 % of whom are Qatari nationals.[92] Qatar also has one of the world's fastest population growth rates due to its robust economic performance. It had a stark demographic increase of 40 % in terms of residents over 2010-2015, although most of the growth was due to a massive influx of foreign workers.[93]

Natural gas is its principal export in its energy sector, with its proven natural gas reserves equal to approximately 14 % of total world reserves.[94] Its estimated 24.7 Trillion cubic meters (TCM) plus 22.3 billion barrels (2021) of associated condensates are the third-largest in the world, behind Russia and Iran.[95] Qatar's reserves-to-production ratio is tentatively estimated at between approximately 100-130 years at current output rates.[96] Most of the

[91] Even though the Qatari leadership and most of the native population follow the teaching of Muhammed ibn Abd al-Wahhab, as the Saudi monarchy does, that is mostly where the similarities in religion end between Qatar and its much larger neighbor. Qatar allows most Western lifestyle options, of course, with some constraints. It must also be noted that the term Wahhabi, is considered deeply pejorative for must adherents. They prefer the Arabic transition of "Unitarian," roughly translated as followers of the One. *Qatar: The Other Wahhabi State*, The Economist (June 2, 2016). For a concise assessment on the influence of Abd al-Wahhab influence on Qatar, see, Allen James Fromherz, *Qatar: A Modern History* (I.B. Tauris, 2012) pp.62-64.

[92] This %age is approximate as Qatar, as with most other GCC countries, at the time of writing, considers demographic data on the size of the indigenous population to be somewhat classified.
Official figures from the Qatar Ministry of Planning Development Planning and Statistic, MDPS Website. Available at http://www.mdps.gov.qa/en/pages/default.aspx

[9393] Ibid, MDPS figures.

[94] *BP Statistical Review of World Energy*, *British Petroleum* (2021). p.34

[95] Ibid

[96] Previously, Qatar's Reserves/production (R/P) ratio was estimated to last for 200 years. However, with the completion

country's gas is located in the massive offshore North Field (See Figure 3.1 below), the world's largest non-associated natural gas field.

But it was when Qatar became the world's largest exporter of LNG in 2006 (overtaking Malaysia), it truly strode onto the world stage. Qatari policymakers, though, have recognized that they cannot be complacent and depend on a mono-export economy for long-term sustainable development. To shift gears, they are currently diversifying the Qatari economy and enhancing its natural gas posture by expanding the downstream natural gas industries, investing in shale gas production sites and LNG plants in North America and globally, while also taking a leading role in global decarbonization efforts. Because of its economic strategy based upon diversification in the natural gas value chain, Qatar is now strongly represented in nearly every sector of the natural gas trade, LNG, Gas-to-Liquids (GTL), pipeline gas, and Natural Gas Liquids (NGL).

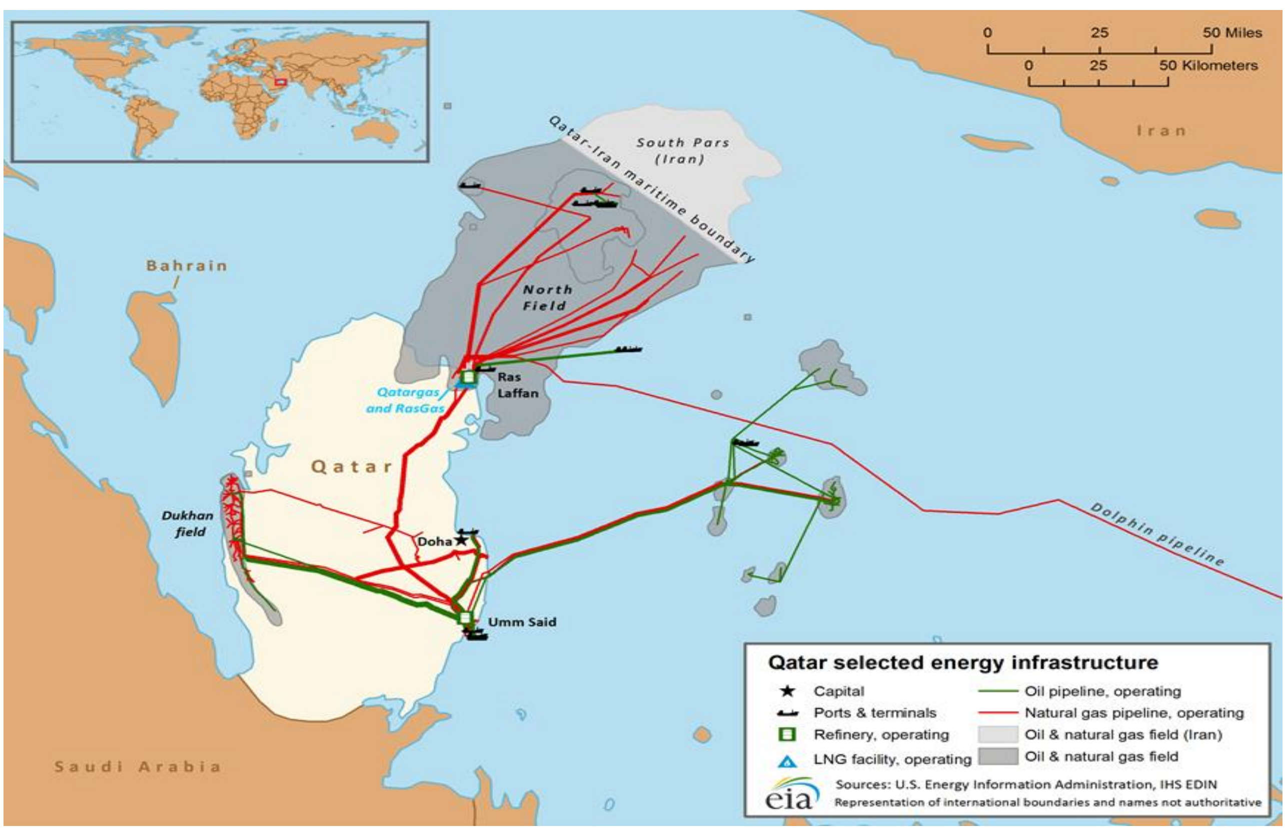


Figure 3.1: Map of the North-West Dome Reservoir and Qatari Energy Infrastructure; Source: Energy Information Administration, IHS EDIN

of several LNG trains, its R/P ratio has narrowed to between approximately 100-135 years. *Qatar Gas Reserves to Last for another 138 Years on Current Output Rates: QNB*, Gulf Times (June 20, 2015).

The North Field (See Figure 3.1) allowed Qatar to become a significant regional gas exporter through the Dolphin pipeline and a major international gas supplier through LNG exports. It is also the cornerstone of Qatar's quest to establish an independent foreign policy outside Saudi Arabian political influence.[97]

This chapter aims to grant a clear overview of the various dynamics operating within Qatar's energy policy. It will assess its overall energy posture and offer an understanding of its structural production/demand/export profile.

In terms of this chapter's outline, Section 3.2 will analyze Qatar's gas reserves and the characteristics of its principal natural gas field, the North Field. Section 3.3. will delve into Qatar's gas sector to review the historical development of Qatar's gas sector against its current challenges and will assess its current policies to manage its carbon reduction initiatives and competition in the global LNG export market. Section 3.4 discusses Qatar's gas demand profile and reviews the major gas demand drivers in the petrochemical and power sectors. And Section 3.5 concludes with an overview of Qatar's natural gas challenges and its potential future posture.

3.2 Qatar's Gas Reserves

The North-West Dome Reservoir (known as the North Field in Qatar and South Pars for the Iranian extension) is a combined gas condensate field located in the Arabian Gulf, spanning the Iranian and Qatari maritime border. Known as the 'Qatar Arch,' the geological structure is a Permian Khuff stratum that lies approximately 3,050 meters beneath the surface and runs north-south through the entire peninsula. Near Qatar's tip, the sub-stratum veers off into a northeasterly direction (see Figure 3.2). There are various estimates as to how much recoverable gas reserves the field holds, but some of the more credible ones maintain that the total amount of gas in the field (both in the Iranian and Qatari zones) is nearly 50.1 TCM, with Qatar's technically recoverable reserves standing at approximately 24 TCM and Iran's at 14 TCM.[98] However, it is essential to mention that

[97] For a broad exposition on the often-difficult relationship between Saudi Arabia and Qatar, see Bernard Heykal, *Saudi Arabia and Qatar in a Time of Revolution*, Gulf Analysis Papers (2013).
[98] Jean-Francois Seznec, *Sharing a Pot of Gold: Iran, Qatar and the Pars Gas Field*, Middle East Institute (August 2016).

many of the available reports conflict regarding the amount of gas the combined North Field/South Pars holds, so the remaining 12.9 TCM may merely be unlikely to be successfully recovered at current levels of extraction technology. [99]

3.2.1 North Field Development and Characteristics

The North Field covers an area equivalent to nearly half the surface area of Qatar (see Figure 3.2). It is a carbonate reservoir with an approximate thickness of 457 meters, variable throughout the reservoir.[100] When discovered, Qatar initially viewed the North Field as a "disappointment" because of difficulties finding export markets for resources designated as 'stranded' natural gas reserves.[101]

---

p.2; Justin Dargin, *The Dolphin Project: The Development of a Gulf Gas Initiative*, Oxford Institute for Energy Studies (Jan. 2008); *Qatar Natural Gas Profile*, Energy Information Administration (Oct. 20, 2015). Accessed November 13, 2021.

[99] Ibid.

[100] Within the main Khuff gas-bearing reservoir, four Khuff zones were defined. Of the four zones, K-4 is the most prolific and contains approximately 60 per cent of the gas reserves. *The Source: Qatar's North Field*, Qatargas Homepage Available at https://www.qatargas.com/english/operations/offshore

[101] Energy Minister Abdullah bin Hamad al-Attiyah, reminisced that, "I remember all the people who advised me and my country not to go into the LNG business." Lucy Williamson, *Qatar's Fortunes Boom with Gas*, BBC News (Feb. 2006).

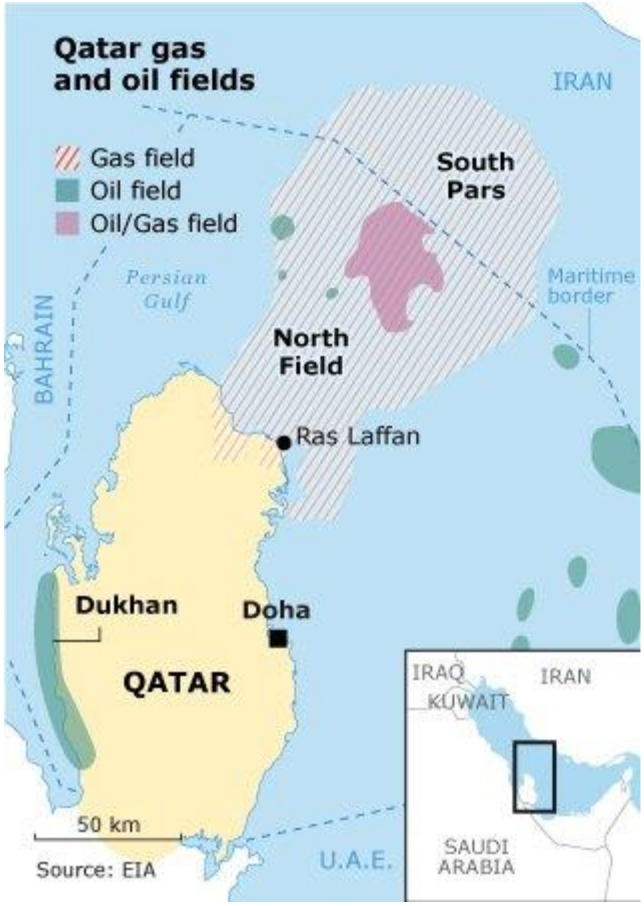


Figure 3.2 Qatar Gas and Oil Fields: Source: Energy Information Administration

Because the Qatar General Petroleum Company (QP) did not perceive its future potential, it earmarked the gas wholly for local consumption.[102] And, since it viewed gas so unfavorably in the early 1970s, Qatar flared approximately 80% of the 6.13 BCM/yr (16.8 Million cubic meters) (mcm/d) of associated natural gas produced daily.[103] As it became more mindful of its gas wealth, Qatar reduced the onshore gas flared to 66% by 1974, and by 1979, to less than 5%.[104]

Even though Qatar nationalized the North Field in the late 1970s, the handover was

[102] Ibid. Qatar Petroleum rebranded itself as QatarEnergy in 2021. Throughout the text, its former name, QP will ne utilized.
[103] Naji Abi-Aad, *Natural Gas Reserves, Development and Production in Qatar*, Oil, Gas and Petrochemicals in Qatar (April 19-21, 1998). p. 6
[104] Talal Malik, 'Gulf Eyes Use for Gas Flares', *Arabian Business* (March 11, 2008); *Qatar: First Gulf Country Joins World Bank-led Effort to Reduce Greenhouse Gas Emissions from Gas Flaring*, Global Gas Flaring Reduction Partnership Home Page (Jan. 25, 2009) Available at <http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:22044056~menuPK:34463~pagePK:34370~piPK:34424~theSitePK:4607,00.html>

amicable. Unlike the somewhat aggressive nationalizations in other MENA and Latin American countries, Shell remained onboard as a contractor to provide technical and support expertise.[105] The fact that Qatar remained on cooperative terms with the international oil companies (IOCs) during the tumultuous 1960s and 1970s was the primary impetus for its current reputation of being a bastion of market stability in a sometimes fractious region. Being forward-looking, the Qatari leadership clearly recognized that there was no strategic benefit to being confrontational with the IOCs and the governments of their headquartered countries.

In addition to the North Field, Qatar has other minor associated gas fields. A Khuff non-associated gas reservoir sits beneath Qatar's oldest producing oil reservoir, the Dukhan oil field. But it is relatively small when compared to other Gulf gas fields. The Dukhan field contains an estimated 141 BCM of associated gas and 1.41 BCM of non-associated gas.[106]

Until the discovery of the North Field, Dukhan produced nearly all of Qatar’s non-associated gas. Minor amounts of gas were also produced by the Al Ghatta Al-Ghazi cap gas deposits, located approximately 3,048 meters below the Khuff region.[107] Additionally, there are smaller associated gas holdings in the Maydan Mahzam, Id al-Shargi, Bul Hanine, and Al Rayyan oil fields. During Khalifa bin Hamad's reign, Qatar failed to pursue a proactive production policy, mainly because the preceding governmental approval process was so arduous that it required the Emir’s personal involvement.[108]

[105] *Middle East, the Strategic Hub: A Bibliographic Survey of Literature*, Volume #550, Headquarters, Department of the Army (1978) p.230
[106] (Anonymous) Interview with QatarEnergy Official (Sept. 6, 2017)
[107] Ibid.
[108] Ibid.

3.3 The Development of the Qatari Gas Industry

3.3.1 The Birth of Qatari Gas Development

Upon discovery of the North Field, Qatar made it the crux of its economic development program. Historically, as with most Gulf nations at that time, Qatar viewed itself through the narrow prism of an "oil producer" and did not readily discern the profitability of natural gas reserves. It took a seminal report commissioned by Qatari officials in 1962 to examine the administrative effectiveness of governmental ministries, the Arthur D. Little (ADL) study, that sounded the early warning for Qatar to diversify from oil into other economic sectors. [109]

The ADL study expressed concern over Qatar's overwhelming economic and financial dependence on the oil sector, which it had (incorrectly) projected would be exhausted by 1982. The report, therefore, cautioned Qatar to develop other non-oil sectors, especially its natural gas wealth. The Qatari government took these recommendations seriously, and in 1964, undertook the initial steps to initiate broad-based implementation. [110]

However, the geopolitical turmoil associated with the 1973 Organization of Arab Exporting States (OAPEC) oil embargo and the 1979 Islamic Revolution in Iran significantly increased global oil prices and channeled enormous revenue inflows to Qatar. Consequently, this massive revenue growth mitigated most of the negative economic impacts they would have otherwise experienced from the declining production rates due to oil field maturity. And, accordingly, the influx of additional revenue lessened the sense of urgency to diversify economically.

For example, from 1973-1974, the oil price rose from nearly 300%, from approximately $3 per barrel to almost $12 per barrel. This monumental foreign revenue inflow allowed the government to funnel the increased oil revenue into massive social and infrastructural

[109] Jill Chrystal, *Oil and Politics in the Gulf: Rulers and Merchants in Kuwait and Qatar* (Cambridge University Press, 1995) p.158
[110] Ibid.

investments, thereby creating the edifice of the modern national social contract on display today. And as with most other oil-producing countries experiencing such windfall profits, the hard decisions accompanying economic diversification fell by the wayside. Despite the ADL's policy suggestions, natural gas receded into the background and only dimly glimmered on the policymaking radar.

However, the geopolitical turmoil associated with the 1973 Organization of Arab Exporting States (OAPEC) oil embargo and the 1979 Islamic Revolution in Iran significantly increased global oil prices and channeled enormous revenue inflows to Qatar. As a result, this revenue growth mitigated most impacts of declining production rates due to oil field maturity.[111]

Despite the ADL study's policy suggestions, Qatar granted natural gas production minimal consideration during this period. Because the country benefited enormously from the oil market upheavals in the 1970s, the government funneled the increased oil revenue into massive social and infrastructural investments.[112]

However, several factors arose that precipitated oil's decline in importance for Qatar.

After Qatar's oil production began declining in the 1970s, IOCs became convinced that its mature oil fields were not worth further investment. Furthermore, the IOCs perceived Qatar's service contracts as not being financially viable for them, which made the prospect of additional large-scale upstream investment less appealing. And then, by the mid-1980s, while the economy was still heavily reliant on the oil sector, falling oil prices due to the massive Saudi oil production expansion meant that between 1979 and 1983, the percentage of government revenues derived from petroleum fell from 93 % to 80 %. [113] In tandem with the stark decline in oil price, Qatari oil production continued to plummet until about 1987, producing a meager amount of around 300,000 barrels per day.

---

[111] At the end of 2020, Qatar's oil reserves stand at 25.2 billion barrels, with a daily production rate of 1.8 million b/d. *BP Statistical Review of Energy*, BP (2021). pp. 16,18

[112] For a detailed table of governmental expenditures pre-and-post 1973, see Ragaei El-Malakh, *Qatar: Development of an Oil Economy* (Taylor & Francis, 1979) pp.59–65.

[113] *The Middle East and North Africa 2004* (Routledge, 2004) p.943. (Accessed July 12, 2021)

The final coup de grâce to oil's formally vaunted position in Qatar's macroeconomy occurred when Qatar officially departed from OPEC in 2019 by stating that it sought to focus on its domestic gas sector. This was undeniably a blow to OPEC, as it often prided itself on being an organization that spoke for the region's interests in the global oil sector since its establishment in 1960. Structurally, though, Qatar's exit did not disrupt the organization's operations, and as discussed above, Qatar's declining oil production did not significantly impact OPEC, one way or the other.

But for Qatar, this volte-face realignment of its foreign policy was seen as an entirely justifiable and prudent strategic response that emphasized its sovereignty to the nearly three-year blockade launched by Saudi Arabia, Egypt, Bahrain, and the UAE.

When viewed geostrategically, the decision to withdraw from OPEC reinforced Qatar's autonomy and lessened Saudi Arabian political influence. What is notable is that despite a not insignificant animosity between Qatar and the blockade supporters, the embargo did not disrupt energy trade amongst the countries. For instance, Qatar did not halt gas exports through the Dolphin natural gas pipeline. And during the blockade, Qatar was still able to export its LNG globally without interference. And as an example of continuing energy collaboration, Qatar and the UAE renewed a concession agreement to develop and operate the joint Al-Bunduq offshore oilfield, even during the height of the diplomatic crisis.

Nor were there any pronouncements that future disruptions on electricity swapping through the Gulf Cooperation Council Interconnection Project would be forthcoming. The principal disruption to Qatar was that its airline, Qatar Airways, could not avail itself of the jurisdictions of the blockade countries for its flights.

To a certain extent, the lack of disruption in the regional energy sector illustrated that the regional energy sector potentially could be the glue of stability for future cooperative ventures in the region. But even though energy trade continued unabated, unforeseen and lasting repercussions for further Gulf partnership could emerge at any time.

But since its transition to natural gas production, Qatar ceased its dependence upon oil production for its foreign revenue generation; therefore, its OPEC departure merely confirmed an existing reality. Also, Qatar's oil fields continued to mature and had been in a steady decline since 2013, from 1.9 million barrels per day to hovering at nearly 1.8 million barrels per day by 2020.[114] All the preceding signified that oil would be of minuscule importance to Qatar's economic growth strategy moving forward. Qatar's future was planted firmly in the natural gas sector.

For Qatari policymakers, LNG was the future and would be fueling the economic growth boom of the Asia-Pacific region, become the bridge fuel in the drive for global decarbonization, and power its foreign policy aspirations.

3.3.2 Seizing the Crown: The LNG Pivot

All was not smooth on Qatar's LNG production journey; several challenges arose in Qatar's transition to becoming a natural gas-based economy. Phase One of North Field development was interrupted several times before its planned start-up date in 1990.[115] Not only did the Iraqi invasion of Kuwait upset most major regional development projects and cause Gulf governments to be externally focused, but Qatar also faced numerous obstacles during this period as well.[116] The evacuation of skilled personnel during Operations Desert Shield and Desert Storm measurably delayed North Field progress. Furthermore, progress was held back due to several infrastructural issues. For example, fourteen of the sixteen production wells in Phase One suffered from cement casing leaks during this period. [117]

A week before the revised start-up date of August 3, 1990, engineers discovered a chemical leak in an onshore pipe and the North Field, thereby shutting it down.[118] September 3, 1991, marked Qatar's twentieth anniversary's independence and the North Field's discovery. It

[114] Every year, Qatar produces nearly 2 % of its oil reserves. *Statistical Review of World Energy*, BP (2021). p. 23 (Accessed July 15, 2021)

[115] See, generally, Justin Dargin, *The Dolphin Project: The Development of a Gulf Gas Initiative* (OIES, 2008).
[116] Mark Grossman, *Encyclopedia of the Persian Gulf War* (ABC-CLIO, 1995) p. 233
[117] David G. Victor, *et al*, *Natural Gas and Geopolitics: From 1970 to 2040* (Cambridge University Press, 2006) p.244.
[118] Ibid.

was also the date that the North Field commenced production. Up to this time, most of Qatar's natural gas came from a couple of onshore and offshore oilfields, from which associated gas was processed at the Umm Said complex.

After this date, Qatar took advantage of two events that significantly increased natural gas demand in the international and regional markets: first, the widespread use of combined cycle gas turbines in the 1990s in power generation; and second, the cost reductions throughout the LNG chain. These developments allowed Qatar to reconfigure its previous strategy and reorient its gas resources primarily from domestic power generation and petrochemical production to the global export market.

However, Qatar is now attempting to regain its leadership position in global LNG export that it had relinquished in the 2010s, beset by a worldwide LNG glut, weak international demand, rising LNG competitors, the slump in global oil prices from 2014-2017, and then again in the wake of the global Covid-19 pandemic of 2020, as well as the growth of consumer cartels',[119] pressure on the dominant long term contractual model.[120] However, as discussed below, when its new trains come online, it is expected to regain that position. Qatar placed a moratorium on the North Field gas exploration and production moratorium from 2005 to 2017. It was repeatedly extended year-on-year to moderate its gas production for future export potential.[121]

The moratorium was lifted in 2017, and in 2019, Qatar announced that it would expand its LNG production from 77 to 126 million tons per annum (MTPA) by 2027. QP planned for its LNG production to increase to around 110 MTPA by 2024 and that it would construct four new LNG trains to manage the proposed increase.[122] The planned output increase comes as

---

[119] India is leading the charge to renegotiate LNG contracts with Qatar by fostering bilateral relationships with other major LNG importers, such as China. *Despite Renewed Rhetoric, A 'Gaspec' Cartel Still Faces Big Challenges*, S&P Global Platts (July 22, 2020).

[120] See, generally, S. Finizio, *et al, Trends in LNG Supply Contracts and Pricing and Pricing Disputes in the Asia Pacific Region*, "Oil, Gas and Law Energy Intelligence," Vol. 8, Issue 3 (May 2020)

[121] As the CEO of Qatargas, Khalid Bin Khalifa Al Thani explained, "The moratorium was put in place by our main shareholder, Qatar Petroleum, to allow them time to study the reservoir performance of the North Field to ensure the long-term, efficient development of this world class gas field," Julia Avena, *Qatar: From Strategy to Implementation*, Oil and Gas Financial Journal (Nov. 20, 2014).

[122] The four LNG mega-trains (8 MTPA each) would come online at intervals of three to six months after the first one begins operation in 2024. Stuart Elliot, *Qatar Sees Four LNG Mega-Trains Coming Online in 3-6 Month Intervals: al-Kaabi*, S&P Global Platts (Oct. 8, 2019).

drilling and appraisal work in the North Field determined that its gas reserves now exceeded 50 TCM.[123] This production increase announcement came as Qatar was locked in fierce competition with Russia, the U.S., and Australia for global LNG dominance as Qatar's rivals had significantly increased their LNG production, sending prices to multi-year lows.[124]

Qatar plans to reduce its carbon footprint with the LNG train expansion by installing CCS infrastructure to reduce carbon emissions from its gas liquefaction and storage by nearly 25 % below comparable operations in other jurisdictions.[125] Qatar is implementing its carbon reduction plans primarily due to its Paris Agreement climate pledges (discussed in depth in Chapter Seven), and to the EU's recently implemented policies, such as its Methane Strategy it announced in October 2020.[126] The European Commission's Methane Strategy requires the emissions reporting requirements for exporters to the EU member countries. It posits the default values for methane emissions if the exporters do not meet the reporting standards. This undoubtedly placed pressure on Qatar to reduce the carbon emissions from its LNG production lifecycle.

Following the promulgation of the EU Methane Strategy, QP signed an LNG supply contract in December 2020 with the Singapore-based Pavilion Energy Trading and Supply Pte Ltd. to export 1.8 MTPA for a decade from 2023. These LNG cargoes will identify and list the emissions levels attached to each cargo. While this agreement does not obligate QP to a specified level of emissions, The Qatari energy minister, Saad al-Kaabi, announced that it represents, "[O]ur first long-term LNG arrangement containing specific environmental criteria and requirements designed to reduce the carbon footprint of the LNG supplies ultimately."[127]

Overall, QP indicated that its carbon reduction plans, a portion of its overall sustainability strategy, would act "as a clear direction towards reducing the emissions intensity of Qatar's LNG facilities by 25% and its upstream facilities by at least 15% and reducing flare intensity

[123] Ibid.
[124] Dahlia Nehme, *Qatar Plans to Boost LNG Production to 126 Mln T by 2027*, Reuters (Nov. 25, 2019).
[125] Kevin Adler, *Qatar Petroleum Commits to Low-Carbon LNG in its Latest Expansion*, HIS Markit (Feb. 11, 2021)
[126] The EU Methane Strategy asserts that non-EU imported pipeline gas and LNG contribute three to eight times the emissions of comparable products produced in the Europe. Ibid.
[127] Ibid.

across upstream facilities by more than 75%."[128]

QP's sustainability strategy also set a target to eliminate flaring by 2030 and reduce methane emissions by implementing a methane intensity target of 2% to apply to all facilities by 2025.[129] The strategy also obligates QP to expand its power capacity by more than 4GW from renewable energy, which would remove more than five mn t/yr of carbon emissions while also planning to remove seven mn t/yr of carbon by 2030 by CCS. By taking a leading role in reducing the carbon intensity across the natural gas value chain, Qatar intend to position itself ahead of its peers as a green and responsible energy giant ready for the "post-carbon world."

Qatar still has several advantages that elude other LNG exporters despite advancing competition from its LNG production peers. Firstly, Qatar has some of the lowest-cost gas production globally because of the revenues from the natural gas liquids- butane and propane- produced mostly wet gas. Therefore, its economies of scale arise because the North Field is nearly a homogeneous field with extremely low production costs. Other producers find it challenging to rival those enabling factors. When considering whether in the future other jurisdictions would be able to acquire market share from Qatar, their typically higher break-even prices must be considered. Moreover, even though new LNG production zones are being constructed globally, no other country can match Qatar's ability to renegotiate legacy contracts and create mutually advantageous contracts.

However, Qatar is currently experiencing a conflict of vision with some of its foreign operators as the government seeks to produce its natural gas reserves over the most prolonged period possible to avoid rapid field depletion. Nevertheless, this view contrasts with the perceived strategy of its foreign partners, who, as a rule, seek rapid profit maximization from producing as quickly as possible to recoup exploration costs. Because of this fundamental difference in views, additional field development in Qatar may face difficulty until consensus can be found.

Because most of Qatar's natural gas was previously associated with oil, periods of weak oil

---

[128] Adal Mirza, *Qatar Sets 7mn t/yr 2030 Carbon Capture Target*, Argus (Jan. 14, 2021).
[129] Ibid.

demand and stringent OPEC quotas obstructed many gas-reliant industries from reaching maximum efficiency. But, even now, due to its significant gas-derived wealth, Qatar faces unique obstacles that other developing countries do not have. While it does not impede capital-intensive investment, its small economy, with consequent limited absorptive capacity and a small demographic base, is potentially economically disruptive.[130] Since it cannot depend upon domestic demand for the economic growth it desires, Qatar will be externally oriented for a long time.

The Qatari leadership considers economic diversification key to overall economic sustainability and has invested billions of dollars across various economic sectors.[131] Even with these enormous strides, the Qatari economy is still overly dependent on gas (upstream and downstream) and the hydrocarbon sector in general since the diversification program is still expanding. However, Qatar's much-vaunted diversification efforts may not represent a substantive transition away from hydrocarbon dependence because most of its economic diversification is concentrated in the chain of downstream value-added industries, such as the petrochemical sector. Although the prices of petrochemicals and other value-added products are much more stable and fluctuate less than crude oil and unprocessed gas, these products are still reliant on the hydrocarbon sector and may not represent proper economic diversification.

3.4 Domestic Demand: Petrochemicals and Power Generation

Part of Qatar's strategy for diversification is to increase the revenue it garners from its natural gas. As discussed in depth in Chapter Six, regional gas prices at the beginning of the 2020s are relatively low when considered against the international oil price. Qatar seeks to extricate itself from this pricing conundrum and increase revenues by converting its natural gas into high-quality, refined products such as GTL and petrochemicals. The Qatari leadership decided to foster domestic industrialization and attract foreign direct investment in the energy-intensive industries with low-cost electricity and feedstock.

[130] Ibid.
[131] *Qatar Doubles Down on Economic Diversification,* Oxford Business Group (2019)

At the crux of the regional disagreements over new or expanded Qatari gas supplies is Qatar's North Field Monetization policy. During the 1990s, Qatar had not only achieved remarkable buyer diversification but had adequately buttressed its economic growth with plans for domestic gas utilization, LNG exports, and GTL. But, by the late 2000s, Qatar reoriented its gas prioritization markedly, granting first allocation rights to domestic projects, followed by LNG export projects, pipeline exports, and GTL production.[132]

Qatar's domestic gas consumption, rising steadily since the 1990s, reached 35 BCM in 2020 (an average increase of 7.2 % over 2008-2018, which is a primary concern.[133] However, while Qatar had one of the most rapidly rising energy demand rates globally, this rapid demand growth has slowed significantly (See Figure 3.3) and may have already plateaued with a predicted stark decline by 2034 as energy efficiency and power/gas pricing is reconfigured.[134]

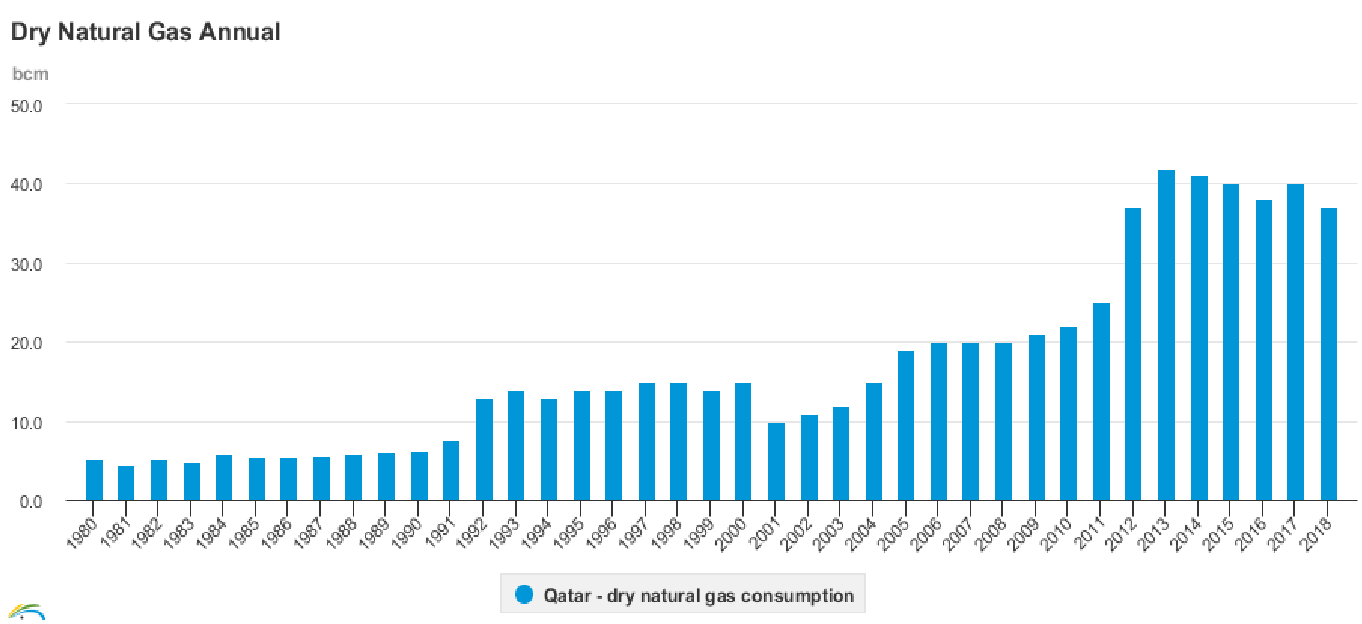


Figure 3.3 Qatari Dry Natural Gas Demand 1980-2020 Source: U.S. Energy Information Administration

[132] GTL production has been given the last priority presumably because of the potential for cost overruns due to the nature of the new technology utilized in the plants.
[133] *BP Statistical Review of World Energy*, BP (2021) p.38
[134] *Infrastructure Investments to Modernise Qatar's Electricity Network*, Gulf Times (Jan. 30, 2018); Robin Mills, *Under a Cloud: The Future of Middle East Gas Demand*, Columbia: Center on Global Energy Policy (April 29, 2020)

3.4.1 Qatar's Petrochemical Sector

Qatar's petrochemical industry grew extremely fast over the previous decade (the sector grew by approximately 10% per annum from 2005-2015), which placed additional demands on the country's gas reserves.[135] Qatar's interest in petrochemical expansion is predicated on the need for a diversified, value-added downstream industry sufficiently stable to withstand the constant fluctuations of the international oil and gas market. [136]

Qatar's goal is to have the world's fourth-largest petrochemicals output with a highly diversified product portfolio. In support of this, it embarked on a $15 billion investment program led by Qatar Petrochemical Company (Qapco), Qatar Chemical Co (Q-Chem), Qatar Vinyl Co (Q-Vinyl), and Qatar Fertiliser Co (Qafco), among others.[137]

However, Qatar's petrochemical market share was threatened by reduced demand in critical overseas markets and increased output in other MENA countries, including Saudi Arabia, the UAE, Oman, Iran, and others.[138] There was also an increase in competition from North America due to the shale gas production boom in which its predominately ethane feedstock was price competitive with naphtha-based feedstock producers during the rise in crude prices from 2011-2014.[139] And, as Qatar and the rest of the MENA region are transitioning away from low-cost feedstock allocation to domestic industries, American-based petrochemical production proved cost-competitive. [140] Yet, the cost advantage that the U.S. had has been severely eroded due to the first two years of the Covid-19 pandemic. While, at the same time, the pandemic also significantly injured the Qatari petrochemicals industry as Chinese demand declined.

[135] See, *Qatar Petrochemical Production Figures*, Gulf Petrochemicals and Chemicals Association, Available at http://www.gpca.org.ae/qatar/

[137] Ibid.

[138] *Chemical Outlook by Region: 2016*, Chemical and Engineering News, Vol. 94 Issue 2 pp. 9-15 (Jan. 11, 2016)

[139] Investment Petrochemical expansion in North America has grown swiftly over the past decade due to the significant growth in U.S. shale gas production, even though it experienced a decline due to sluggish oil prices from 2014-2017.

[140] *U.S. Ethane-Based Petrochemical Plants Challenged by Low Crude Prices*, Reuters (May 12, 2020).

The rapid expansion of the Qatari petrochemical sector was made possible by inexpensive natural gas feedstocks ($0.75–1/MMBTU; feedstock prices account for nearly three-quarters of production costs), robust state support of sector development, and the geographical proximity of significant export markets, such as China, the other East Asian countries and India. These countries were the fastest growing areas for petrochemical demand. But with the previous breakneck sectoral expansion, many project plans faced delays originating from feedstock shortages.[141]

Even though OPEC has a somewhat optimistic view that petrochemical demand growth will return and even potentially exceed past growth rates due to increasing global population rates and rising GDP (before Covid-19), it still faces threats from environmental pollution regulations across the world that are targeted at single-use plastic waste and the so-called circular economy which is based on broad-based recycling as well as the still uncertain state of the health of the global economy due to Covid-19.[142] Therefore, the safe bet on petrochemical demand growth is shaky and may severely impact Qatar's petrochemical profitability in the near midterm.

3.4.2 Power Sector

The domestic power generation sector constitutes Qatar's single most gas-hungry sector. Qatari per capita electricity generation is the world's highest (2021), with demand rising by 6-8 % yearly.

The main structural drivers of Qatari power demand are the residential and energy-intensive industrial sectors. In terms of the industrial sector, the Qatalum aluminum plant, which began operation in 2010, placed significant upward pressure on power demand emanating from the industrial sector. Residential power demand increases were driven by the demographic growth since 2010, at approximately 27 %.[143]

To meet its growing demand, Qatar increased its generation capacity significantly over the

[141] (Anonymous) Interview with QP Official (Sept. 6, 2017

[142] Tsvetana Paraskova, *Oil Demand Growth Won't Be Saved by Petrochemical Boom*, Oil Price (Oct. 20, 2020).

[143] Much of the residential power demand is driven by air conditioners.

past several decades. Current power generation capacity stands at 11.5 GW, a stark increase from a mere 1,200 MW in 1997. Qatar already has adequate generation capacity, but peak demand quickly rose and reached 8.4 GW in 2019.[144]

Qatar has also tapped international debt markets to partially finance the billions needed to expand the power and water sector.[145] The infrastructure expansion's transmission and distribution portion alone is estimated to reach between $15–20 billion.[146] As with many other Gulf countries, Qatar has been attempting to meet peak demand by a two-pronged approach of increasing power supply and instituting a comprehensive grid renovation.[147] And Qatar is especially proactive as peak demand is set to grow even more in preparation for the 2022 FIFA World Cup games.

As with many of Qatar's other megaprojects, the principal factor behind its frenetic development of the power sector is to supply the enormous amounts of electricity needed to fuel the country's energy-intensive industries, which are undergoing significant expansion and require a consistent power supply. While Qatar does not face blackouts and other gas/power allocation disruptions plaguing the other GCC countries, its rapid growth still places enormous pressure on its utilities and sometimes supply outstrip demand or demand edges closer to supply.

The decision to separate generation from transmission and distribution helped Qatar avoid the shortages suffered by its neighbors through facilitating prompt decision-making about new plant construction.[148] However, by taking both a cautious approach to its future natural gas development and a prudent stance towards power construction, Qatar is aiming to provide a cushion for its future industrial development.

[144] *Qatar's Reserve Power Surplus Records Highest in Region*, The Peninsula (Jan. 4, 2020).
[145] Ibid.
[146] Ibid.
[147] (Anonymous) Interview with QP Official (Sept. 6, 2017)
[148] Ibid.

3.5 Conclusion: The Transformative Gambit: Challenges and Opportunities

Qatar's former Emir, Hamad bin Khalifa Al-Thani was the visionary who foresaw Qatar's vast natural gas resources as central to its security and economic development. His father, Khalifa bin Hamad Al-Thani, was far less driven in promoting the country's resource development. Not only did the development of its natural gas sector help Qatar avoid the impending collapse of oil production and the resultant foreign policy concerns, but this resource also enhanced Qatar's global importance considerably. As the far-sighted emir understood, Qatar's wealth was also its vulnerability, a fact that required reliance on the international community, and particularly on the U.S., for security needs. Qatar has made much progress in hoisting itself from an undeveloped Emirate to becoming one of the most progressive and advanced Gulf states. Its progress has proven itself to be integral to the region's peace and stability and to the future security of the global natural gas supply.

Qatar successfully succeeded in its breakneck journey to the world's largest LNG producer in the late 2000s and early 2010s due to the prodigious reserves in the North Field and coordinating production with various IOCs in the RasGas and Qatargas joint ventures. Even though Qatar experienced a significant drop in LNG demand due to the global financial crisis of 2007-2008, it transformed the crisis into an opportunity and successfully managed its market position to create a portfolio of over 25 importing countries to diversify its customer base. As a result, it emerged relatively unscathed from the global economic turmoil during that period, which ultimately allowed it to continue to expand its LNG profile.

Qatar has also proved itself to be quite flexible in adapting itself to the worldwide LNG market by incorporating different contractual models, such as long, medium- and short-term contracts, oil, and hub indexation pricing, as well as spot sales. And it seems Qatar was able to rein in its gas demand increases, such that, in 2012, Qatari gas demand started to plateau and appears unlikely to continue its rapid historical growth rates. But even though there will still be significant investments coming online in the downstream industries, aggregate natural gas demand may continue to increase from the mid-2020s; however, in 2034, domestic gas demand is predicted to decline when energy efficiency policies, gas/power pricing configuration and national decarbonization plans begin to take hold.

Overall, Qatar's cost of production in the natural gas sector has allowed it to remain ahead of its competitors, principally because of the prodigious location of the North Field and the large amounts of LPG, condensate, and ethane the field delivers. And, as another tool in its arsenal, Qatar is poised to significantly increase its investments in overseas energy assets in North America, Asia, Africa, and perhaps other jurisdictions, to leverage its dominance over its rising competitors. Qatar's investment of billions of dollars in its LNG production and global LNG transport fleet expansion will allow it to leapfrog ahead of the competition in the coming years.

Qatar’s leadership has also determined that it should initiate more of a “green” focus for its gas operations, and we can expect to witness more carbon reduction policies to be implemented that can drive efficiency gains throughout the gas and industrial sectors. Reducing the carbon intensity of its energy sector operations is becoming paramount in Qatar policymaking as the government has recognized numerous benefits it may reap from implementing decarbonization policies. While the Gulf countries, and most of the Global South, fiercely contested the early global climate negotiations, they have subsequently become much more proactive in these conferences and even led the charge with multibillion-dollar renewable energy investments and decarbonization initiatives.

Typically, there is a symbiotic relationship between carbon intensity and energy intensity; when one is reduced, the other declines as well. Therefore, with the implementation of robust decarbonization strategies, Qatar would be able to reduce the opportunity cost of low-cost domestic natural gas consumption to reserve more gas earmarked for export to the lucrative international market for foreign revenue generation.

Additionally, installing more energy-efficient equipment improves a facility's operational efficiency, which places it as a significant competitive advantage in the global economy. And as part of its foreign policy, the Qatari government seeks to develop an outsized role in climate negotiations, which it feels such a posture would benefit the country as it aims to promote natural gas as a global bridge fuel (replacing coal and oil) as the world transitions to renewable energy sources such as solar, wind, biomass, and other clean energy sources. And an added benefit of this role is that Qatar would also position itself as a global steward of the environment. Lastly, implementing carbon reduction policies allows Qatar to create alternative revenue streams with the potential sale of carbon credits.

Yet, Qatar will have to deal with some challenging obstacles for the near to mid-term. The Covid-19 pandemic has decimated the global economy, and while global hydrocarbon prices have begun to rise, a significant amount of volatility remains in global energy markets. As a result, this will drive Qatar to increase its dependence on the resurgence of Asian LNG demand. And Qatar will need to implement a more multifaceted economic diversification that builds robust forward and backward linkages throughout various sectors, such as finance, downstream commodities, logistics, and even tourism. The interlocking of diverse economic sectors allows a mutually reinforcing growth dynamic that transcends being a mono-exporter. Nonetheless, Qatar is undeniably in a favorable position despite these issues compared to Australia, the US, and Russia, all still suffering to a significant degree from the effects of economic shutdowns and unable to avail themselves of the streamlined decision-making process that Qatar enjoys

Chapter Four: Background and Outlook of the Emirati Energy Sector

4.1 Brief History of the UAE

The UAE offers a bit of a paradox in the global energy market. It is a country that boasts the eighth-largest gas reserves in the world and is a significant gas and oil exporter, yet it must also import substantial amounts of natural gas. The UAE was formed in 1971/1972 when a group of tribal Sheikdoms- Abu Dhabi, Dubai, Ajman, Sharjah, and Umm al Quwain, Fujairah, and Ras al-Khaimah-came together in a federal union (See Figure 4.1).

The UAE is currently attempting to meet several goals which would reconfigure its macroeconomic structure:

- Diversify its economy away from being a “mono-exporter” of unprocessed and unrefined hydrocarbons.
- Develop an advanced industrial base and downstream gas sector to form backward and forward linkages throughout the national economy.
- Reduce its domestic hydrocarbon demand (through subsidy reform, energy efficiency policies, environmental campaigns, etc.) to facilitate more productive uses of its resources, e.g., downstream industries, export, etc.
- Achieve climate and greenhouse gas reduction goals by reducing its carbon intensity per unit of GDP
- Invest in alternative energy (renewable+nuclear) to allow it to take a more significant share of the domestic energy mix.

The objective of this chapter is meant to give a thorough understanding of the aforementioned “paradox” and discuss the various structural dynamics in operation in the Emirati energy sector. Special attention is given to natural gas consumption and demand while assessing sectoral demand through the macroeconomy.

Figure 4.1: Map of the UAE: Source WPMAP.Org

In terms of this chapter's outline, Section 4.2 provides an overview of the Emirati natural gas sector while analyzing the natural gas demand drivers against production and imports. Section 4.3 offers supply and demand predictions in light of the impact the Covid-19 pandemic had on the global economy and the OPEC+ oil production reductions. And Section 4.4 concludes with a summary and an analysis of future structural demand/production challenges.

4.2 Overview of the UAE Natural Gas Sector

The UAE has one of the strongest economies in the Middle East-North Africa (MENA) region. It has been on a solid upward growth trajectory for the past four decades.[149] Its robust hydrocarbon and non-hydrocarbon sectors have driven the UAE's strong economic expansion. In the nearly half-century since independence, the UAE emerged as one of the leading Arab economies and is one of the most diverse, investor-friendly, and profitable places to conduct business in the world.[150]

While oil has been a crucial hard currency generator for the UAE, the true backbone of the Emirati economic expansion and diversification has been the natural gas molecule. This is as the country focused its development on the downstream natural gas sector as the basis

[149] For a detailed analysis of the Emirati economy, see, *United Arab Emirates:* International Monetary Fund website. Available at https://www.imf.org/en/Countries/ARE

[150] This is according to numerous metrics that tally overall quality of life and investor sentiment. In 2020, the World Economic Forum rated the UAE as number one globally for macroeconomic stability. See, *The Global Competitiveness Report 2020*. Available at https://u.ae/en/about-the-uae/uae-competitiveness/global-competitiveness-report-of-the-world-economic-forum

for its industrial production growth. While the country is blessed with prodigious amounts of natural gas, the rise in Emirati natural gas demand strained its ability to fuel its economy through indigenously produced low-cost associated gas. The growth in gas demand (at approximately 6-8 % per annum since the early 2000s) arose in the wake of increased gas consumption in the downstream value-added industries and the power-generation sector (See Figure 4.2).[151] However, it must be noted that gas demand has been relatively flat since 2015, with growth projected to plateau for the near to midterm as various alternative energy (nuclear+renewable), energy efficiency measures, and power pricing reformation begin to come online and take root.

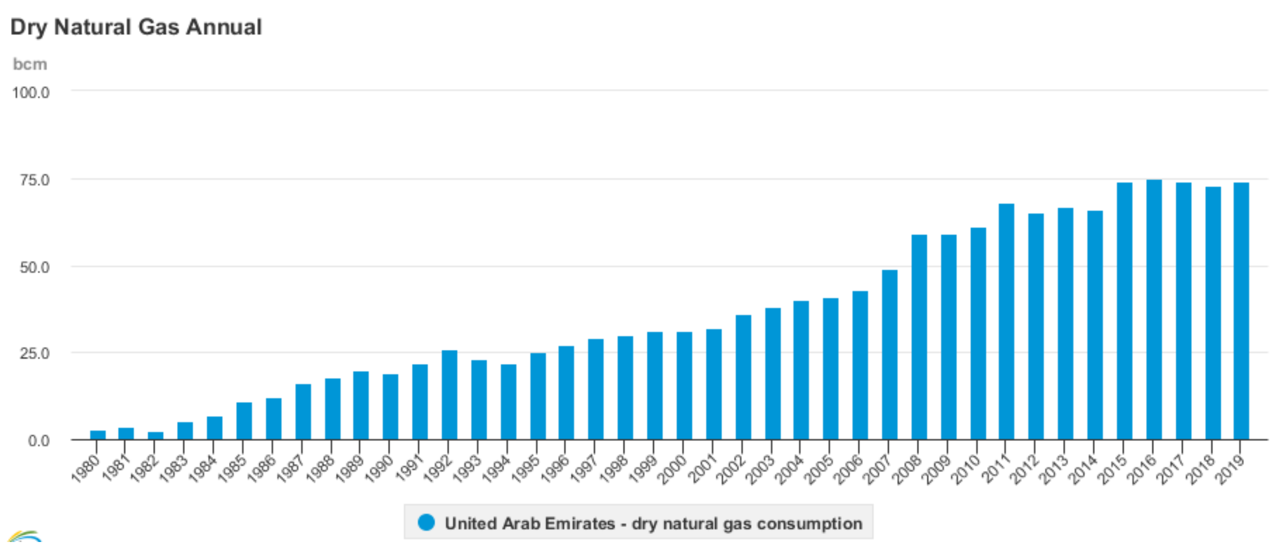


Figure 4.2: Emirati Natural Gas Demand 1980-2020: Source: U.S. Energy Information Administration

As will be discussed in Chapter Six, it is essential to understand that the historical per capita growth in Emirati gas/power demand has been driven primarily by the extremely low government-mandated prices. And this low gas price created many perverse incentives that stimulated over-allocation/high demand and reduced incentives to develop the more costly non-associated natural gas reserves and engage in renewable energy investment.[152]

[151] *Statistical Review of World Energy*, BP (2021) p. 38

[152] The reduction in incentives for unassociated gas production in the region was related to the prevailing terms of investment framework that limited the return on investment for IOCs to produce from unassociated natural gas fields. While the MENA region has been making some headway in reconfiguring their natural gas pricing regime, there is still much progress that needs to be implemented. For a concise review of MENA steps towards subsidy reform, see, generally, Jim Krane, *Energy Kingdoms: Oil and Political Survival in the Persian Gulf*, Columbia University Press (2019).

And, this administratively priced natural gas, i.e., gas prices that are set by the government and not subject to market supply/demand forces, resulted in a significant amount of what could be termed "false demand." This led to the gas allocation shortages that rippled throughout the MENA region in 2007/2008. Administrative gas prices that do not at least meet the cost of production and delivery tend to encourage excessive and haphazard consumption of non-renewable hydrocarbons, as well as disincentivizing technological innovation. Additionally, the low gas price failed to induce production in Emirati non-associated gas fields. Of which, the majority contain complex natural gas, such as sour or tight gas, which has a higher production cost when compared to the inexpensive associated natural gas that is still constitutes most of Emirati gas production.[153]

The challenges for the UAE in the mid-to-long term relate to maintaining its economic competitiveness in the face of growing competition in the energy-intensive industries and petrochemical sectors from Asia and North America. Therefore, the fundamental difficulty at the crux of its energy issues is how the UAE will manage intergenerational equity, adhering to its international carbon reduction commitments while creating a sustainable basis for future economic growth.

4.2.1 Domestic Natural Gas Reserves

The UAE holds the seventh-largest proven gas reserves globally, i.e., 3.3 % of the global total.[154] And it is the fourth largest MENA gas reserves holder.[155] Emirati gas reserves have remained relatively constant at around 6 TCM since the 1990s.[156] Domestic Emirati reserves should endure another century at 2021 rates of production.[157] Gas reserves are unequally distributed among the seven emirates, with Abu Dhabi holding the lion's share of 94%, approximately 5.60 TCM of the UAE's total reserves. [158] Sharjah has 4%, Dubai 1.5 %, and

[153] The cost of production for sour gas has been decreasing, however, it is still severalfold higher than the cost of producing conventional associated natural gas. Ibid.
[154] *Statistical Review of World Energy*, BP (2021) p. 38
[155] *UAE Country Profile,* Energy Information Administration (2019).
[156] BP Statistical Review of World Energy (2021); *UAE: Facts and Figures*, OPEC Website: Available at http://www.opec.org/opec_web/en/about_us/170.htm
[157] Ibid.
[158] Because the gas fields in the Northern Emirates have matured, their respective production rates declined in recent years.

Ras al-Khaimah 0.5 %.[159] However, production rates in Sharjah and Ras al-Khaimah are declining as their fields are maturing.

The UAE is now attempting to extensively develop the Khuff non-associated gas reserves under the Umm Shaif and the Abu Al Bukhush oil fields, which is considered one of the largest contiguous hydrocarbon reservoirs in the world. (See Figure 4.3). [160]

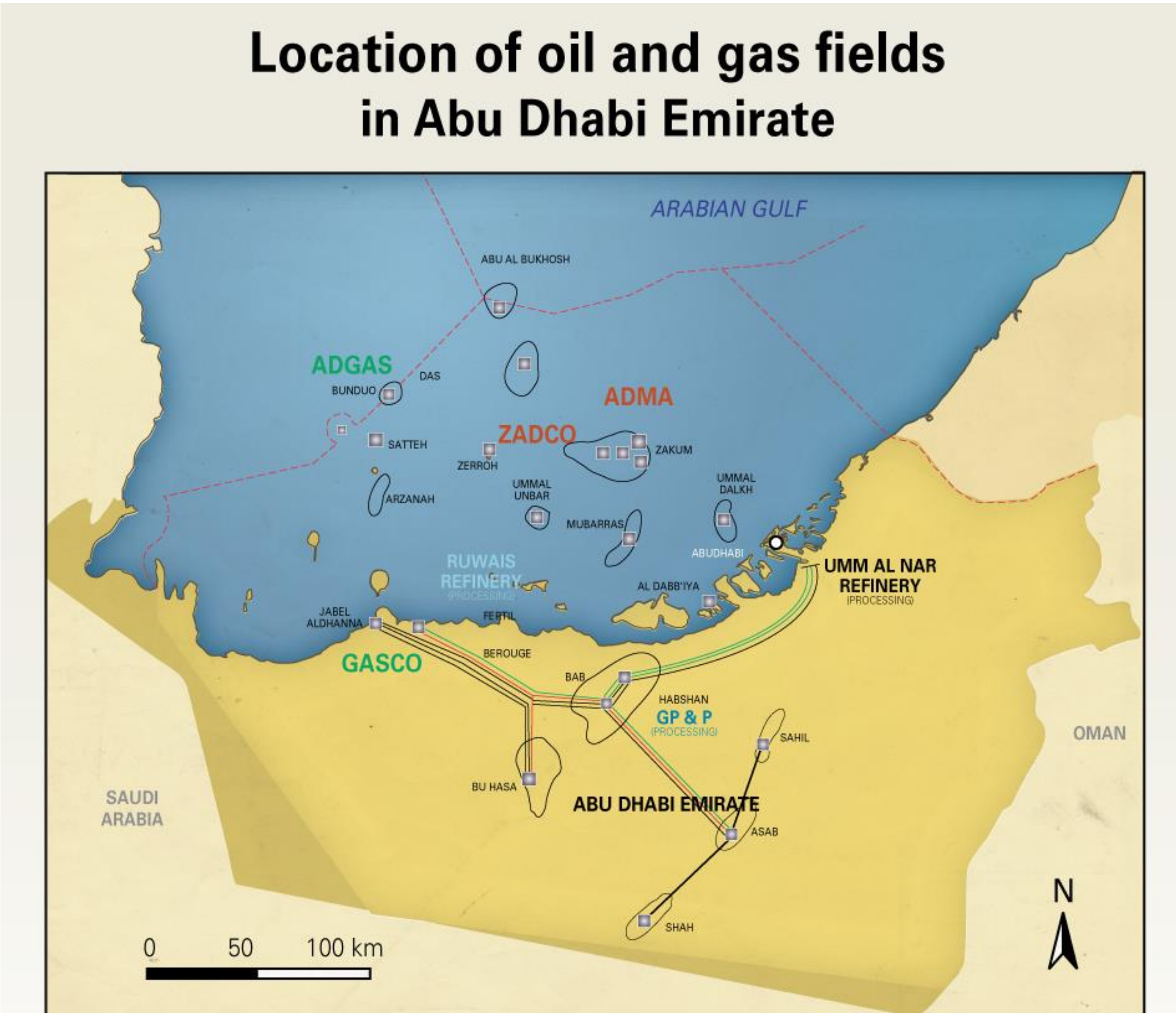


Figure 4.3: Location of Abu Dhabi Gas and Oil Fields: Source: Environment Agency Abu Dhabi

However, post-2030, it is non-associated tight and sour natural gas expected to produce the most incremental supply in the UAE. Most of the government's focus is on developing the

[159] *UAE Country Profile,* Energy Information Administration, (2019)

[160] The Permian Khuff formation underlies most of the region, this formation holds the oil and gas reserves of Saudi Arabia, Bahrain, Qatar, Iran, and United Arab Emirates, as well as minor oil deposits in Saudi and Omani fields. (Anonymous) Interview with ADNOC Official (May 15, 2017).

Shah, Bab, and Hail gas fields.[161] Shah gas field development-the world's largest ultra-sour gas project-began in 2015.[162] It is a $10-12 billion mega-project representing sustained NOC-IOC (ADNOC-Occidental) collaboration to stimulate the development of this field's high sulfur content gas.[163]

Though, there are many environmental risks associated with the Shah project because sour gas is highly toxic and flammable.[164] The level of sulfur content in the Shah gas field set a regional benchmark for sour gas development as it requires substantial processing that adds substantially to the production cost. Due to the production and processing costs, estimates hover between $4-$5 per MMBTU, a several-fold increase compared with domestic Emirati natural gas prices of approximately $0.75 per MMBTU.[165] This price differential persistently led to the lack of investment in unconventional non-associated gas fields in the UAE in the past. Yet, there are opportunities to offset the costs somewhat by selling processed sulfur on the global market.[166] Other major sour gas projects in the UAE included the offshore Hail field and the Bab gas project.[167]

Due to the breakneck industrialization and economic expansion, the gap between production and consumption widened. Gas shortages transformed the UAE from a traditional natural gas exporter to an LNG and natural gas importer via Qatar's Dolphin pipeline. However, as most UAE natural gas production is from associated gas reserves,

---

161 The UAE was one of the first countries in the MENA region to initiate non-associated complex gas production. (Anonymous) Interview with ADNOC Official (May 15, 2017).

162 Ultra-sour gas is defined as when the hydrogen sulfide (H2S) is 10% or more. In comparison, the Shah gas field has an H2S content that averages twenty-3%. The fields also contain significant amounts of CO2 and other exotic contaminants, such as mercapan (a mixture of carbon, hydrogen, and sulfur). Nick Amott, Stephen Mogose; *Examples Illustrate Sour-Gas Processing Megaproject Metrics*, Oil and Gas Journal (Aug. 1, 2016).

163 The field is being developed by Al-Hosn Gas, a joint venture between ADNOC (60 %) and U.S. based Occidental Petroleum (40 %). *Adnoc Intends to Go Ahead with Al Hosn Sour Gas Expansion*, ADNOC (Nov. 8, 2016); Fareed Rahman, *Production at Abu-Dhabi Shah Field to be Ramped Up*, Gulf News (March 29, 2016).

164 *Recommended Practices for Sour Gas Development Planning and Proliferation Assessment*, Canadian Association of Petroleum Producers (May 2004).

165 See, generally, Jim Krane, *Too Much of a Good Thing: Subsidy Reform and Tax Increases Defy Academic Theory on The Rentier Middle East*, Center for Energy Studies (Sept. 2019).

166 The potential sulfur to be produced from the project is estimated to be more than 4.2 Mt/yr. The sulfur can be granulated and shipped, either piped or trucked, to the Habshan gas-treatment plants in Ruwais. See, generally about the development of sour gas in the UAE. Justin Dargin, "The UAE Gas Sector: Challenges and Solutions for the 21st Century" in (ed) Bassem Fattouh and Jonathan Stern, *Natural Gas Markets in the Middle East and North Africa*, OIES Press, March 2011, 471-472

167 However, due to the cost structure, the Bab Sour Gas Project was delayed after Shell decided against its involvement due to technical difficulties and increasing costs. *Adnoc Says its $10bn Bab Sour Gas Project in Seeing Progress*, Meed (Feb. 8, 2018)

additional incremental supply will come from non-associated and complex gas reserves. [168] And, until recently, these sour reserves were considered too costly to produce. The advent of new technology has made sour gas developments much more economically viable while still more expensive than conventional gas.

4.2.2 UAE Natural Gas Production and Imports

The UAE was one of the first countries in the Gulf region to monetize its natural gas reserves in the mid-1970s. Before 1973, there was little interest in producing natural gas, and consequently, the government flared most of it as a waste product from oil production. However, with the onset of the OAPEC oil embargo, global oil prices increased nearly fourfold, and accordingly, the government's interest in producing gas was piqued.[169] In 1977, the Abu Dhabi Gas Liquefaction Company (ADGAS) constructed the first LNG-plant on Das Island to process associated gas from the Um Shaif, Lower Zakum, and Bunduq oil fields (See Figure 4.2).[170] ADGAS then shipped it under a long-term contract to the Japanese utility company, TEPCO. Emirati gas production at that time stood at just 3.9 BCM.[171]

Since then, phenomenal gains have been made in output, which increased close to thirteen times, reaching 55.4 BCM in 2020, or 2.8 % of global natural gas production of that year.[172] And the total gross output was 40 % higher at 82.4 BCM.[173] The gap between marketed and total volumes comes from the extensive use of natural gas EOR for boosting oil output from declining fields.[174] But more indicative of the regional energy challenges, the UAE consumed 69.6 BCM, which exposed it to a shortfall of 14.2 BCM in 2020.[175]

[168] As most of Abu Dhabi's current gas production is slated for export commitments, the gas shortfall between domestic demand and production is mostly being met by imports from Qatar and the LNG market. The UAE is seeking to reduce its reliance on imports, but also meet its growing natural gas/energy demand. As a result, Abu Dhabi is focusing on developing domestic sour gas production to meet the growing shortfalls. (Anonymous) Interview with ADNOC Official (May 15, 2017).

[169] In 1974, over 93 % of natural gas was flared, but by 1980, nearly half was utilized for export by LNG or consumed domestically. And, by 1983, Abu Dhabi was consuming nearly 92 % of its gas. Shihab Ghanem, Industrialization in the UAE in (ed) Ibrahim Abed, Peter Hellyer, United *Arab Emirates: A New Perspective* (Trident Press Ltd, 2001). p.267

[170] (Anonymous) Interview with ADNOC Official (May 15, 2017).

[171] *Organization of Arab Petroleum Exporting Countries*, OAPEC News Bulletin, Volumes 5-7 (Information Department, OAPEC., 1979).

[172] This figure excludes gas which was flared or reinjected. Reinjected gas accounts for an additional 18 Bcm/yr. Natural Gas, *BP Statistical Review of World Energy*, BP (2021) p. 36

[173] Ibid.

[174] Gas flaring is still an issue in the UAE, even though it has made significant strides in reducing it.

[175] *BP Statistical Review of World Energy*, BP (2021). p.38

Between 2019-2020, the UAE imported 20.2 BCM of natural gas from Qatar through the Dolphin natural gas pipeline.[176] As discussed above, because much of the UAE's gas is associated with oil reservoirs or is sour gas in non-associated fields, Emirati authorities focused primarily on increasing production capacity by advancing their technical expertise on sour gas treatment technology and developing oil-gas separation technology.

Even though the UAE increased its gas production slightly in the mid-to-late 2000s, since late 2006, gas demand continued to outstrip incremental production increases steadily. As discussed in section 4.2.3 below, a major factor of Emirati natural gas demand's sustained elevation is because of its disproportionate role in power generation. Sectorally, the Emirati power sector depends on natural gas for generation by 98 %, with fuel-oil comprising the rest.[177] However, as discussed extensively in Chapter 6, this somewhat obscures that the low administrative gas/power prices are the main driver for the high demand rates, with multiple negative externalities rippling throughout the entire macroeconomy.

4.2.3 Natural Gas Demand and Drivers

The abundance of energy resources in the UAE brought enormous wealth to the country. After experiencing high GDP growth rates on the back of the oil price rise from 2001-2008, GDP growth rates have remained, after a dip due to the global financial crisis, steady until the plunge in GDP in 2020 due to the onset of the Covid -19 pandemic. Most of the UAE's economic development arrived on the back of an increase in oil and gas output. And, natural gas is still the predominant fuel source (See Figure 4.4), even though demand has plateaued over the late 2010s and is predicted to decline by the mid-2020s (See Figure 4.2). Still, the UAE has one of the world's highest per capita power consumption. Furthermore, a resident of the UAE consumes approximately 9,000 kilograms of oil equivalent (kgoe) per year, much higher than Western industrialized countries such as the U.S. and the U.K., where each resident consumes nearly 8,000 and 3,200 kgoe/person, respectively, per annum.[178] And

[176] Ibid. p.42

[177] However, this is going to change soon as there are various alternative and renewable energy projects coming online in the early 2020s.

[178] United Arab Emirates, U.S. Energy Information Administration (2018) Available at

this consumption rate is several-fold higher than the global average at 1,700 kgoe.[179]

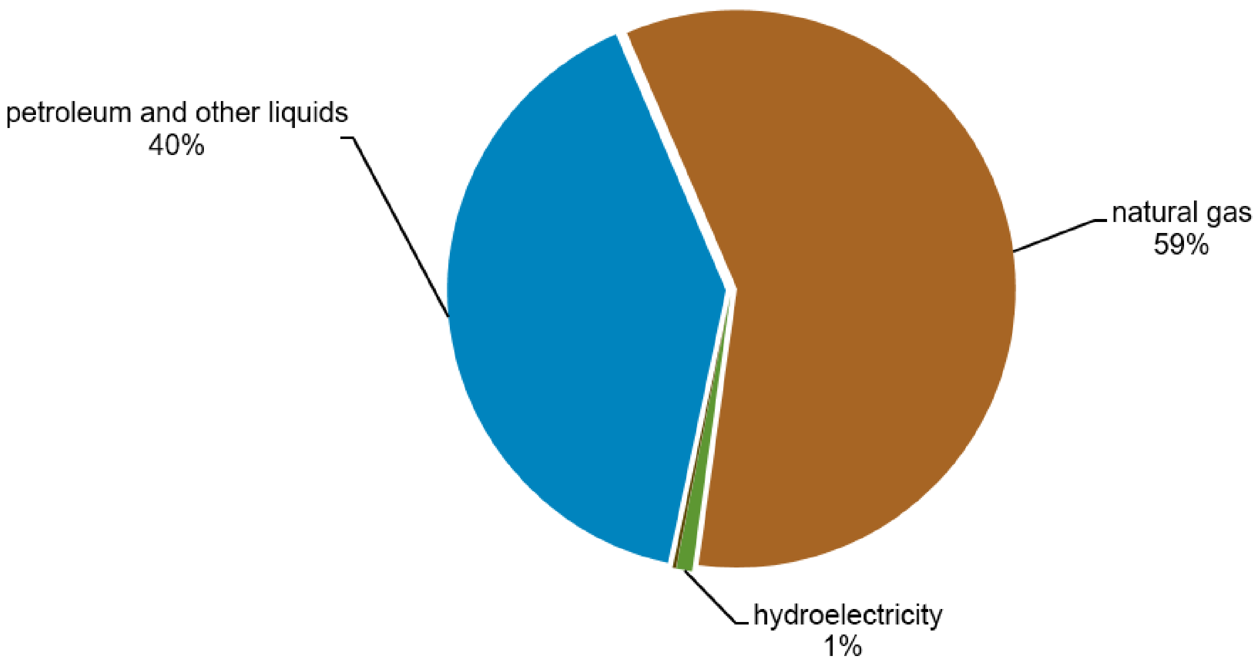


Figure 4.4: Total Primary Energy Consumption in UAE by Fuel Type, 2018: Source BP Statistical Review of Energy, 20

Rising GDP, fueled by low gas/power prices, as well as being coupled with expanding domestic natural gas consumption had a cascading effect throughout the national economy. These factors not only produced widespread gas shortages during the late 2000s, especially in the energy-poor Northern emirates, but also impacted the ability to sustain gas exports and collect the associated foreign revenue. More specifically, natural gas demand rose by approximately 7-8 % per annum during the 2000s until beginning to plateau around 2015.[180] In 2008 alone, when the gas allocation shortages expanded beyond the ability of the country to manage indigenously, gas consumption rose by more than 20 %, which illustrated the steadily rising domestic consumption trends.[181] (See Figure 4.2).

https://www.eia.gov/international/overview/country/ARE

[179] Ibid.

[180]Databases from the *BP Statistical Review of World Energy* (2021).

[181] Ibid

There are multiple reasons for the rapid increase in domestic natural gas demand. Firstly, along with the GDP growth, the UAE experienced a population boom in the last decade, coinciding with a youth bulge that compounded high consumption rates. Since 2001, the UAE's population tripled over the past 15 years and continued to grow by 3 % per annum to reach approximately 11.077 million by the end of 2019.[182] The vast majority of the population now live in the energy-intensive megalopolises in the country, thereby contributing to urbanization-led demand increases.

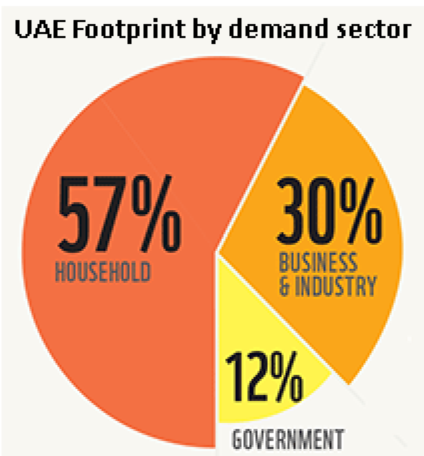


Figure 4.5: Emirati Gas Demand Footprint: Source: Energy Information Administration

Other significant factors driving domestic gas demand are the extended utilization of EOR techniques and increased electricity consumption. A total of 65% (or 56.6 Mtoe) of the country's complete energy needs are supplied by natural gas, a share that will continue to rise until the diversification of energy supply away from oil and gas and into renewable and nuclear energy comes to fruition, as discussed in Chapter Six). EOR is also a significant consumer of natural gas, comprising nearly 30 % of the country's natural gas production. (See Figure 4.4 for sectoral demand).

But it is electricity, by far, the largest consumer of natural gas outside of the resource-extracting industry as nearly 100 % of generation is gas-fired.[183] The industrial sector consumes another 10-12 BCM, growing by an annualized average of 7% in the last decade.

But it is the issue of pricing, indeed, that is truly at the heart of the stratospheric rise in per capita gas/power consumption, not just in the UAE but throughout the region. The UAE incurs a reasonably high fiscal cost for its administrative gas pricing regime. In the UAE, the

[182]Author's calculations based on IMF and World Bank country statistics. The Emirati population initially experienced a demographic boom following the discovery of oil when policymakers invested billions of dollars in infrastructure projects. There was another increase in the early 1990s when there was major renovation conducted that replaced the older buildings and single-family houses with modern high rise apartment buildings. And, additionally, there was another population spike that occurred during the oil price spike from 2001-2008 that witnessed authorities invest in multiple megaprojects across many sectors. The vast majority of the increase came from expatriate labor. United Arab Emirates, International Monetary Fund website (2020). Available at https://www.imf.org/en/Countries/ARE

[183] This is, of course, until the UAE's nuclear and solar power plants come online. EOR consumption is calculated as the difference between total gross natural gas production and the marketed output, which is utilized in the power generation and power sectors of the economy.

direct energy cost to the government budget is $3.8 billion, approximately 2.9 % of the GDP.[184] The government makes these fiscal payments to domestic energy companies to compensate for the production/delivery cost gap and the domestic allocation price. And, as discussed earlier, whereby the majority of future incremental supply will come from more expensive non-associated fields and increased LNG import, this differential is poised to grow even more significant. Chapter Six contains a detailed discussion of the Emirati energy pricing framework and its movement towards subsidy removal.

As discussed in more depth in Chapter Six, initial steps have been made to reform the Emirati energy sector. The Emirati government is planning to significantly reduce per capita gas/power consumption and stimulate production in non-associated gas fields in the coming years.

4.3 Supply and Demand projections

While the Emirati gas sector has expanded since the 2000s, it did not change significantly in any structural manner. Future trends will likely exert immense pressure on the energy sector that will modify its structure in the long term. As discussed in depth in Chapter 6, the Emirati government is investing billions of dollars in energy efficiency programs and alternative energy power generation (nuclear and renewable) to reduce the share of natural gas in the domestic energy mix. And, as Chapter 6 delineates, the outlook for solar is promising given the record-setting low costs achieved in Abu Dhabi and Dubai.

After a slight decrease in natural gas demand in the wake of the global financial crisis by 0.7 % in 2009, Emirati natural gas demand began its rise again in 2010 and 2011 by 2.9 % and 3.5 %, respectively (See Figure 4.2).[185] While the UAE experienced economic growth after that, gas demand fell again due to the oil price decline from 2014-2017 and the Covid-19 global economic downturn. The Emirati economy contracted by -6.9 in 2020.[186] However, it is estimated that the Emirati economy will resume growth of up to 4.3 % in 2022.[187]

Due to the reformation of the domestic power/gas subsidization structure, renewable energy

[184] (Anonymous) Interview with ADNOC Official (May 15, 2017).
[185] *BP Statistical Review of World Energy*, BP (2020). p.24
[186] Khatija Haque, *Outlook 2021: UAE's Economic Growth in 2021*, Gulf Business (Jan. 9, 2021).
[187] *Yousef Saba, Gulf Rebound Set as Saudi Arabia, the UAE Seen Topping 4% Growth in 2022*, Reuters (July 26, 2021).

projects, energy efficiency implementation, and the pandemic, natural gas demand growth is likely weaker than previously.[188] However, the ultimate gas growth rates will depend on the Emirati government's ability to implement its *2030 Economic Vision* program, which aims to diversify the Emirate's economy by raising non-oil output from around 70 % to 80 % of GDP in the next ten to fifteen years.[189] However, as discussed above, demand rates will likely begin to slow and even plateau for the rest of the 2020s.

The UAE plans to invest approximately $300 billion in infrastructure development projects, including airport expansion plans, energy terminals, and new industrial cities to host more than 130,000 residents and expand electricity generation capacity.[190] Additionally, the UAE is committed to job creation for its nationals, which will require further industrial expansion. Hence, the federal government aims to increase industrial investment to an annual average of 25 % by 2025.[191] Moreover, the UAE focused on the expansion of its petrochemical sector by deploying ADNOC to develop aggressive petrochemical expansion as part of its convergence strategy to facilitate new technology development, skill-set transfer, and growth of local businesses in industries that mutually reinforce each other, such as engineering and plastics related manufacturing to enable profit maximization of the value chain of its hydrocarbon output.

Even if the global economy makes a full recovery in the short term, i.e., by 2024/25, at the latest, the share of natural gas in the domestic energy mix will rise much more slowly and then would likely decline due to the nuclear energy and several renewable energy projects coming online in the next several years and subsidy reform through power/natural gas pricing reconfiguration.

It is even possible that 2019-2021 could represent the peak of Emirati gas demand and that it will continue to plateau or decline after that. Regardless of whether the demand peak was reached or will be reached within the next several years, undeniably, the subsidy-fueled growth in gas demand since the early 2000s will likely be anachronistic throughout the

---

[188] IMF projections based on the IMF country-specific statistical database. United Arab Emirates, International Monetary Fund website (2020). Available at https://www.imf.org/en/Countries/ARE

[189] *UAE and the Agenda 2030 for Sustainable Development* National Committee on Sustainable Development Goals (2017)

[190]Ibid.

[191] Ibid

2020s.[192] Nonetheless, associated gas production is expected to increase as the UAE implements its expansion plans to ramp up oil production. The UAE has implemented a more assertive oil production policy and would likely resist deeper OPEC+ cuts.

4.4 Conclusion

After a slight decrease in natural gas demand in the wake of the global financial crisis by 0.7 % in 2009, Emirati natural gas demand began its rise again in 2010 and 2011 by 2.9 % and 3.5 %, respectively.[193] However, the ultimate gas growth rates will depend on the Emirati government's ability to implement its *2030 Economic Vision* program, which aims to diversify the Emirate's economy by raising non-oil output from around 70 % to 80 % of GDP in the next ten years.[194]

The UAE plans to continue investing in infrastructure development projects, expanding report capacity, construct new energy terminals, and develop industrial cities, while and expanding electricity generation capacity. Additionally, the UAE is committed to job creation for its nationals, which will require further industrial expansion. Moreover, the UAE focused upon petrochemical sector expansion as well by directing ADNOC to develop drive forward petrochemical expansion as part of its convergence strategy to acquire new technology development, facilitate skill-set transfer, and promote growth of the private sector in industries that mutually reinforce each other, such as engineering and plastics related manufacturing to enable profit maximization of the value chain of its hydrocarbon output. [195]

However, it appears that the UAE's gas demand growth has plateaued and has been nearly flat since 2015 (See Figure 4.2). This is likely to remain the case as additional capacity comes online for nuclear, renewable energy, coal-powered generation, and power sector tariffs are reformed in conjunction.

---

[192] Robin Mills, *Under a Cloud: The Future of Middle East Gas Demand*, Center on Global Energy Policy (April 2020). p. 49

[193] BP, Ibid

[194] Fareed Rahman, *UAE Aims to Increase Contribution of Non-Oil GDP to 80 %*, Gulf News (Oct. 10, 2015).

[195] Anthony McAuley, *ADNOC Weighs Ambitious Downstream Expansion*, The National (June 4, 2016); see, generally for a broad analysis on the UAE's petrochemical expansion strategy, Hashim Al Hashemi, et al, Abu Dhabi-UAE Petrochemical Cluster, Harvard Kennedy School (May 4, 2012); Florian Neuhof, "Petrochemical expansion to fuel 'quality jobs' for the UAE", The National, December 2, 2012

Chapter Five: Saudi Gas Production: Strategy and Challenges

5.1 Introduction: The Growth of the Oil Titan

Saudi Arabia is the de facto leader of the Gulf region because of its undisputed dominance in the global oil sector. However, due to domestic and geopolitical dynamics, Saudi Arabia's vaunted position is not as secure as it once was, resulting in the Kingdom facing significant challenges on many fronts. These challenges include substantial demographic increases, domestic energy/power demand growth, and regional geopolitical tensions. On the geopolitical front, Saudi Arabia has become entangled in several regional conflicts, such as the Syrian Civil War, the Yemeni conflict, and the turmoil in Libya.[196]

However, the major issue with which Saudi Arabia must contend as we head into the 2020s, the nexus upon which its future progress lies, is how to increase its incremental natural gas production sufficiently. Natural gas production is critical for Saudi Arabia as its successful utilization will allow it to meet its macroeconomic reform goals, economic sustainability, industrial expansion, and job creation.

Domestic decarbonization is also crucial as Saudi Arabia's almost frenetic pace to reform its macroeconomy illustrates the seriousness with which the Saudi leadership assigns to the manifold consequences of global warming. Global decarbonization efforts threaten the Kingdom as the international efforts to reduce global oil demand would severely impact Saudi export revenue. Additionally, the country's geography and extreme temperatures leave it uniquely vulnerable to the impacts of increased warming.

It is important to remember that Saudi concern about decarbonization is principally predicated upon adequately priming its macroeconomy to manage the future expected decline in global oil demand. Secondly, Saudi Arabia seeks to forge a diversified economy

[196] Saudi Arabia's geopolitical concerns are focused upon containing and blocking perceived Iranian expansionism, such as into Iraq, Syria and Lebanon, and its alleged role in encouraging Shiite minorities in the Gulf- and elsewhere-to engage in violent domestic action to overthrow their respective governments. Thomas Hegghammer, *Jihad in Saudi Arabia: Violence and Pan-Islamism since 1979* (Cambridge University Press, 2010).

that would reduce its domestic consumption of hydrocarbons (and the opportunity cost associated with its consumption) to export more to the international market. The Saudi government is also concerned about the environmental impact of climate change, but as of the early 2020s, that concern tends to rank near the bottom of the agenda.[197]

While facing the challenges mentioned above, Saudi Arabia also managed severe oil price volatility over the past decade. Saudi oil policy was primarily characterized by exporting unrefined crude oil to the global market for much of its existence. This strategy granted Saudi Arabia its immense wealth on display today but left it highly vulnerable to oil price fluctuation that has increased since the mid-1980s.

The reason why volatility has grown in the global oil sector has been due to the increase in regional instability (and the related fear premium), the financialization of the oil-based commodities markets, international decarbonization efforts, and the growth of supply from other oil producers outside of OPEC.[198] Saudi authorities have realized that expanding into the upstream and downstream natural gas sectors is crucial for continued macroeconomic development if they want to continue their growth strategy.

Because most of Saudi Arabia's natural gas is associated, it relates to Saudi oil production policy. While Saudi Arabia can maintain its swing producer status by ramping up or reducing its oil production on short notice, there are still various externalities associated with defending such a posture. One of the most significant of these is that removing oil from the export market stands at odds with its goal of increasing its domestic natural gas production from associated reservoirs to meet its domestic demand growth.

[197] Saudi Arabia did not privilege environmental protection due to its accelerated development that began in the late 1960s to the 1970s. This development occurred in tandem with an increase in the birth rate, a significant inflow of domestic workers, and a stark rise in living standards. All of these events were compounded by the fact that Saudi Arabia did not have any meaningful environmental protection regulations and laws until the 1990s and 2000s. Additionally, as discussed in depth in Chapter Seven, in its Paris Agreement NDC, Saudi Arabia reserved the right to renege on its climate commitments if its economic development were unduly impacted by either domestic or international decarbonization efforts. Tarik M. Al-Soliman. "Environmental Impacts and the Need for a National Environmental Policy in Saudi Arabia." *Journal of Architectural and Planning Research* 10, no. 3 (1993): 221

[198] *What Drives Crude Oil Prices?* U.S. Energy Information Administration. Available at https://www.eia.gov/finance/markets/crudeoil/spot_prices.php#:~:text=The%20volatility%20of%20oil%20prices,fixed%20in%20the%20near%2Dterm.

In 2016, under Crown Prince Mohammed Bin Salman, Saudi Arabia announced it would implement a broad-based national transformation entitled, Vision 2030, reforming Saudi Arabia culturally, economically, and geopolitically. Vision 2030 intends to refashion Saudi Arabia into a country less reliant upon foreign oil production/export revenue by fostering economic diversification. This plan includes extensive reform in the energy sector, beginning with the partial privatization of the national oil company (NOC), Saudi Aramco, initiated in December 2019.

This chapter will assess Saudi efforts' successes and failures to produce from unconventional gas fields viably and identify the barriers that could disrupt future production while discussing it against the backdrop of Saudi Arabia's proposed plans to enter the global LNG market (import or export).

The main issues that impede Saudi Arabia's incremental gas production are that, while it has engaged in energy price reformation (discussed in depth in Chapter Six), it has yet to comprehensively reform its natural gas pricing framework which would allow its incremental gas production to become economically feasible. While it seems that the Saudi leadership has telegraphed its determination to make these projects succeed, it remains to be seen whether Aramco has effectively surmounted the logistical, financial, and political obstacles that forestalled its initial gas production programs in the 1990s and early 2000s.

In terms of this chapter's outline, Section 5.2 will overview the Saudi oil sector and detail the market volatility and the role Saudi Arabia played in the ensuing market share competition that significantly impacted the global oil market in the 2010s.

Section 5.3 will assess Aramco's efforts to increase its unconventional gas production, as the government focuses on stimulating shale gas production. Additionally, this section will analyze the technical, environmental, and technological challenges Saudi Arabia faces to produce from the fields sustainably. Section 5.4 will review Saudi gas import and export plans to determine which option would most likely be best aligned with the overall Saudi gas policy, i.e., meeting domestic gas demand growth. Section 5.5. will conclude with a chapter summary and an assessment of Saudi Arabia's current demand/production postures and how it may align with its future goals.

5.2 The Saudi Oil Sector

Saudi Arabia stands at the forefront of the global oil sector and is the dominant petro-state with the world's largest conventional oil reserves, holding approximately 16 % of the world's total proved oil reserves.[199] According to the BP Statistical Review, Saudi Arabia had about 297.5 billion barrels of proven oil reserves by the end of 2020.[200] These reserves are contained in nearly 130 major oil and gas fields. However, more than half of Saudi oil reserves are held in nine fields in its eastern regions. The Ghawar field is considered the world's largest oil reservoir (a supergiant field), both in production and total remaining reserves.[201] This reservoir contains proven oil reserves of 70 billion barrels and produces nearly half of Saudi Arabia's daily oil production (at about five mbpd).[202] As such, the Ghawar field has singular importance to the global oil market. Saudi Arabia also has the world's largest offshore oil field christened, Safaniyah, containing nearly 35 billion barrels.[203]

However, Saudi Arabia's position as the largest oil producer often fluctuates with Russia and the U.S. For instance, in May 2016, Saudi Arabia overtook the U.S. as the world's largest oil producer, at 12.58 million barrels a day. [204] Then, it transitioned to second place as Russia

---

[199] The Saudi oil and gas sector accounts for about 50 per cent of gross domestic product, and about 85 per cent of export earnings.
Energy Information Agency; *Saudi Arabia; Saudi Arabia Facts and Figures*, OPEC website. Available at http://www.opec.org/opec_web/en/about_us/169.htm

[200] *BP Statistical Review of World Energy*, BP (2021) p. 16

[201] *Saudi Arabia*, Energy Information Administration (Oct. 20, 2019).

[202] The Ghawar field by itself contains more oil than about seven countries in the world. However, there is some speculation that the Ghawar field does not contain as much oil as the official figures indicate. Matthew Simmons was one of the primary proponents of the theory that the Ghawar field does not contain as much recoverable oil as the Saudi government states. However, his tends to be a minority view in the oil sector. See, generally, Matthew R. Simmons, *Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy* (John Wiley & Sons, 2011). Some surveys indicated that increased drilling in parts of the Ghawar field were due to field expansion rather than in keeping certain parts of the field producing with enhanced oil recovery. *Ghawar Field Reserves Decline Overstated, Survey Says*, Oil and Gas Journal (Dec. 17, 2007).

[203] Ibid.

[204] In May 2016, the U.S. lost approximately 460,000 barrels a day of high-cost oil and natural gas liquids production, to reach 12.2 million barrels per day. Saudi Arabia gained 400,000 barrels a day of output from its low-cost oil production and produced 12.58 million barrels in that same month. The reason for this reduction was because of global oversupply and Saudi Arabia's ability to withstand a relatively low oil price environment when compared to many U.S. small cap energy companies, many of whom were also overleveraged.

surged to the lead in December 2017.[205] Moreover, by early 2020, the U.S. overtook the other two countries, reaching nearly 13 mbpd of oil production.[206]

Despite its oil production rivalry with Russia and the U.S., Saudi Arabia is the largest global oil exporter. It can supply the international market with most of its produced oil, which few other countries can do on the same scale.[207] The difference between its oil production and domestic consumption granted Saudi Arabia its principal swing producer position.[208] Yet, it is essential to recognize that while these top three oil producers regularly compete for the number one primary global oil producer position, not one of them has retained the top position for long in the 2010s.[209] This scenario is likely to persist for the 2020s as well.

Nevertheless, Saudi Arabia and some other significant oil producers felt threatened by the sharp increase in American shale oil production over the past decade. As a result, Saudi Arabia attempted to acquire market share growth against the rapidly expanding American oil production as efficiency gains in the U.S. shale oil sector made it the de facto marginal cost producer on the world market. In 2014, Saudi Arabia initiated a price war with the U.S. shale industry in a bid to cause many of the overleveraged and higher-cost American producers to go out of business.

Still, that venture ultimately failed as Saudi Arabia, and the other OPEC members could not absorb such a low-price environment for the midterm. By mid-2016, Saudi Arabia reined in its production to facilitate creating a price floor to stanch the financial hemorrhaging. And the impact of the price war was that it forced many of the uncompetitive American producers out of the market while causing the remaining companies to become more efficient in a type of darwinistic process. While global oil prices began a gradual ascent, the Covid-19 pandemic at the beginning of 2020 halted the upward growth and initiated a steep decline that

---

205 However, Saudi Arabia is the foremost global oil exporting country as it exports the majority of its production. This contrasts with the U.S.

206 Robin Mills *US Shale Will be the First Casualty of the Price War*, Euractiv (Mar. 16, 2020).

207 At current rates of production (approximately 8.5 mbpd in 2020), it is estimated that Saudi Arabian oil reserves could endure for another seventy years.

208 A swing producer in the oil sector is a country that can rapidly increase or decrease production to attempt to maintain the market in an approximate equilibrium.

209 Russia was able to take Saudi Arabia's position due to OPEC quotas implemented that reduced Saudi oil production in Dec. 2017.

eventually stabilized by 2021.

5.3 Saudi Natural Gas Sector

While reliant on the oil industry for much of its history, Saudi Arabia is rapidly diversifying into the upstream and downstream gas sector with billions of dollars in investment. As with Qatar and the UAE, the natural gas molecule is critical in Saudi Arabia's industrialization and diversification drive and is at the center of the Saudi Vision 2030, its overall macroeconomic development strategy. Transitioning from its primary role as a crude oil exporter, Saudi Arabia utilizes natural gas as the primary feedstock for its petrochemical industry, power generation sector, enhanced oil recovery, the refining industry, and water desalination plants.

However, the Saudi natural gas sector is not as developed as that of its oil industry. While holding the fifth-largest natural gas reserves globally, at 6 TCM (end of 2020), its production continues to grow slowly but steadily at 112.1 BCM per annum (See Figure 5.1).

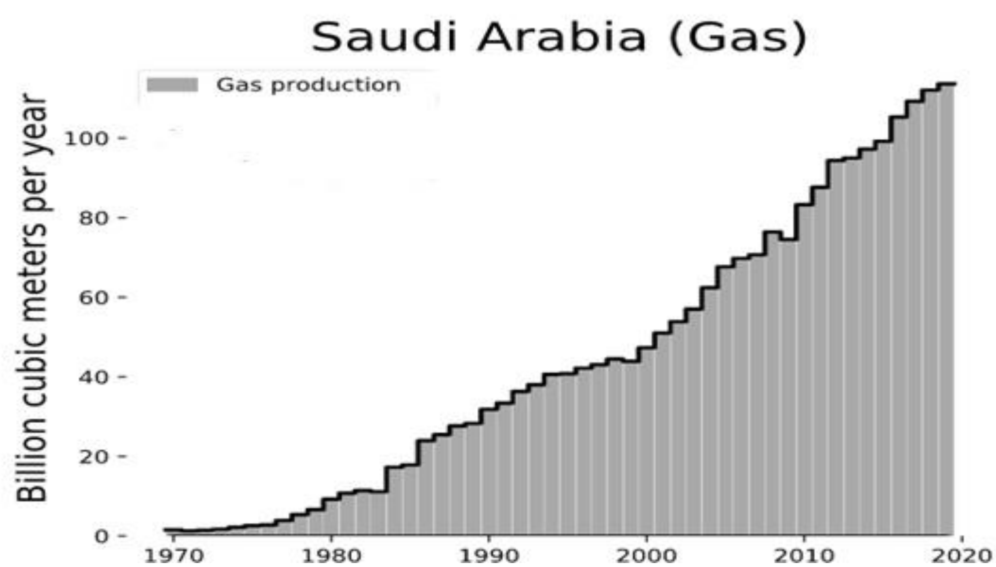


Figure 5.1: Saudi Gas Production 1970-2020: Source: BP Statistical Report (2021)

As discussed below, Saudi Arabia's natural gas exploration is increasing substantially to meet its growing power demand and downstream industrial requirements. Saudi natural gas consumption rates have been growing year on year, reaching approximately 112.1 BCM in

2020.[210]

The Saudi oil sector is tightly interwoven with its gas sector, as most Saudi natural gas is associated with oil production. To deploy its oil more strategically and meet its growing gas demand requirements in the power generation and water desalination sectors and the downstream industry, Aramco is attempting to increase its non-associated gas development. In a stark recognition of the growing dependence of the Saudi economy on associated natural gas production and its impact on the country's swing producer role, Khalid Al Falih, the former energy minister, announced in 2017 that: "We cannot do what we did in the 1980s and 1990s by swinging in the millions of barrels to respond to market conditions."[211]

Therefore, the Saudi government implemented gas and power price reform in the mid part of the 2010s to transition its domestic price much closer to the marginal cost of production to incentivize domestic gas development and reduce its natural gas demand. Saudi gas price reform, as discussed in depth in Chapter Six, while still somewhat modest and incremental, has become increasingly important for the Saudi leadership to propel the economy forward by reducing hydrocarbon/power demand and funneling the oil and gas to more productive economic uses (export and downstream industrialization).

Despite Saudi Arabia's understanding of the need to comprehensively develop its gas sector to meet its future economic development goals, there are still significant obstacles that the country must overcome.

5.3.1 Incremental Gas Production

Since the late 1990s, Saudi Arabia has attempted to increase its domestic non-associated gas production dramatically. Even though Saudi incremental gas production grew, the government's gas production programs have not been as successful as they could have been and progressed haphazardly.

The reason for this is that for nearly the past hundred years, Saudi Arabia has been a country

[210] Ibid.
[211] *Saudi's Associated Gas Needs Limit its Swing Role*, Argus (Mar. 10, 2017).

dominated by the oil sector. Furthermore, well into the 21st century, Saudi Arabia is still struggling to develop an effective hydrocarbon diversification strategy. Saudi gas development policies typically encountered two obstacles: firstly, the government's focus on being the preeminent producer in the global oil market. And, secondly, Saudi law designated Aramco as the sole domestic hydrocarbon producer, which tended to not be as efficient in streamling development plans.

As a result, when the Kingdom launched programs to encourage IOCs to develop their gas resources in the 1990s, it could not effectively reach its gas production goals because of these countervailing forces. Even though Saudi Arabia had an abiding need to produce its natural gas, political consensus still held that Saudi hydrocarbon production should be solely under the state's purview with limited participation by IOCs. As such, the terms of the investment were not financially viable for IOC involvement.

This political obstruction of a clear economic need was also the case with the $25 billion Natural Gas Initiative and the Rub al-Khali (Empty Quarter) non-associated gas project in 2003-2004.[212] Initially, the IOCs were interested as these proposed projects represented the first upstream opportunities for them to participate since the Saudi government nationalized its oil sector in the 1970s. Nevertheless, the lack of a firm political commitment to develop the projects resulted in the IOCs departing one after the other. One of the principal issues that illustrated the dearth of political investment was the program's back-and-forth nature. The Saudi government would terminate a project after signing agreements and then invite another round of bidding.[213] This cycle would then begin anew.

The failure to develop Saudi non-associated gas reserves in any appreciable manner caused Aramco to promulgate the Accelerated Transformation Program (ATP) in 2010 to attempt the process anew. The ATP was meant to reinvigorate the previous unsuccessful joint ventures that Aramco had with the IOCs. The express purpose of the ATP was to expand Aramco's exploration and production activities into areas of Saudi Arabia not previously explored in-depth, such as the deep waters of the Red Sea, as well as to facilitate the

---

[212] *The Saudi Natural Gas Initiative*, Stratfor (June 5, 2002).
[213] Robert Mabro, *Saudi Arabia's Natural Gas: A Glimpse of Complex Issues*, The Oxford Institute for Energy Studies (No Date).

development of tight sands and shale formations (South Ghawar and the Rub'a al-Khali).[214] Aramco did have a modicum of initial success when in 2012, it announced the discovery of significant reserves off the coast of the Red Sea. Aramco hoped that these finds would meet at least part of its increasing gas requirements that were quickly causing gas allocation issues.[215]

After the Red Sea gas discoveries, Saudi Arabia focused its attention on its unconventional gas reserves to supply its goal of doubling overall national gas production. In furtherance of that, in 2013, Aramco publicized that it had located three significant shale gas deposits, in South Ghawar (close to its supergiant oilfield), the Jafurah Basin in the east of the country next to South Ghawar, and at Turaif in the Northern Borders province (See Figure 5.2).

Figure 5.2: Map of Major Saudi Arabia Oil/Gas Fields: Source: Phillippe Charlez, Geopolitics of Unconventional Gas Resources Outside America, Society of Petroleum Engineers (2016)

However, developing unconventional supplies is highly complex and costly (as discussed below in Section 5.3.2).

[214] Khalid Al-Falih, *Asia Business Council*, Asia Business Council. (2011) May 19. Available at http://www.asiabusinesscouncil.org/docs/Al-FalihDCMay2011.pdf
[215] *Saudi Arabia's Gas Discovery in Red Sea Comes at Opportune Time*, Offshore Technology (March 27, 2019)

When global oil prices began to stabilize in 2017 when Saudi Arabi reined in its production, it started a concerted effort to develop these fields. It first began to produce its tight gas from the Turaif deposit to deliver gas to a recently built power station in the Waad al-Shamal industrial city. This resolved the lack of connectivity to the national Master Gas System (MGS) distribution network to a certain degree. [216]

To decisively boost its gas production, Saudi Arabia pivoted to the Jafurah field, which holds the country's largest unconventional gas reserves. In early 2020, it launched the most massive shale gas production outside of the United States.[217] In February 2020, Saudi authorities officially approved it with an expected $110 billion development cost.[218] Jafurah is estimated to hold approximately 5.7 TCM of gas, comparable to the Eagle Ford shale gas field in the U.S.[219] Aramco plans to develop the field in stages, with the initial stage operational in 2024. By 2036, plateau production is expected to reach 62.3 MCM/d of gas alongside nearly 12 MCM/d of ethane and 550 kb/d of additional gas liquids and condensates. [220]

Saudi production will focus on the Jurassic Tuwaiq Mountain formation, with its manifold organic content, low water saturation, and high gas saturation.[221] As discussed in Section 5.3.2, the relatively long ramp-up period is reflective of the understanding of the reservoir's complexities and the lack of critical enabling factors.

The Saudi government also places enormous importance on the rich liquid content of the

---

[216] Japan's JGC Corporation and Canada's SNC-Lavalin carried out the engineering, procurement, and construction (EPC) contracts respectively for the first and second phases of the gas system, which reached full 190mn ft^3/d capacity in late 2018. Claire Dunkley, *Saudi Gas Drive Goes Unconventional*, Petroleum Economist (Feb. 11, 2019).

[217] Rania El Gamal and Simon Webb, *Saudi Arabia Launches Largest Shale Gas Development Outside the U.S,* Reuters (Feb. 24, 2020).

[218] *Saudi Arabia Forges Ahead on Ambitious LNG Expansion Plans*, The Arab Weekly (Sept. 6, 2019)

[219] Jafurah will be able to produce about 130,000 barrels a day of ethane, representing about 40% of the kingdom's current production and about 500,000 barrels a day of gas liquids and condensates, representing about 34% of the country's output.

[220] Rami Shabaneh and Majid al-Suwailem, *The Prospect of Unconventional Gas Development in Saudi Arabia*, KAPSARC (Mar. 18, 2020). P.3

[221] Ahmed Hakami, *et al*., "Characterization of Carbonate Mudrocks of the Jurassic Tuwaiq Mountain Formation, Jafurah Basin, Saudi Arabia: Implications for Unconventional Reservoir Potential Evaluation." *Journal of Natural Gas Science and Engineering*: 1149-1168 (2016).

reservoir to assist its downstream development. Saudi Arabia's petrochemical sector has borne the brunt of reduced allocation due to the national gas shortage and the government's focus on gas provision to the ever-increasing power generation requirements; the successful development of Jafurah will assist it in meeting downstream gas demand. Jafurah's raw gas will be piped to a greenfield gas processing plant located close to the field. Additionally, there is also a provisional plan to ship the NGLs north to the Wasit gas complex located by Jubail.[222]

If Saudi Arabia can reach its production target on schedule, it could become the world's third-largest gas producer by 2030. Over the 22-year development, the field's exploitation could add nearly $20 billion to Saudi GDP annually and provide the Saudi government with almost $8.5 billion of net income.[223] To secure that end, Aramco and Halliburton inked a three-year contract in 2018 to help facilitate Saudi shale production. Halliburton was specifically chosen for its expertise in drilling and completing shale oil and gas wells in the U.S. as it is the primary company behind the U.S. shale gas boom in North Dakota, Oklahoma, Louisiana, and Texas.[224]

5.3.2. Gas Production Challenges

Even though much progress has been made in developing Saudi's non-associated gas fields, there are still significant gaps in its water scarcity, transport infrastructure and its technical skillsets. All these issues will obstruct Saudi Arabia's efforts to produce its incremental gas supply successfully.

To rectify the technical deficiencies, the government has focused on three core areas, developing domestic unconventional gas research departments, inviting Western IOCs to assist in field production, and engaging in knowledge transfer with American and European educational/technical institutions.

[222] Jubail was constructed to handle the production from Aramco's initial offshore non-associated gas. *Aramco Lets Contract for Wasit Gas Plant*, Oil and Gas Journal (April 20, 2018).
[223] Donna Abu-Nasr, *Saudis Stake $110 on Jafurah Unconventional Gas Field* (Feb. 24, 2020)
[224] In 2017 along, Saudi Arabia awarded $4.5 billion in contracts to international oil services companies to increase its non-associated gas production. Clifford Krauss, *Halliburton, and Saudi Aramco Reach Deal to Increase Gas Output*, New York Times (May 28, 2018).

In the mid-2010s, Aramco established an unconventional gas department to manage its unconventional gas development nationwide. In the process, Aramco hired a multitude of unconventional gas specialists to bring their expertise to bear.[225] The unconventional gas department focuses on hydraulic fracturing, fluid chemistries, and geomechanics to enhance Aramco's knowledge base and competitiveness for unconventional gas extraction. The intention is that these research programs will mitigate the risk that these unconventional wells may not produce according to expectations and that enhanced technical skills will improve production rates.

A more direct method that Aramco is pursuing to further its unconventional gas extraction is offering foreign investors- such as IOCs-attractive investment frameworks to bring their advanced technology and managerial skills to its reservoirs. Whereas in the early 2000s, as discussed above, Aramco did not develop a coherent framework to encourage IOC gas investment, the Saudi leadership has now telegraphed its political intent to realize its gas ambitions. As a result, IOCs indicated their interest in returning to the Kingdom.

Saudi Arabia is also funneling significant amounts of money to develop indigenous knowledge transfer clusters. Partnerships have been formed with various Ivy League and top-tier global universities to educate and train the next generation of Saudi professionals. This goal is part and parcel of the ambitious Vision 2030 strategy that the Saudi Government is implementing to create a Saudi knowledge economy society within a decade. It is possible that because of these sustained investments, within a generation, Saudi Arabia would no longer have to depend upon the acquisition of foreign investment or technology to develop its oil and natural gas reservoirs.[226]

In addition to Aramco's knowledge deficit, the company must develop its drilling and well completion capacity to successfully unlock its unconventional gas reserves, such as from Jafurah. Aramco does have access to advanced gas extraction technology, including horizontal multistage fracturing and underbalanced coiled tubing drilling. However, the lack

[225] Rami Shabaneh and Majed Suwailem, *The Prospect of Unconventional Gas Development in Saudi Arabia*, KAPSARC (April 2020) p. 4

[226] Nonetheless, until Saudi Arabia can effectively use its own indigenous skillset to develop its incremental gas reserves, the Kingdom will still have to depend on IOCs and foreign oilfield services companies, as well as the acquisition of advanced hydraulic fracturing technology from Western countries.

of trained shale gas production personnel forces Aramco to still depend upon Western oil services companies.[227]

Shale and tight gas are challenging to produce due to the low permeability of such reservoirs. These wells must be manually stimulated to make the reservoir more porous to liberate the gas for collection.[228] In addition to the need for horizontal and advanced hydraulic fracturing, many more wells need to be drilled and produced simultaneously than conventional associated gas wells.[229] These factors substantially add to the end production cost. [230]

However, Saudi Arabia had learned from the North American experience with unconventional gas production when it applied such techniques to its tight gas sands development in its northern areas. Even though Aramco is progressing with gas production technology acquisition and developing trained personnel, the country still lacks the enabling factors that undergird the North American shale gas boom.

Adding to the complexity of Saudi production plans, shale and tight gas formations require a significant amount of water to coax the gas out. Aramco hopes to obtain the water from shallow aquifers that lie relatively close to its production sites. Yet, the water requirements of shale gas production run high. Similar sites in the US, such as Eagle Pass, consume between 3.5 to 4.3 million gallons daily. [231] But, as production at Eagle Pass has shown, usage of this amount of water has not proven to be a simple process for Texas and would likely be even less successful in the arid Saudi deserts [232]

As a rule, fracking does not initially require more water than other energy development. Nevertheless, as shale gas production tends to decline after a few months markedly, the most

---

[227] *The Prospect of Unconventional Gas Development in Saudi Arabia*. p. 4

[228] Tight gas resides in carbonate reservoirs and low-porosity sandstones, while shale gas is trapped in shale formations.

[229] For more information about the dynamics of unconventional gas production, see, National Petroleum Council, "Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources," 2011, p. 205.

[230] (Anonymous) Interview with Aramco official (Aug. 7, 2017).

[231] Benton Arnett, *et al*, "Water Use in the Eagle Ford Shale." Technical, College Station, TX: The Bush Business School of Government and Public Service (2014).

[232] Andrew Kondash, *et al*, *The Intensification of the Water Footprint of Hydraulic Fracturing*, *Science Advances* 15 Aug 2018: Vol. 4, no. 8.

economical method to maintain production rates is to drill more wells, thus requiring more water.[233]

Some unconventional fields may require up to 40 fracking stages, with some estimates contending that up to 125,000 gallons of groundwater may be required.[234] To reduce the country's already limited water supply burden, Aramco is concentrating on reduced water fracking techniques and researching utilizing seawater for fracking.[235] If the research into seawater utilization proves successful, it could provide a blueprint for other countries with significant shale reserves and contend with severe water constraints.

In that vein, Nasser Amin, the CEO of Aramco, confidently announced that Aramco had developed a technique to utilize seawater for fracking, which would overcome the lack of water supply in the Saudi desert.[236] While Amin believes that production costs will decline over the field's lifetime, these costs would still have to fall by 50-70% to match current domestic gas prices.[237] Jafurah's reservoir complexities are not insurmountable; several technical papers suggest that its field characteristics closely resemble the Eagle Ford shale play in South Texas, which significantly reduced its operating cost over time.[238] Nonetheless, for Aramco to successfully produce from Jafurah for the mid-to-long term, operational costs and domestic feedstock prices would have to be aligned.

In addition to the challenges mentioned above, while natural gas is hailed as a bridge fuel and less carbon-intensive than either oil or coal, some environmental externalities need to be rectified, especially from shale gas production. Even in the U.S., which has been producing from shale gas deposits for nearly a decade, shale gas production has not been

---

[233] It is possible, though, to use wastewater as well for shale and tight gas production,

[234] *The Prospect of Unconventional Gas Development in Saudi Arabia*. p. 4

[235] A.B. Abdul Majid, *et al*, "Seawater Based Fracturing Fluid: A Game Changer in Hydraulic Fracturing Applications in Saudi Arabia." Manama, Bahrain (2017).

[236] Verity Ratcliff and Anthony Di Paola, *Saudi Aramco See Shale Gas as Kingdom's Next Energy Bonanza*, Bloomberg (April 29, 2019).

[237] Ahmed Al-Mubarak, *et al*, *Saudi Arabia's Unconventional Program in the Jafurah Basin: Transforming an Idea to Reality with the Jurassic Tuwaiq Mountain Formation*, The 22nd World Petroleum Congress. Istanbul (no date).

[238] Furthermore, the initial results from Jafurah's appraisal wells also show production rates similar to Eagle Ford, which gives credence to the belief that, as with Eagle Ford, the field economics and productivity will improve once development begins apace. Ahmed Hakami, *et al* "Characterization of Carbonate Mudrocks of the Jurassic Tuwaiq Mountain Formation, Jafurah Basin, Saudi Arabia: Implications for Unconventional Reservoir Potential Evaluation." *Journal of Natural Gas Science and Engineering*: 1149-1168.

without criticism.[239]

Climatologists have blamed shale gas and oil production for the rising methane concentrations in the environment and, thereby, accelerating the pace of climate change.[240] As Saudi Arabia begins to produce more shale gas, Aramco will come under significant scrutiny for its methane emissions and its ability to meet its pledges under the Paris Agreement.[241] For its part, Saudi Arabia argues that it reduces its carbon footprint by displacing fuel oil for power generation with gas and converting more of its oil into petrochemical products.[242]

Potential Saudi gas export plans also must be assessed against the fact that the country still has significant gas demand requirements for its own needs. As of 2021, it was still burning nearly 400,000 b/d of oil for power generation, in addition to large volumes of diesel and fuel oil. Furthermore, it would seem that Saudi Arabia's primary goal would be to fuel switch to reduce crude oil demand in the power sector. If that strategy were pursued, there would not be any viable amount of gas for export.[243]

5.4 Rising Energy Demand

5.4.1 Sectoral Gas Demand

Like most other energy-rich Gulf countries, Saudi Arabia had experienced rapidly increasing gas demand growth, averaging 4.6 % per annum from 1987-2017 (See Figure 5.3).[244] [245] However, between 2017-2020, there has only been a 1.2 % increase, which suggests that the demand growth rate may be slowing, as in Qatar and the UAE. Still, due to its relative energy

[239] Omar Faraj, *et al*, "First Shale Gas Experience in Saudi Arabia: Lessons Learned," *Journal of Engineering Research* Year 1-No 2 Sept. 2013 pp.29-42 (2013)
[240] Hydraulic fracturing has also been blamed for increased seismic activity and aquifer pollution in various U.S. states; however, there is still debate as to whether it is the cause. Yuzhong Zhang, *et al*, "Quantifying Methane Emissions from the Largest Oil Producing Basin in the United States from Space" *Scientific Advances*, Vol 6, No. 17 (Apr. 22, 2020).
[241] Aramco released more than 40 billion metric tons of greenhouse gases between 1992 and 2017, the equivalent of almost 5 % of industrial carbon dioxide and methane. Carbon Majors, *Climate Accountability* (Oct. 8, 2019)
[242] *Saudi Aramco Building Global Gas Business to Cut Carbon Footprint*, Reuters (Mar. 26, 2019)
[243] Brian Wingfield, *et al*, *New Decade, New OPEC Oil Curbs. Same Mixed Results*, Bloomberg (Feb. 20, 2020).
[244] Bassem Fattouh and Rami Shabaneh, "The Future of Gas in Saudi Arabia's Transition" in (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES 2019) p.86
[245] Ibid.

inefficiency, Saudi total energy consumption is approximately three times higher per capita than the global average.

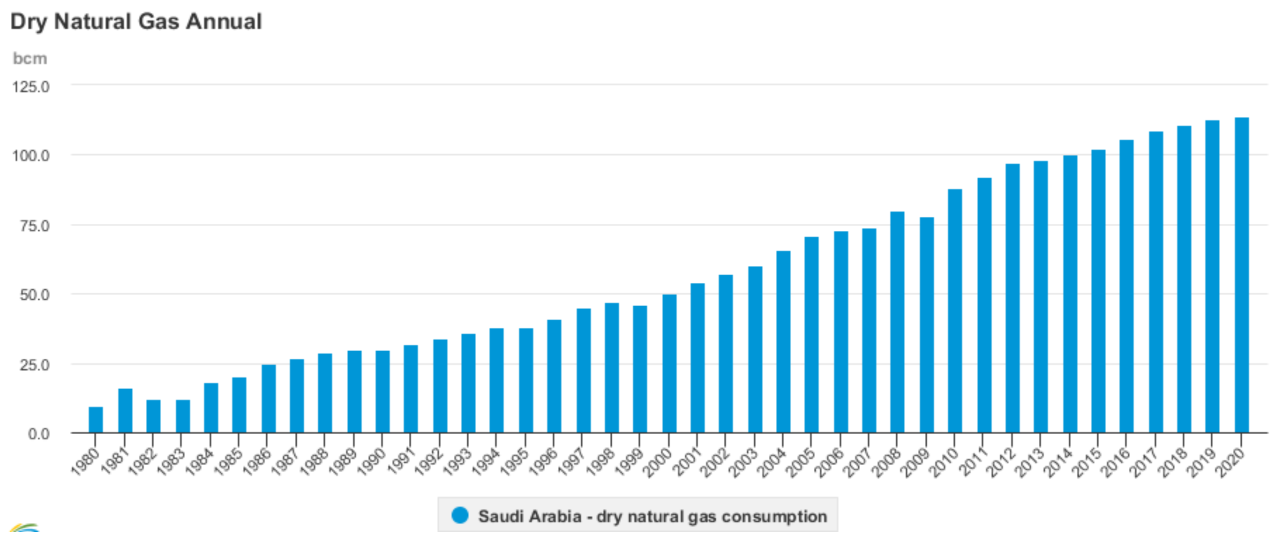


Figure 5.3 Saudi Gas Demand from 1980-2020: Source: U.S. Energy Information Administration

As discussed in Chapter Six, reducing domestic gas demand has proven difficult when contending with the lack of robust energy efficiency standards and specifications, a general awareness of energy usage reduction amongst the population, and a domestic pricing framework that is still below regional and global norms.[246]

Previously, crude oil held a privileged position in Saudi Arabia's primary energy demand. But now, natural gas consumption has been steadily rising to become a significant source of domestic energy demand over the past several decades.[247]

In Saudi Arabia, the main driver of gas demand is the power sector, consuming nearly 70 % of the gas produced by 2018.[248] Industrial sector demand reaches almost 22 % of gas consumption, while non-energy use stands at 7%. [249] However, as Saudi Arabia sought to

[246] Oman's natural gas price is $3.00/MMBTU, while India's regulated price is $2.39/MMBTU, for example.
[247] Bassem Fattouh and Rami Shabaneh, "The Future of Gas in Saudi Arabia's Transition" in (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES 2019) p. 87.
[248] This does not include gas consumed by the oil sector.
[249] Bassem Fattouh and Rami Shabaneh, "The Future of Gas in Saudi Arabia's Transition" in (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES 2019) p.87.

expand into the downstream industries, the petrochemical industry increased its economic importance. It grew to account for nearly 60 % of Saudi Arabia's non-oil exports in 2017/2018. In 2019, Saudi Arabia announced more than $2 billion worth of new investment deals to further expansion in that sector.[250]

It is still expected, though, despite Saudi efforts to tame gas demand growth, the traditional drivers such as population growth rates, the transition to gas in the power sector, relatively low gas prices, industrialization, and economic growth will continue to increase gas demand for the next decade. However, the domestic gas demand rate is still likely to slow as the internal dynamics of the two main gas demand sectors-power and petrochemicals are changing, as discussed below.[251]

The Saudi power sector has two dialectical factors in operation. The government is introducing pricing reform in the power sector, massively investing in renewables, and implementing energy efficiency measures. However, at the same time, because Saudi Arabia is substituting gas for oil, upward demand will continue. As of late 2021, Saudi Arabia plans to increase gas share in the power generation mix to 75 %, up from 55 %, with renewables and nuclear to comprise the remaining amount by 2030.

5.4.2 Power Sector

Saudi Arabia is the 12th largest consumer of generated electricity, with crude oil and gas as the principal feedstocks. Furthermore, Saudi power sector demand has been rapidly growing over the past decade. Extreme weather conditions (which create high demand for air conditioning), improvements in living standards, urbanization, economic growth, and increasing population have been the main drivers. Additionally, the Saudi strategy of

[250] These deals were signed between Saudi Arabia General Investment Authority and five of the world's largest petrochemical producers, German BASF, Anglo-Dutch Shell, Japanese Mitsui & Co, French SNF and Dutch Advanced Metallurgical Group (AMG). Nurluqman Suratman, *Saudi Arabia Signs More than $2 bln Worth of Petrochemical Deals*, ICIS (Nov. 22, 2019).

[251] Bassem Fattouh and Rami Shabaneh, "The Future of Gas in Saudi Arabia's Transition" in (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES 2019) p.88

diversification into the energy-intensive industries, coupled with low energy pricing, creates a type of economic distortion that enables ‘wasteful” consumption” and state budgetary strains.[252]

However, Saudi Arabia prioritizes diversifying its alternative energy sources, including renewables and nuclear (Chapter Six discusses these alternative energy investment plans). Its interest is predicated upon its pledged decarbonization goals under the Paris Agreement to mitigate climate change and to also reduce the inherent vulnerabilities in its domestic energy security. Nevertheless, the Saudi position on renewable energy is not merely focused on its power needs. The government believes that investment in this sector would localize renewable energy manufacturing to become a regional exporter of renewable energy, clean energy infrastructure, and technical expertise. Of no less importance would be that increased renewable energy consumption allows Saudi Arabia to maintain or increase its oil exports. Moreover, the Saudi development of its renewable energy sector would buttress energy diversification, enlarge the role of the private sector and create employment opportunities for it burgeoning cadre of university graduates.

Saudi power demand grew at an average per annum rate of 5 to 7 % from 2007 to 2017, growing from 169 TWh to 298 TWh (an increase of 70 %).[253] This is when compared to the average growth of 5.5 % in non-OECD countries. Additionally, Saudi peak load grew from 35 GW to 62 GW during the same period. The Saudi Electricity and Cogeneration Regulatory Authority (ECRA) plans to reduce its peak load by 14 % and its aggregate power consumption by 8 % from 2014 levels by 2025.[254] It is estimated that Saudi peak demand will reach nearly 130 GW from 80 GW in 2032, a stark trend (See Figure 5.4).[255] However, the Saudi power demand rate of increase is expected to slow until 2034 due to slower economic growth, a projected exodus of expatriate workers due to indigenization policies, and energy/power price subsidy reform.[256]

[252] Bassem Fattouh and Rami Shabaneh, “The Future of Gas in Saudi Arabia’s Transition” in (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES 2019) p. 88
[253] Ibid.
[254] Ibid.
[255] Jessica Obeid, *Saudi Arabia New Renewables Giant*, Gulf Monitor (Jan. 24, 2020) Approximately seventy % of Saudi Arabia’s power consumption is due to air conditioning usage, Ayhan Demirbas, Ayman A. Hashem and Ahmed A. Bakhsh, *The Cost Analysis of Electric Power Generation in Saudi Arabia*, Energy Sources, Part B: Economics, Planning, and Policy (2017), 12:6, 591-596
[256] Robin Mills, *Under A Cloud: The Future of Middle East Gas Demand*, Center on Global Energy Policy (April 2020) p. 33

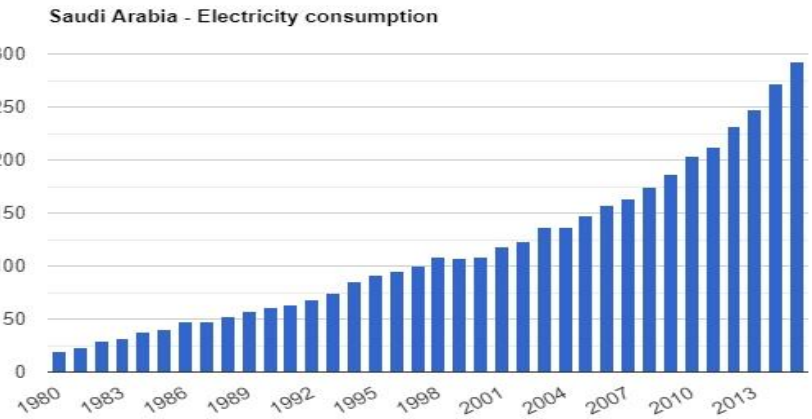


Figure 5.4: Saudi Electricity Demand: Source: TheGlobalEconomy.com, The U.S. Energy Information Administration

Even though the reductions in subsidies and energy efficiency efforts over the past decade have resulted in downward pressure on the demand growth rate, the increase is still significant. The government has attempted to match the growth rates with its annual installed capacity growth averaging 7.7 %.[257] Even though Saudi Arabia has substantial nuclear and solar energy potential, it still generates approximately 99 % of its electricity (2020) by fossil fuels (See Figure 5.5).

[257] Ibid.

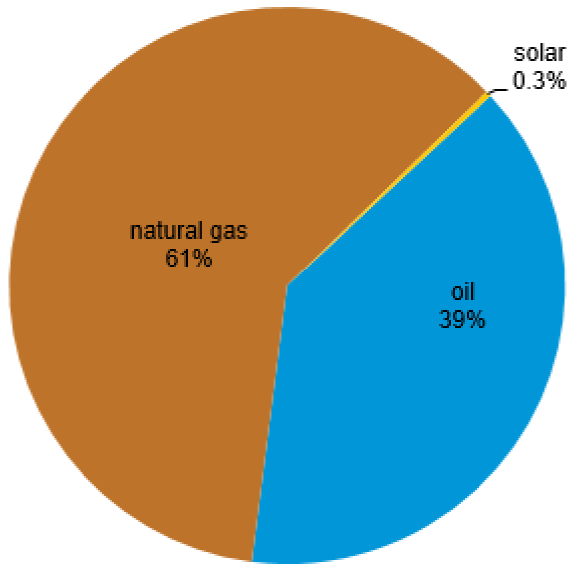


Figure 5.5: Saudi Domestic Power Generation Fuel Mix: Source Graph by the U.S. Energy Information Administration

5.4.3 Industry and Petrochemicals

Saudi gas demand via its industrial sector has not risen as rapidly as in the past, but it may continue apace if its Vision 2030 implementation policies are successful. Industrial gas demand growth is expected to increase during 2022-2030 by 5.3 to 7.7 % per annum.[258] By approximately the beginning of the 2040s, aggregate industrial gas demand will likely begin to decline.

Petrochemicals are another critical driver of Saudi gas demand; as of 2019/2020, it stands at approximately 28.32 MCM/d.[259] The domestic petrochemical sector has grown significantly due to the immense Saudi hydrocarbon reserves and low-price associated gas feedstock. Its petrochemical sector has generated nearly $33 billion in export revenue (2016), the largest export sector after oil.[260]

---

258 Ibid.

259 The exact data is unavailable; however, it may be deduced from the fact that Aramco produced nearly 254.9 MCM/d of methane and 28.32 MCM of ethane, nearly all the ethane is allocated to petrochemicals.

260 Bassem Fattouh and Rami Shabaneh, "The Future of Gas in Saudi Arabia's Transition" in (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES 2019) p.98

Upcoming oil and gas projects in the Saudi Arabia by sector, 2021-2025

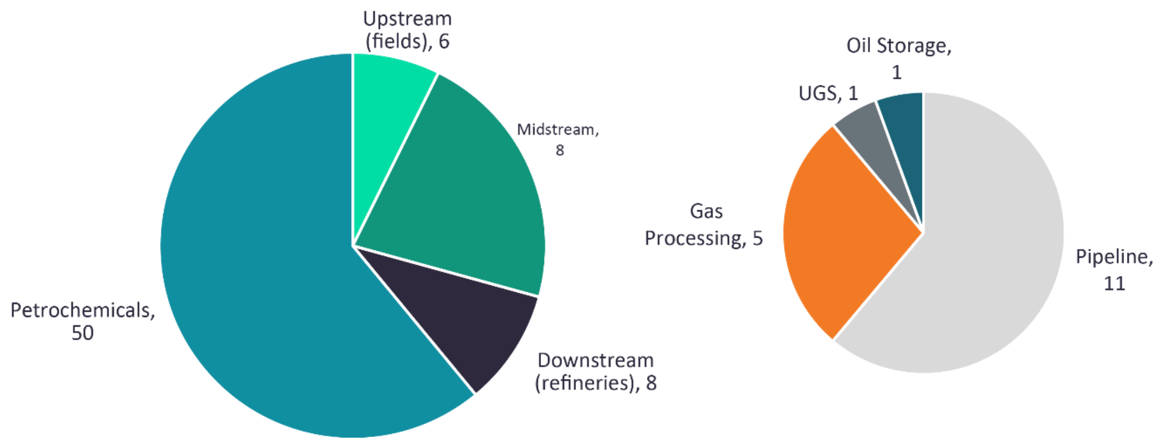


Figure 5.6: Upcoming Oil and Gas Projects in Saudi Arabia, 2021-2025 Source: GlobalData, Oil, and Gas Intelligence Center

And the petrochemical sector comprises a significant proportion of Saudi Arabia's diversification plans (See Figure 5.6). Additionally, the Saudi government is encouraging the utilization of oil-derived feedstock. The increased utilization of oil-based feedstock is meant to provide a feasible alternative feedstock to ethane. The ethane supply is already constrained and required for diversification of petrochemical products to extend the value chain.[261]

Still, the Saudi government arrived relatively late in understanding the importance of the petrochemical sector for economic development. Saudi Arabia's petrochemical sector only came into existence after most of its regional competitors began to produce petrochemicals in copious quantities. The delay was perhaps psychological in origin. Saudi Arabia based its economic strategy-and weltanschauung- on exporting large quantities of unrefined crude, which provided a rapid path to growth, even if the margins were low at a particular time of extreme fluctuation. However, this paradigm is now evolving.

Moreover, to take advantage of projected rising demand in the global petrochemical sector and facilitate national diversification aims as outlined in the Vision 2030 statement, the

[261] Ibid. p.101

government merged Aramco and Sabic into one unit during the summer of 2020 to take advantage of economies of scale.[262]

The merger of the two companies will accelerate Aramco's downstream strategy while leveraging its global petrochemical growth opportunities. The Saudi government also perceives that global oil demand will likely decrease in the coming decades due to international decarbonization efforts and the projected growth in electric automobiles. Therefore, if it secures markets for its oil (transformed into petrochemicals) before the expected demand decrease, it will have an early start in downstream sector growth for the long term.

The Saudi government seems to have placed its petrochemical demand estimates on the IEA's critical findings that petrochemical demand will be one of the primary sources for hydrocarbon-based demand growth until 2040. Therefore, as global oil demand will likely fall, petrochemical demand will still likely experience growth.[263]

Even though it still has much more work to do, Saudi Arabia successfully transformed much of its flared gas-reducing it from 40 % in the 1970s to 3 % by 2018- into profitable petrochemical export revenue generators.[264] Moreover, while this evolution took place over an extended period, approximately 50 years, Saudi Arabia has significantly invested in its downstream industrial sector to bolster its indigenous knowledge base, and further economies of scale will not take nearly as long.

However, the Covid-19 crisis has reverberated throughout the global energy sector and negatively impacted several premier projects. In early September 2020, Saudi Arabia canceled its plans to construct the $20 billion crude-chemicals plant to be built at Yanbu in a bid to preserve Aramco's pledge to pay out $75 billion in dividends annually during the early 2020s.[265] Aramco desired to construct the Yanbu plant to have a new outlet for its oil production as the world proceeds with the global economy's decarbonization. As many of

---

262 *Aramco Completes its Acquisition of a 70% Stake in Sabic from the Public Investment Fund (PIF)*, Saudi Aramco Website (June 17, 2020).
263 Petrochemical demand more closely tracks GDP than primary energy demand. See, generally, *Petrochemicals Set to Become the Largest Driver of World Oil Demand, Latest IEA Analysis Finds*, International Energy Agency (Oct. 5, 2019).
264 Rystad Energy UCube (accessed September 2017).
265 Verity Ratcliffe, *et al*, *Petrochemical Plan After Oil Crash*, Bloomberg (Sept. 3, 2020).

Aramco's greenfield projects are canceled or placed on hold, Saudi Arabia's petrochemical growth strategy appears to be increasingly fraught.

5.5 Conclusion

Saudi Arabia needs to rapidly develop its incremental natural gas reserves to grow its downstream sector, provide inputs for water desalination and power generation, and reform its macroeconomy in line with its diversification strategy. The importance of natural gas for Saudi Arabia cannot be overstated as it is the veritable backbone for all facets of its industrialization policy. However, the most significant challenge that Saudi Arabia faces is in ascertaining the most advantageous balance between natural gas/power pricing reform, maintaining a competitive energy and industrial sector, while also stimulating incremental gas production. For Saudi Arabia to achieve its macroeconomic goals as outlined in its Vision 2030, pricing reform and demand-side policies will have to go much further and faster in the future.

Even though Saudi Arabia indicated an interest in gas export and announced that it would potentially export gas in the near future, outside of its first LNG shipment to Asia, it seems an exceedingly unlikely outcome in the mid to late 2020s. Furthermore, in addition to its domestic gas needs, a robust export strategy would imply that Saudi Arabia would be able to compete against established producers who would likely still have much lower production costs in the late 2020s and early 2030s when any Saudi market entry would potentially occur.

Saudi Arabia still has significant hurdles to overcome for Jafurah's successful exploitation, at least to the U.S. shale gas industry level. As with most gas development, the issue is not the size of the reserves; instead, it is the reservoir's economics, i.e., the breakeven cost of production against domestic and international gas prices. This determines whether Saudi Arabia *should* produce from specific fields, such as Jafurah, or consider other alternatives to meet its domestic gas requirements, such as LNG import. Even so, it may be the case that Saudi Arabia's gas demand, such as the UAE's and Qatar's, may stabilize at a plateau by 2024, as energy efficiency measures, power sector pricing reform, and renewable energy projects begin to come online.

As discussed in Chapter Six, Saudi authorities have finally committed themselves, even if somewhat haltingly, to reduce gas demand through a multitiered approach of energy-efficiency effort and power and gas price reformation. To date, as detailed in Chapter Six, Saudi gas price reform has not yet been able to bridge the gap with its unconventional gas production costs, which will pose additional problems (in addition to the long ramp-up period) for Aramco to develop from these reservoirs successfully over the next decade. Considering the lack of enabling factors, that production costs and domestic gas prices do not currently align and that Jafurah will not produce in any appreciable amount until the 2030s, LNG import is likely the most viable (and urgent) option as the outlook for Jafurah's production is economically unpromising as it stands.

Chapter Six: Combatting Rising Energy Demand: Decarbonization Efforts

6.1 Introduction: Background of the Arab Social Contract and Regional Energy Pricing

Sustainable development and the prudent utilization and consumption of natural resources emerged as one of the most critical issues in the twenty-first century.[266] And, indeed, it is likely going to be the principal issue which global leaders must contend with in the mid-to-long term. Yet, the Gulf countries, until recently, granted scant regard to sustainable development as they sought to pursue economic growth regardless of the environmental cost. Industrialization and urbanization were the twin pillars of their macroeconomic programs. At the same time, Gulf policymakers, much as the policymakers of other rapidly developing countries, considered the negative externalities of natural resource exploitation and pollution as the necessary byproducts of economic growth.[267] Prior to the rapid development of the Gulf countries, their traditional tribal and religious codes mandated good environmental stewardship. In the rural areas, the nomadic Bedouins implemented a code known as *Hima*, which mitigated excessive grazing through field rotation utilization, while in the urbanized areas, the inhabitants practiced recycling which minimized pollution.

However, this was to change with the introduction of state centralization in the Gulf countries created a new cultural context of modernization that superseded traditional environmental management practices.[268] When the governing authorities transferred environmental regulation from the local and tribal authorities to the central government, the authorities declared that land was state property, thereby abolishing the ancient *Hima* system. Therefore, we can trace the first major policy shift that privileged economic development over environmental stewardship to the beginning of oil production in the Gulf

---

[266] Sustainable development is defined within this text as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

[267] See, generally, Tarik M. Al-Soliman. "Environmental Impacts and the Need for a National Environmental Policy in Saudi Arabia." *Journal of Architectural and Planning Research* 10, no. 3 (1993): 221

[268] Ibid.

from the mid-twentieth century.[269] The advent of hydrocarbon production in the region triggered a whole host of environmental modifying events, such as increased urbanization and housing, industry, expanded agriculture production, and expansive water desalination.[270] Alongside the relatively low environmental awareness of the populace, which engages in ecologically unfriendly behavior, are the institutional attitudes which sponsored massive industrialization drives that favored largescale construction and mega industrial projects at the expense of the environment.[271]

In the eyes of the Gulf policymakers, the West industrialized by giving nary a glance to environmental degradation; therefore, as with other developing regions, environmental consideration was a "problem for the rich."[272] Therefore, the Gulf governments felt that industrialization should proceed apace to grant their citizens the quality of life found in the West.[273] This focus on a robust industrialization still continues today, and perhaps is even more important as the regional governments seek to develop resilient economies in a rapidly approaching "post-oil world."[274]

But the industrialize-at-all-costs notions are evolving as Gulf governments realize that long-term economic development cannot succeed at the cost of environmental degradation.[275] To a certain degree, it may be said that the Gulf's Overton's Window rapidly expanded in the 2010s, where climate change and decarbonization issues were becoming much better understood among the political leadership as they sought to transform their role in global environmental stewardship.[276]

---

[269] Ibid. p 222

[270] Ibid.

[271] Kaltham Al-Ghanim, "Contradictory Forces in the Gulf Environment: Old and New Cultural Values and Knowledge" in ed Paul Sillitoe, *Sustainable Development: An Appraisal from the Gulf Region* (Berghanhn: 2014)

[272] For a discussion of this issue, please see, Sunita Narain, *Environmentalism of the Poor Vs. Environmentalism of the Rich*, Arizona State University Lectura Series (no date). Available at https://sustainability.asu.edu/media/wrigley-lecture-series/sunita-narain/

[273] For a detailed analysis on the processes that drove Saudi Arabia and its neighbors to seek industrialization over environmental concerns, see, generally, Haider Mahmood, Tarek Tawfik Yousef Alkhateeb, and Maham Furqan, "Industrialization, Urbanization and CO2 Emissions in Saudi Arabia: Asymmetry Analysis" in *Energy Reports*, Volume 6, (2020) pp. 1553-1560

[274] A large majority of Gulf businessmen favor industrialization as the key to foster economic diversification. Alexandre Raffoul and Fatima Al Zahra Hewaidi, *How Industrialization Could Future-Proof MENA's Gulf Economies*, World Economic Forum (June 28, 2021).

[275] For a comprehensive review of how the Gulf governments have incorporated sustainability into their industrialization strategies, see, generally, Osama Sweidan, *The Environmental and Energy Polices to Enable Sustainable Consumption and Production in the Gulf Cooperation Council Countries*, Clean Technologies and Environmental Policy Journal (2021)

[276]

While the Gulf countries depend on hydrocarbon production and export, they are navigating between Scylla and Charybdis as the region is one of the most susceptible to the dire impact of climate change. What fuels the Gulf economies also provides the impetus for potentially making the area uninhabitable for humans. Recent studies predicted that by late this century, deadly heatwaves could ripple throughout the region that could cause temperatures to be too high for basic human survival. [277]

This chapter contends that while most pricing reform in the region has been focused on the power and water sectors, these can be viewed as a surrogate of direct gas pricing reform, given the amount of natural gas utilized in these sectors. This chapter addresses the research gap concerning the interrelationship between energy pricing reform in the region related to climate change, alternative energy development, and energy demand reduction policies. This chapter will also review the policy decisions these countries implemented, such as energy efficiency measures, fuel switchovers from more carbon-intensive oil to natural gas, and alternative energy deployment.

In terms of this chapter's outline, Section 6.2 reviews the historical industrialization of the Gulf region, with the focus on the utilization of natural gas as the primary fuel for development. Section 6.3 assesses how administrative gas prices led to a variety of perverse economic outcomes throughout the region. Section 6.4 discusses the three selected Gulf countries' energy pricing reform efforts to reduce their domestic energy consumption. Section 6.5 articulates the various alternative energy deployment strategies in which the three selected countries have thus far engaged. And Section 6.6 concludes with an overview of the similarities and dissimilarities between the UAE, Saudi Arabia, and Qatar regarding their energy/power pricing reform initiatives and how they would impact their renewable energy investment moving forward.

[277] For instance, in July 2015, temperatures in Bandar-e Mahshahr, Iran, reached 163 degrees Fahrenheit. Jeremy Pal and Elfatih A. B. Eltahir, "Future Temperature in Southwest Asia Projected to Exceed a Threshold for Human Adaptability," *Nature Climate Change*, Vol. 6 (Feb. 2016).

6.2 Energy Sector-Based Industrialization in the Gulf Region

When the Gulf countries began to develop economically in the 1970s, Gulf policymakers viewed natural gas as perhaps the most effective means of creating a domestic industrial base.[278] Since the 1970s, in the wake of the "first oil price revolution" emanating from the OAPEC oil embargo, the Gulf countries poured numerous investment streams into mega-industrial projects to reduce their dependence on hydrocarbon exports and the inherent volatility of the global oil market.[279] Yet, since the beginning of the 2000s, several significant economic forces morphed the contours of the worldwide energy sector, consequently impacting Gulf economic growth. The "second oil price-revolution," a period of increased oil prices from the year 2000-2008, reflected a slow but steady increase in oil prices to the triple digits that enriched the economies of the Gulf countries.[280] For instance, during 2000-2008, the GCC economies collectively tripled in size to $1.1 trillion.[281]

However, the global financial crisis undercut what had seemed like an inevitable upward trend in Gulf economic growth. When alarm about the global financial crisis climaxed in December 2008, oil prices dropped precipitously to approximately $30 per barrel.[282] Combined with capital flight and constrained capital markets, the GCC countries were significantly affected by the economic turmoil, but relief was in sight as international oil prices[283] began to steadily increase until they reached over $100 per barrel from 2010-2014.[284]

---

[278] For a cogent discussion of the political economy of the Middle East, development, and energy resources, see, Julia Devlin, *Challenges of Economic Development in the Middle East and North Africa Region* (World Scientific, 2010) pp. 3-10.

[279] Ibid.

[280] The first oil price revolution was the several-fold price increase that occurred in the wake of the OPEC oil embargo of 1973.

[281] For a broad-based discussion on the so-called oil "super cycles" and the reasons for oil volatility, see, generally, Jeff Baffes, *et al*, *Understanding the Plunge in Oil Prices: Sources and Implications*, *Economic Prospects and Policy Challenges for the GCC Countries*, International Monetary Fund (Oct. 5, 2013)

[282] *Global Economic Prospects* (2015)

[283] There are various forms of oil sold on the international market, termed as "benchmark oils." The pricing differentials depend upon the production location and the relative quality. Therefore, when the term "global oil prices" is utilized, typically, it comprises, Brent, West Texas Intermediate and Dubai/Oman, although other crudes can also form a benchmark crude.

[284] Much of this surge in international oil prices that occurred during 2014 was driven by the political crisis in Iraq during the summer of that year, as well as various geopolitical issues relating to the Arab Spring and Islamic State expansion.

Despite the economic setbacks of the global financial crisis, the second oil price revolution heralded a period of unparalleled industrial expansion in the Gulf region. The Gulf countries initiated enormous value-added (petrochemicals, fertilizers), energy-intensive (cement manufacturing, aluminum smelting), and power expansion projects in the region. Additionally, during the same period of 2000-2008, the regional population increased from 28 million to 39 million.[285] The majority of the demographic bulge was composed of youth (under 25), which spurred the Gulf countries to focus on job creation as a tool to alleviate potential socio-economic discontent, especially so since the formation of the Arab Spring protests.[286] This rapid population growth also caused the Gulf governments to focus on infrastructure development and housing construction, which led directly to a rise in energy/power consumption across all sectors (see Figure 6.1).

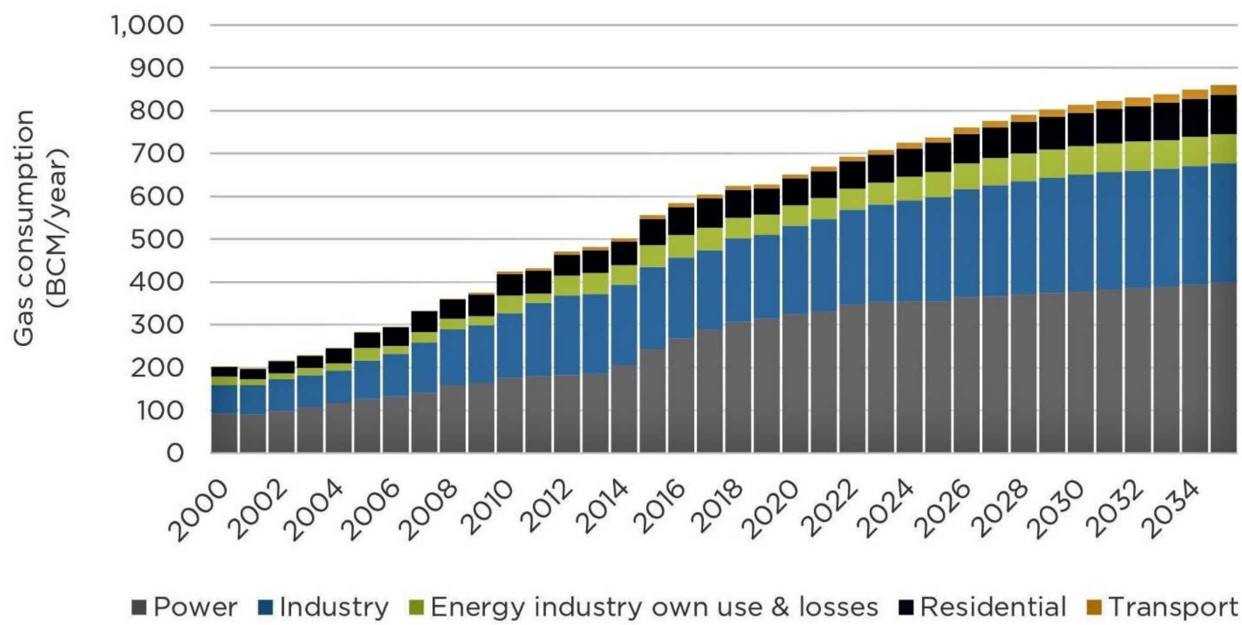


Figure 6.1 Middle East Project Regional Gas Demand by Sector Source: Robin Mills, Under a Cloud: The Future of Middle East Gas Demand, Columbia (April 2020)

Figure 6.1 also illustrates how gas consumption in the region overall has evolved. As can be seen, the industrial sector became a critical driver of gas demand, taking up more significant

[285] Population growth in the Gulf is at approximately 2.5 % per year. At these rates, the population in the Gulf is expected to double within 30 years. See, generally, *The GCC in 2020: The Gulf and Its People*, Economist Intelligence Unit (Sept. 2009).

[286] Harald Finger and Daniela Gressani, *Toward New Horizons: Arab Economic Transformation amid Political Transition*, International Monetary Fund (2014) pp1-5; 61-79

proportions of gas demand over the years. And, if the demand rates continue a business-as-usual trend, then industrial gas usage will expand even as power demand in on a trend to plateau+ over the next decade.

The gas molecule has been at the center of most Gulf countries' industrial expansion and economic diversification plans. This development model did not pose any risks for the Gulf countries until the expansionary pressure became too great by the mid-to-late 2000s, and the region's associated natural gas could not match the demand growth.[287] For Saudi Arabia, Qatar and the UAE, as well as the other Gulf countries, their energy balances have been composed of oil and gas, and virtually nothing else, until recently. By 2007, the widening supply-demand imbalance fissures became starkly apparent when blackouts and allocation disruptions metastasized throughout the region.[288]

Gulf countries also faced growing economic pressures due to the massive expansion of government expenditures in the wake of the Arab Spring.[289] The significant increase in governmental spending programs increased what is known as the "breakeven oil price," or the price of a barrel of oil required for an oil-producing country to remain fiscally solvent.[290] For example, on the eve of the American invasion of Iraq in 2003, the breakeven price for a barrel of oil in much of the region was approximately $30 (nominal prices without taking account of inflation).[291] Nearly a decade later, the regional breakeven oil price increased to $90-100 per barrel.[292] Nonetheless, in 2017, the average breakeven oil price for governmental solvency in the Gulf declined for the first time since 2003 to nearly $80 per barrel in 2018 in the wake of improved governmental budgets and subsidy reforms.[293] As

---

[287] For a background of the history of Gulf gas demand, see, Amy Myers Jaffe, *et* al, *The Geopolitics of Natural Gas: The Gulf Cooperation Council Natural Gas Conundrum: Geopolitics Drive Shortages Amid Plenty*, Harvard Belfer Center (Oct. 2013).

[288] Ibid.

[289] The combined social spending by Gulf countries to stave of social discontent reached approximately $150 billion in only the first year of the protests. Vicky Kapur, *Arab Spring Cost GCC $150bn*, Emirates 24/7 (Sept. 6, 2011).

[290] There are two kinds of breakeven price frameworks in energy related literature. One refers to the price that a barrel of oil needs to garner on the market for a production project to remain fiscally viable. The other, and the definition used in this text, is the price a government needs to obtain for a barrel of oil to maintain its budgetary outlays.

[291] *Middle East and North Africa Economic Developments and Prospects, October 2012: Looking Ahead After a Year in Transition*, World Bank (World Bank Publications, 2012). p. 21

[292] The variability is because different methodologies are utilized by different organizations. However, within the region, there is significant variability, at the low and high end of the spectrum. Prior to the pandemic, in 2018/2019, Saudi Arabia's breakeven oil price was approximately $78, while the UAE's breakeven prices was $90. Qatar's breakeven oil price defied its neighbors' trends and rose from $24.20 in 2008 to $47.10 in 2018. See, *Regional Economic Outlook Middle East and Central Asia*, International Monetary Fund (May 2018).

[293] Prior to the pandemic, in 2018/2019, Saudi Arabia's breakeven oil price was approximately $78, while the UAE's breakeven prices was $90. Qatar's breakeven oil price defied its neighbors' trends and rose from $24.20 in 2008 to

prices fell to around $30/bbl in 2020, this created significant problems for the oil and gas producing countries. Even though the price rebounded to more than $70/bbl in 2021, the global oil markets' overall volatility and cyclical nature causes the regional governments to face alternating periods of feast and famine.

A bifurcated development strategy is thereby emerging within many Gulf countries, especially Saudi Arabia. As the Gulf countries attempt to rely upon their comparative advantage and expand their industrial base (i.e., diversification) so as not to depend solely upon oil exports, their industries "need" access to low-priced (or at the very least, consistent) natural gas and oil to maintain the international competitiveness of their products. Yet, simultaneously, as their economies expand and governmental expenditures increase through infrastructure development and subsidization of various economic sectors, there is a greater incentive to develop the downstream oil sector and defend higher oil prices to capture the lost opportunity cost.

The region's primary challenge is that their gas pricing policies actively discourage the development of their non-associated gas reserves, which have a production cost several-fold higher than their associated gas production.[294] The crux of the problem for the Gulf countries is that their gas deficits are not related to the scarcity of natural gas; instead, it is the failure to create effective policies that would promote upstream exploration-

production and demand reduction. [295]

Additionally, the petrochemical sector, which is the basis of Gulf economic diversification, is also threatened by the lack of comprehensive energy price reform as the gas shortages impact allocation to these national industries as the Gulf countries attempt to transition away from hydrocarbon dependence and develop a diversified and sustainable modern economy. But, as the next section will discuss, the low-cost pricing structure of natural gas hinders their ability to realize these strategic goals.

$47.10 in 2018. See, *Regional Economic Outlook Middle East and Central Asia*, International Monetary Fund (May 2018).

[294] For an excellent assessment of MENA energy pricing policies, see, generally, (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES Press: 2019).

[295] Ibid.

6.3 The Development of Gulf Energy Pricing

Rapidly increasing natural gas demand in the Gulf region has been driven mainly by administrative pricing. These prices tend to be much lower than the various international prices of natural gas. The average regional natural gas price hovers around $1.50 per MMBTU in the Gulf.[296] While contrary to what is often read in the international press, these administrative natural gas prices are not, strictly speaking, "subsidies,"[297] as is often alleged.[298]

At the same time, uncovering a commonly agreed-upon definition of subsidies has proven to be inordinately difficult, as most countries and multilateral organizations have developed their own definitions. Similarly, this distinction is illuminated most clearly when utilizing the most common definitions of "subsidy," such as "measures that, for consumers, keep prices below market levels or, for producers, above market levels, or reduce costs for consumers and producers."[299] The World Trade Organization's Agreement on Subsidies and Countervailing Measures (ACMS) defines subsidies that all WTO members have accepted.[300]

> Article 1 of the Agreement states that a "subsidy" exists when there is a "financial contribution" by a government or public body that confers a "benefit." A "financial contribution" arises where: (i) a government practice involves a direct transfer of funds (e.g., grants, loans, and equity infusion), potential direct transfers of funds or liabilities (e.g., loan guarantees); (ii) government revenue that is otherwise due is foregone or not collected (e.g., fiscal incentives such as tax credits); (iii) a government provides goods or services other than general infrastructure, or purchases goods; or (iv) a government entrusts or directs a private body to carry out one or more of the above functions. A "benefit" is conferred when the "financial contribution" is provided to the recipient on terms that are more favorable than those that the recipient could have obtained from the market.[301]

In contrast, the International Energy Agency (IEA) utilizes the "price-gap" approach, comparing domestic energy prices against the international market prices. This approach

---

[296] See, generally, (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES Press: 2019).

[297] However, there are a wide range of actual subsidies in other segments of the energy and power sector. There are subsidies in the power sector, or both consumption and generation, as well as subsides for gasoline.

[298] See, Nick Williamson and Mhari Main Garcia, *Gas Shortages in the Middle East: An Unlikely Paradox*, An International Comparative Legal Guide to Gas Regulation (2011).

[299] Phillip O'Keefe, et al, *The Future of Energy Use* (Earthscan, 2010) p.268

[300] *Agreement on Subsidies and Countervailing Measures*, World Trade Organization Website: Available at http://www.wto.org/english/docs_e/legal_e/24-scm.pdf

[301] Ibid.

tends only to consider consumer subsidies. The price-gap method tends to be attractive due to the overall complexity of the myriad of various energy policy interventions; however, it can be criticized because it neglects to assess many different forms of subsidies.[302] The price-gap limitations center upon two primary factors, the challenges in accurately estimating the data inputs required to calculate the price-gap, as well as the types of policy interventions that this analytic tool cannot capture.[303] In terms of the data inputs, it is challenging to track patterns across various countries and fuels. And there are difficulties in establishing pricing benchmarks with commodities that are not traded easily, such as natural gas, which has regional pricing variations. [304]

Price-gap assessment utilizes long-run marginal cost (LRMC) estimates as a stand-in that incorporates the notion that the alternative supply would arrive by new construction instead of imports.[305] But, applying the new capacity cost in advance is difficult for extensive and complicated capital projects as the volatility in the commodity markets and credit market dysfunction make determining accurate prices somewhat challenging. Furthermore, even global price benchmarks for commodities may be distorted. They may contain some level of embedded subsidies, and back calculating the extent of the subsidies may be nearly impossible in many jurisdictions.

Lastly, another limitation of the IEA's price-gap approach is that it does not explain how governments may ultimately compensate producers for providing the product for sale at a lower price. The IEA merely calculates the price difference and labels it as a subsidy, even though the difference could have been through a direct budgetary transfer (a subsidy) or from a tax concession (which is not often considered a subsidy). In any case, the IEA's price-gap method does not report this. Still, the gas markets in the three selected countries have undergone some modest reform, and the forward momentum has slightly stalled. As a result, the regional gas markets are not near to being even modestly liberalized by the beginning of the 2020s.

---

[302] For a detailed assessment of the IEA price-gap approach, see, Doug Koplow, *Measuring Energy Subsidies Using the Price Gap Approach: What Does it Leave Out?*, International Institute of Sustainable Development (Aug. 2009).
[303] Ibid. P.5.
[304] Ibid.
[305] The long run marginal cost (LRMC) is the change in long run total cost of production of a certain good or service resulting from the change in the quantity produced. This is often utilized in price-gap calculations whereby alternative supply sources cannot be imported.

When these commonly utilized definitions are compared against the negligible marginal production cost of each additional unit of associated natural gas in the region, and that Gulf gas is not set below the cost of production or domestic "market" levels terming the gas sector in the three selected countries as being subsidized may be inaccurate. This is the case because the gas market is not liberalized in the region, so there is no effective "market" price as the price is not a function of supply and demand. Furthermore, there is effectively no unified global price for natural gas (the market is still segmented regionally). Therefore, it is difficult to judge the domestic prices against a worldwide gas price (which does not yet exist). Yet, as illustrated through Chapters Three-Five, the Gulf States' domestic natural gas pricing policies are causing gas allocation disruptions and exacerbating budgetary pressures as they attempt to keep their industrialization and diversification strategies on schedule by providing low-priced natural gas feedstock to their national industries.[306]

In the past, and as it is currently, when most of the natural gas produced was associated natural gas, i.e., low production cost and easily accessible, having such a low-cost framework was economically feasible.[307] But, as natural gas and power consumption substantially increased, along with rising upstream production costs in non-associated and unconventional natural gas fields (ultra-sour, tight, shale), the current natural gas pricing framework (the average price in the Gulf is at $1.50 per MMBTU) has remained affordable in Saudi Arabia and the UAE as long as the government underwrites the gap between production cost and delivery cost.[308] But being affordable does not necessarily mean that it is *sustainable* when considering the regional governments' ever-expanding budgetary commitments and rising production costs. Furthermore, the cost of producing from non-

[306] This occurs as all the Gulf countries, with the notable exception of Qatar, are experiencing gas shortages as demand has consistently outpaced production since approximately 2008. As a result, there have been blackouts in the power generation sector in many countries, and many of their energy intensive industries and petrochemical companies are unable to acquire the gas they need to maintain operations. Ibid. See, Adal Mirza, *Energy Markets Underestimate Middle East Supply Vulnerability*, Atlantic Council (Jan. 12, 2020).

[307] Economically feasible meaning that there was an abundance of gas, and it would be freely allocated to the cost of production to the various nascent industries that had not yet experienced rapid growth. Therefore, the domestic gas demand was manageable. For a comprehensive discussion of the history of Gulf industrial development, and the role of natural gas, see, generally, Jean-Francois Seznec, Mimi Kirk, *Industrialization in the Gulf: A Socioeconomic Revolution* (Routledge, 2010).

[308] Unsustainable chiefly because the low gas price is not enough to stimulate production of unconventional gas fields that have a much higher production cost, and because the low price encourages overuse of the resource, leaving crippling gas deficits in the wake. In Qatar, the cost of gas production is roughly equal to the long run marginal cost, and therefore does not imply a subsidy by the definitions utilized above. See, (ed) Carlo Altomonte, Massimiliano Ferrara, *The Economic and Political Aftermath of the Arab Spring: Perspectives from Middle East and North African Countries* (Edward Elgar Publishing, 2014). Pp. 200-201

associated complex gas reservoirs is several-fold higher (approximately between $4-7 per MMBTU) than the production cost of conventional associated natural gas.[309]

Consequently, if the same administrative gas pricing framework for associated natural gas is utilized for non-associated and unconventional natural gas (or LNG imports), then it would allocate natural gas at below the new cost of production (or import), which would then, by most commonly used definitions, result in a subsidy. However, the extremely low-cost pricing framework, rapid population growth, and the expansion of the downstream gas industries caused regional gas demand to increase by an average of approximately six to 8% per annum from the beginning of this century (see Figure 6.2).[310] As a result of this demand pressure, the investment logic that caused foreign energy-intensive industries to relocate to the region has concomitantly evolved. And this is already occurring as many downstream and energy-intensive companies migrated to the U.S. to take advantage of low-cost shale gas inputs.[311] In order to compete with U.S.-based petrochemical production, many Gulf countries are starting to consider utilizing U.S. Henry Hub pricing as a benchmark so that their downstream gas industries may more effectively compete with their U.S. rivals on cost.[312]

Using the IEA definition, subsidies declined substantially in 2019/20 because of the sharp drop in regional spot prices, which in early 2020 hovered around $1.5-2/MMBTU. But they have increased significantly in 2021, to approximately $10/MMBTU; the price of internationally traded LNG, which is the incremental source of domestic supply for the UAE, is considerably higher than the Emirati domestic gas price. Therefore, considering all factors, the IEA's definition tends to be problematic when applied in a period of extreme price volatility. For all of its problems, the LMRC and delivery cost versus domestic price are better definitions.

Nonetheless, the significant challenges are not just limited to the natural gas sector; regional oil demand is also high. This is due to two interrelated factors. Firstly, as natural gas shortfalls cascaded through the regional economies, Gulf countries, such as Saudi Arabia,

[309] Ibid; see, (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES Press: 2019). p.5
[310] Abdullah Al Badi and Imtenan Al Mubarak, "Growing Energy Demand in the GCC Countries," *Arab Journal of Basic and Applied Sciences*, Vol. 26, 2019 Issue 1.
[311] *Shale Gas, Competitiveness, and New U.S. Chemical Industry Investment: An Analysis Based on Announced Projects*, American Chemical Council (May 2013); Ed Crooks, *US Shale Gas Sparks a Chemical Revolution*, Financial Times (Dec. 17, 2012)
[312] (ed) Jonathan Stern *The Future of Gas in the Gulf: Continuity and Change* (OIES Press: 2019) p. 227

the northern Emirates, and Kuwait, utilized more fuel oil for power generation.[313] When hydrocarbons are consumed domestically at below-market prices instead of exported at international market rates, a significant opportunity cost results and, therefore, less foreign revenue inflows for the government.[314] In Saudi Arabia, for example, oil demand is partly due to the expansive petrochemical sector.[315] However, the principal source of demand is from the Kingdom's large power generation sector, which is supported by low-priced heavy fuel oil and crude.[316] The average transfer price of heavy fuel oil from Saudi Aramco to the power utilities is $2.20/barrels for heavy fuel oil and $4.24/barrels for crude oil.[317] This low oil price encourages exceptionally high consumption rates, and consequently, does not stimulate power utilities to make capital investments in energy-efficient equipment.[318] Yet, since 2018, Saudi Arabia's oil consumption has been declining, despite increasing population and electricity consumption, while natural gas consumption has been plateauing from the late 2010s due in a large part to the pricing reconfiguration during the mid 2010s (See Figure 5.3).[319]

---

[313] Abdullah Al Badi and Imtenan AlMubarak, "Energy Demand in the GCC Countries," *Arab Journal of Basic and Applied Sciences*, Vol. 26, 2019 Issue 1.; Mohamed Darwish and Rabi Mohtar, *Prime Energy Challenges for Operating Power Plants in the GCC*, Energy and Power Engineering, 2013, 5, 109-128

[314] In well-functioning markets, cost equals opportunity cost. However, in imperfectly functioning markets, opportunity cost equals the best available alternative. For a concise discussion on the nature of opportunity costs as it relates to various markets, See, Paul A. Samuelson, *Economics* (Tata McGraw-Hill Education, 2010) pp.176-178

[315] Ibid.

[316] Saudi Arabia has been attempting to compensate for this decline in oil exports by privileging the export of more expensive oil grades. However, this is merely a short-term response to a deep-seated structural problem. Power demand has been growing at a rate of 8 % over the past several years and seems set to continue growth at this rate until its renewable energy projects come online.

[317] Murad Anwer and Walid Matar, *Reforming Industrial Fuel and Residential Electricity Prices in Saudi Arabia*, Kapsarc (July 2017). p. 9

[318] Ibid.

[319] *Saudi Arabia Used Less Crude Oil for Power Generation in 2018*, U.S. Energy Information Administration (June 3. 2019).

6.4 Energy and Power Pricing Reform in Saudi Arabia, the UAE, and Qatar

6.4.1 The Gulf Social Contract

Reform of domestic energy pricing is a regional trend that nearly all MENA countries have undertaken to some extent. However, the data on pricing in the three selected countries, the entire region, tends to be poor or non-existent. Most of the gas prices are not available in the public domain. Policymakers throughout the region realized that energy pricing reform is required to balance their hydrocarbon consumption/supply dynamic. Before the price collapse of 2014, oil-exporting countries were earning significant profits from exportation to the global market. Still, at the same time, they were beginning to suffer from the opportunity cost of low domestic energy prices. When the oil price collapsed in 2014, the Gulf countries, on average, witnessed a total revenue decline by nearly 10 % of their GDP in one year.[320]

The Gulf countries had to increase their domestic energy prices to balance their governmental budgets, which greatly reordered their rent distribution framework by allocating fuel, gas, water, and electricity at below-market prices. [321] The global oil price decline of 2014 gave a sense of urgency for energy price reforms; every MENA energy-rich country had begun to experience natural gas allocation shortfalls. To understand the advent of energy price reform in the MENA region, the broader issue of the Arab Social Contract must be placed as the centerpiece. The Gulf countries have a political system predicated upon the state-led distribution of welfare in energy, water, and food subsidies and a vast public sector to absorb university graduates.[322] As part of this social contract, the ruling families have a relatively unrestricted political autonomy in exchange. [323] The production and exportation of natural resources were what financed this framework.[324] The Gulf countries have adhered to the fundamental tenet of rentier state theory, which holds that the

[320] Tom Moerenhout, *Energy Pricing Reforms in the Gulf: A Trend, Not (Yet) a Norm*, Global Subsidies Initiative (Jan. 2018). p.2.
[321] Ibid.
[322] Ibid.
[323] Ibid.
[324] See, generally, Hedi Larbi, *Rewriting the Arab Social Contract*, Belfer Center (May 2016).

citizenry accepts state authority and responsibility for security issues while distributing rent (hydrocarbon income).[325]

It must be noted, however, that this Gulf social contract only applies to "citizens." However, unlike many countries in the world, obtaining citizenship was nearly impossible for the massive numbers of expatriate workers, even though they comprise about 33% prevent of the Saudi population, nearly 85% in the UAE or the approximately 95% of the Qatari workforce.[326] In the Gulf region overall, expatriate workers are thought to reach nearly 70% of the total regional population. The colossal influx of foreign workers occurred with the advent of the OAPEC oil embargo of 1973, in which the Gulf states-flush with foreign revenue- relied upon foreign workers to industrialize their countries.

Gulf citizenship was particularly difficult to acquire due to several overlapping factors. The Gulf states, being recently constructed, were understandably concerned about "culture dilution," in that with the large numbers of workers the local population could be easily displaced. Additionally, as they have generous and extensive welfare frameworks, enfolding large numbers of individuals into that framework would place burdens on the countries finances, and, lastly, there is a security standpoint to these issues in that the Gulf states also fear that bestowing citizenship on large numbers of people with other confessional backgrounds would upset the delicate sectarian balance in many of their countries and could potentially lead to sectarian bloodshed or upheaval as regularly occurs in other MENA countries.[327] High on the list of concerns of Gulf policymakers is that the flow of foreign workers represents a form of colonization and would lead the locals to go the way of most of

[325] Zaid Belbagi, *Renegotiating the Social Contract in the GCC: Lessons from the Rousseau Playbook*, The Oxford Gulf and Arabian Studies Forum (no date). p.4.

[326] Ksenia Svetlova, *The Great Gulf Citizenship Competition*, The Media Line (Nov. 18, 2021).

[327] Mindful of the potential socio-political discord that could result, the Emirati leadership surreptitiously hired Erik Prince, the founder of the somewhat notorious Blackwater private military companies, to construct a nearly $500 million desert base in Abu Dhabi in 2011 with the goal of quelling internal conflict if an Arab Spring type situation arose or if foreign workers rebelled. An interesting point is that most of the mercenaries were veterans of bloody conflicts in South America, Africa and other far-flung places. In general, Muslim special operators were not preferred as the guiding notion was that South American mercenaries would be more likely to follow mission specifics without having to take religious identity in account if it were necessary to conduct largescale pacification campaigns of Muslim workers. Mark Mazzettii and Emily Hager, *Secret Desert Base Set Up by Blackwater's Founder*, The New York Times (May 14, 2011).

the nearly extinguished indigenous populations in the countries of settlers, such as New Zealand, Australia, the United States and Canada.[328]

Even though many of the expatriate workers had lived in the Gulf countries for decades, built there homes there and raised families, they could not get citizenship. The Gulf states have a highly specific form of a labor regime which is based on rigid market segmentation between foreigners and nationals. But despite the fact that the Gulf countries have been engaging-with varying degrees of success in labor indigenization-the need to participate and compete in the global market is obligating them to modify their existing social constructs. Many of the countries, such as Saudi Arabia and the UAE are tentatively experimenting with granting citizenship to select groups of talented individuals.[329] The Gulf states have also been under external pressure from global human rights organizations and the home governments of many of the expatriate workers for alleged human rights violations against their workers. These international recriminations have caused the Gulf states to seek to publicly remedy some of the most prevalent excesses associated with their foreign labor supply that is not accorded the same legal and social rights as the local citizenry.[330]

While it appears exceedingly unlikely that within the 2020s we will witness a wholesale radical restructuring of the social contract and extension of the franchise, it is undeniable that as many Western countries are attempting to restrict immigration, the Gulf countries will move in the other direction in tandem with their reimagining of their welfare and subsidization regimes.

Social contract theory is nearly as old as the study of philosophy itself, yet it fully developed with Thomas Hobbes in his second law of nature.[331] At its essence, Hobbes explained that the bedrock of the social contract is where citizens surrender their individual liberties in exchange for some form of common security, whether it is physical or otherwise. And, the

---

[328] Justin Dargin, *Desert Dreams: The Quest for Arab Integration from the Arab Revolt to the Gulf Cooperation Council* (Republic of Letters, 2012). p.221

[329] Ksenia Svetlova, *The Great Gulf Citizenship Competition*, The Media Line (Nov. 18, 2021).

[330] Noha Aboueldahab, *Social Protection, Not Just Legal Protection: Migrant Workers in the Gulf,* Brookings Institution (August 23, 2021).

[331] After Hobbes, both John Locke and Jean-Jacques Rousseau developed this theory even further with additional elements.

contract, according to Hobbes, is the "mutual transferring of rights."[332] The social contract is central to most rentier states, the Gulf states being no exception. In countries with robust democracies, the social contract encompasses the unspoken "bargain" between the representatives of labor, the state, and capital.[333] Yet, in Middle Eastern rentier states, the social contract incorporates the position of state institutions instead of the more formalized citizen input in more democratic countries.[334]

While, as discussed below, the UAE, Qatar, and Saudi Arabia are engaging in energy pricing reform, substantial barriers remain. The underlying concern amongst Gulf policymakers and reiterated by Gulf scholars is how the public may react to any modifications of the social contract, energy pricing being a key component.[335] As Krane notes, historically, stark revisions in commodity prices have been the cause for social unrest, riots, and uprisings in various countries.[336] Therefore, in their energy price revisions, the three selected Gulf countries have been moving somewhat carefully, if not methodically. It should be noted that the gas prices given are in nominal terms, whereas due to inflation, in real terms, the gas price has been declining. This could have the impact of nullifying the energy pricing and energy-efficiency gains experienced since the mid to late 2010s.

Overall, except for Qatar and the UAE, the Gulf countries experienced increasing poverty rates and domestic energy demand when global oil prices declined in 2014. The Gulf countries could only manage the aforementioned by expanding budgetary outflows due to high revenues from previous years. Saudi Arabia, Oman, and Bahrain began to run fiscal deficits and were obligated to reform their respective domestic energy prices. And even other countries that had smaller populations and large hydrocarbon reserves were also running deficits by 2016.[337] Between the three selected countries of this study, Saudi Arabia, Qatar, and the UAE, the pace of energy pricing reforms reflect the relative importance that each

---

[332] Thomas Hobbes, *Leviathan* (Penguin Books Limited: 2017) p. 38

[333] Jim Krane, *The Political Economy of Subsidy Reform in the Persian Gulf Monarchies*, Baker Institute for Public Policy (Aug. 8, 2016). p. 5.

[334] Ibid.

[335] Jill Crystal, *Oil and Politics in the Gulf: Rulers and Merchants in Kuwait and Qatar* (Cambridge: Cambridge University Press; 1990); Gregory F. Gause III, "The Political Economy of National Security in the GCC States." In Gary Sick and Lawrence Potter, eds. *The Persian Gulf at the Millennium* (New York: St. Martin's 1997); Christopher Davidson, The *United Arab Emirates: A Study in Survival* (Boulder 2005): Christopher Davidson, *After the Sheikhs: The Coming Collapse of the Gulf Monarchies* (London: Hurst, 2012)

[336] *The Political Economy of Subsidy Reform in the Persian Gulf Monarchies.* p. 6

[337] Ibid.

respective government places on the requirement to transition from an allocative state to a productive state that would be able to create a more significant role for its private sector in the broader macroeconomy.

Despite the evident necessity of increasing domestic energy prices, the road to pricing reform is still fraught with hazards. Additionally, gas pricing reform, for the most part, lagged after initial progress in the mid-2010s; reform of power sector prices can be used as a substitute of direct gas pricing reformation to a large degree due to the large amount of natural gas consumed in regional power generation (see Figure 6.1).

The following sections will discuss each of the three selected countries' efforts to reform its domestic energy pricing framework and the challenges they have yet to overcome.

6.4.2 Saudi Arabia and Energy Price Reform

The Saudi government launched its first phase of energy price reform in late 2015, targeted to increase the price of natural gas, diesel, power, water, and gasoline. Even though the price increases were relatively modest by international standards and still hovered well below international levels, it illustrated that a significant policy shift was occurring. The government was willing to make difficult decisions to overcome its fiscal deficit and progress its macroeconomic transformation. The Saudi government has several reasons for its domestic energy pricing framework, such as wealth transfer to low-income citizens, fostering the competitive advantage of its energy-intensive industries, and attracting foreign investment. These were, of course, in addition to the foundation of the Arab social contract, which allowed the elite to maintain political power without popular representation and enfranchisement.

Yet, in the wake of the oil price collapse in 2014, the Saudi government was expending significant sums on its welfare framework. As a result, the government needed to reduce its budget deficits and funnel investment to various sectors to expedite diversification. Therefore, the difficult decision to undertake price reformation began in the highest levels of government.

The first phase of the price reform met with relatively slight resistance as the Saudi domestic prices were still extremely low when compared to most other countries (See Table 6.1).

Table 6.1: Saudi Arabia Price Reform

Product	Unit	2015	2016	Increase	2018	Increase
Natural Gas	($/MMBTU)	0.75	1.25	67%	Unchanged	0
Ethane	($/MMBTU)	0.75	1.75	133%	Unchanged	0%
Gasoline - Low Grade	($/litre)	0.12	0.2	67%	0.365	83%
Gasoline - High Grade	($/litre)	0.16	0.24	50%	0.544	127%
Diesel Transport	($/litre)	0.07	0.12	79%	Unchanged	0%
Diesel Industry	($/barrel)	9.11	14.1	55%	16.15	15%
Arab Light Crude	($/barrel)	4.24	6.35	50%	Unchanged	0%
Arab Heavy Crude	($/barrel)	2.67	4.4	65%	Unchanged	0%
Kerosene	($/barrel)	23.00	25.7	12%	Unchanged	0%

Source: APICORP Research

As the Saudi populace generally accepted the first phase of price reform, the government did not feel the need to publicize the reforms nor to introduce compensatory programs.[338] While the Saudi government deemed the first phase as attaining its goal, it decided to implement more incremental increases and delayed its initial plan to reach international prices by 2020 by five years, until 2025. On January 1, 2018, the Saudi government decided to continue with the second phase of pricing reform that increased power tariffs for residential and commercial consumers and gasoline prices in January 2018 (See Table 6.2) to a predetermined reference price.[339] This could be considered a part of gas pricing reform, as a large share of power generation comprises natural gas; therefore, the increase in governmental revenues from power pricing reformation could help bridge the natural gas allocation cost/price gap.

Table 6.2: Saudi Power Tariffs Reform

Sector	End-2015	Start-2018	% Change
Residential: 1-6,000 kWh/month	0.05	0.18	260
Residential - above 6,000 kWh/month	0.30	0.30	0
Industry	0.18	0.18	0
Government	0.32	0.32	0

Source: MEES

Phase Two of the energy price reform incorporated a cash transfer program of approximately $6.7 billion under a Citizen's Account scheme to low and middle-income families for predefined income brackets.[340] As the IMF argues, a compensation scheme is perhaps one of the most essential pillars of any significant energy price reform policy as it is needed to

[338] *Saudi Energy Price Reforms Getting Serious*, APICORP Energy Research, Vol. 3, No. 65 (February 2016). p.1
[339] *Saudi Arabia Extends Deadline for Energy Price Reform*, Gulf Base (Dec. 21, 2017).
[340] Ibid. *Saudi Energy Price Reforms Getting Serious.* p.2

manage any potential adverse impact upon the more impoverished demographics of a country.[341] Cash transfers also tend to encourage public acceptance of reform measures. With the program's initial inception on December 21, 2017, more than 3.7 million households applied, representing over half of the number of Saudi households of 5.46 million.[342] Saudi policymakers chose a gradual phase-in of the energy pricing reform to allow the economy to acclimate to the increased prices and enable the country to diversify away from oil so that the private sector would have a more significant role in the macroeconomy.

Overall, the Saudi government successfully implemented the initial two phases of energy price reform (the first phase implementing gas price reconfiguration); nonetheless, there are still some challenges ahead. Firstly, higher energy and power prices tend to apply upward pricing pressure on other products and services that require power and fuel for transportation. As a corollary, higher power and energy prices influence wage expectations as citizens begin demanding higher future wages. Secondly, the Saudi government did experience some data complications for the identification of eligible recipients. Thirdly, to progress successfully, the government must ensure that its government databases are robust and coherent. And, lastly, the government did not increase natural gas and diesel prices for the industrial sector during the second phase. In 2017, when the Saudi economy contracted due to output cuts, the government extended the timetable for full implementation of the subsidy reform program until 2025.[343] Likely, the Covid-19 pandemic that began in early 2020 will further stall subsidy reform that has not gained traction for natural gas reform since 2016.

Overall, natural gas pricing reform largely ran out of steam after 2016. This slowdown may illustrate the still mighty vested power of the influential energy-intensive and downstream gas industries.[344] It appears that the Saudi government slowed the reform timeline and other parts of their austerity program because of concerns about the potential impact on private sector growth, bolstering economic competitiveness and the politics of the social contract.[345]

---

[341] *Saudi Arabia: Selected Issues*, International Monetary Fund (2015) p. 62.

[342] *Population and Vital Statistics, Housing Survey*, General Authority for Statistics: Kingdom of Saudi Arabia website. Available at https://www.stats.gov.sa/en/indicators/228

[343] For an extensive analysis of Saudi Arabia's subsidy reform, see, Redouane Sarrakh, *et al, Impact of Subsidy Reform on the Kingdom of Saudi Arabia's Economy and Carbon Emissions*, Energy Strategy Reviews, Vol. 28 (Mar. 2020)

[344] For a detailed analysis of the domestic challenges that Saudi Arabia faces in implementing comprehensive energy pricing reform, see, Redouane Sarrakh, *et al*, "Impact of Subsidy Reform on the Kingdom of Saudi Arabia's Economy and Carbon Emissions," *Energy Strategy Reviews*, Volume 28, 2020,

[345] As illustrated elsewhere in the text, there is always a fair amount of disquiet on policymakers minds about

Unless the government is willing to restart and accelerate energy sector reform, full liberalization of the Saudi natural gas market seems likely to be a very long-term prospect.

Be that as it may, in the fiscal plan announced in December of 2017, residential, commercial, and industrial power consumption would be linked entirely to international benchmark prices by 2025.[346]

In order to bolster its pricing reform policies, the Saudi government has incorporated a comprehensive energy efficiency strategy through the Saudi Energy Efficiency Program (SEEP) established in 2012.[347] Through the efforts of SEEP, the Saudi government hopes to manage the impact of inflationary pressures on the competitiveness of its energy-intensive and downstream gas industries. Despite Saudi goals of stimulating the growth of the non-oil sector, downstream and energy-intensive industries, such as petrochemicals and aluminum smelting, will likely remain significant drivers of future economic growth.

The conventional perception held that the Arab Social Contract was too rigid to allow such pricing modifications before the Saudi pricing reforms. Still, the public's somewhat pacific response to the pricing reforms illustrates that while the historical articulation of the Saudi social contract will likely never completely disappear, it is instead being remolded to reflect a new reality.[348]

6.4.3 Emirati Energy Price Reform

The UAE, much as its neighbors, considered its prevalent energy pricing framework as being nearly inviolable. This is because, as discussed above, low energy and power prices were an essential pillar of the general Arab Social Contract. Still, as stated above, Gulf governments began to tinker with energy prices in some form in the early 2010s; as of 2018, all Gulf

potentially upsetting the delicate socio-political balance by too rapid reform. Many other countries in the Middle East and beyond that abruptly modified their energy pricing regimes embedded in the social contract experienced severe unrest. Adel Hamaizia and Tom Moerenhout, *Five Takeaways from a Decade of Energy Subsidy Reform in MENA*, Chatham House (Feb. 16, 2022).

[346] However, the Saudi government did not indicate to which international benchmark they form the link. To date, while prices have increased, we have not seen any firm progress in terms of an international linkage. *Saudi Electricity CEO Says Power Consumption Growth to Slow*, Reuters (March 21, 2018).

[347] See, generally, *Growth Through Diversification and Energy Efficiency: Energy Productivity in Saudi Arabia*, KAPSARC (Nov. 2017).

[348]

countries had implemented energy pricing reform in one way or another. Amongst its Gulf peers, the UAE was the first Gulf country to institute electricity price reforms as Dubai began by implementing tariff reforms in 2008, with additional pricing reform in 2011. After that, in January of 2015, Abu Dhabi launched another round of reforms. Electricity prices in the northern emirates of Fujairah, Ras al-Khaimah, Umm Al Quwain, and Ajman were modified in 2015. However, the focus of their policy shift was upon expatriates. And, in Sharjah, the local government unveiled a new tariff framework for electricity by commercial and industrial concerns in 2014. More broadly, throughout the UAE, gasoline and diesel prices were liberalized to meet global pricing benchmarks which are set on a monthly basis.[349] As of yet, there has not been any substantive gas price reconfiguration in Dubai.

Dubai was one of the first emirates to take pricing reform seriously due to its energy import-dependent posture and austerity measures undertaken in the wake of the global financial crisis. However, in the 2000s, energy demand rose precipitously, and demand rapidly outpaced available supply. Consequently, Dubai imported pipeline gas (the Dolphin pipeline) and LNG to manage the shortfall. However, while the gas import bill was higher than domestically produced associated gas, the domestic gas tariffs did not rise in tandem; as a result, the Dubai leadership recognized that to tame the demand growth, they would have to reform energy and power prices.[350]

In 2008, Dubai Electricity and Water Authority (DEWA) introduced a slab framework of tariff increases based on electricity consumption in 2011, initially only applying to expatriates.[351] Additionally, a fuel surcharge was added to cover the additional cost of LNG importation. Subsidy reform was critical for Dubai and the other emirates due to their power companies' inability to absorb significant financial losses over the long term.

After that, the Dubai government unveiled an extensive public relations campaign to explain the reasons for energy and power price reform and encourage lower consumption.[352] DEWA designed this system to reward more efficient energy consumption with higher prices for higher levels of consumption. [353] In 2011, the Dubai government implemented a 15-20 %

[349] See, generally, Tom Moerenhout, *Energy Pricing Reforms in the Gulf: A Trend but Not (Yet) a Norm*, Global Subsidies Initiative (Jan. 2018).
[350] Ibid.
[351] Tom Boersma and Steve Griffiths, *Reforming Electricity, Water and Fuel Subsidies in the United Arab Emirates*, The Oxford Energy Forum Issue 108 (March 2017).
[352] Ibid.
[353] Ibid .

increase in the slab unit cost of power for residential expatriates, government, and industry. The Dubai government also implemented incremental electricity and water price increases for Emirati nationals.[354] Unlike Saudi Arabia, the Dubai government did not initially offer a compensation program to offset the rise in prices. However, many citizens complained and voiced their anger in the local media outlets. This led the Dubai government to rescind the power tariff increases for citizens in a lower income bracket.[355] Nonetheless, the Dubai government retained the tariff power tariff increases for most citizens. [356] As a result, by 2012, power demand declined by an average of 3%.[357]

Abu Dhabi began to consider energy and power tariff reform when Dubai implemented its changes; however, Abu Dhabi did not institute them until August 2015. [358] Abu Dhabi differed from Dubai to the degree that it did not face a large LNG import bill. It did not economically suffer to the same extent as Dubai did (such as Dubai's extensive property market during the global financial crisis). Nonetheless, Abu Dhabi faced an increased cost burden for its non-associated gas production as it typically has a higher hydrogen sulfide ratio. The authorities in Abu Dhabi felt that the time was opportune to increase tariffs as the costs were rising while the global oil price was falling. Furthermore, anecdotally, it seems that the youth were more amenable to accepting economic reform than previous generations, tying it to the overall growth in environmental sustainability awareness.[359]

In late 2014, the Abu Dhabi government announced that it would increase tariffs for expatriates, while nationals would only incur a minor increase in power rates and incremental increases for water consumption beginning in January 2015. As with Dubai, Abu Dhabi initiated a public relations campaign before the planned increases focused on sustainability and conservation to explain why price increases were required. In Sharjah and the northern emirates, electricity prices were also raised for expatriates and commercial and industrial users.[360]

---

[354] Ibid. Generally, Emirati nationals pay three to four times less than expatriates for electricity and water. This, in effect, had expatriates cross-subsidizing citizens.
[355] Jim Krane and Francisco Monaldi, *Oil Prices, Political Instability, and Energy Subsidy Reform in MENA Oil Exporters* (June 2017) p. 13
[356] Ibid.
[357] Ibid. p. 14.
[358] Ibid.
[359] Tim Boersma and Steve Griffiths, *Reforming Energy Subsidies-Initial Lessons from the United Arab Emirates*, The Brookings Institution (Jan 2016) p.11
[360] Ibid. *Oil Prices, Political Instability, and Energy Subsidy Reform in MENA Oil Exporters* (June 2017) p. 14

The Emirati government removed price controls on transportation fuels on the federal level, which allowed them to move in tandem with global benchmarks.[361] But, as of yet, there has been no movement on increasing domestic gas prices to either the total marginal costs or the cost of imports. Abu Dhabi has indicated that it had implemented gas price increases in January 2017, but it did not provide detailed information, and in any case, it is not publicly available.[362]

6.4.4 Qatar and its Energy Pricing Framework

Unlike Saudi Arabia and the UAE, Qatar had not experienced pressing financial difficulties nor natural gas allocation challenges due to its energy pricing framework. Therefore, it adopted much more of an ad hoc approach to energy pricing reform. Yet, it did incur budget deficits of 9% of GDP in 2015/16 due to the 2014 global oil price decline. The Qatari government also directed those state-owned institutions to reduce operations and lay off redundant expatriate staff to reduce financial outlays. [363]

Due to the aforementioned, Qatar's energy pricing strategy is still relatively inchoate. Qatar increased transportation fuel prices in 2011 by approximately 25 % and announced that it would eventually index them to global prices.[364] In 2014 diesel prices increased from $1.04 to $1.58 per gallon, while gasoline prices rose by 30 % from $1.04 to $1.38 per gallon.[365] In terms of the power sector, Qatar is an outlier amongst its GCC peers as it is free to citizens but was increased for expatriates based on monthly consumption rates. And, since June 2016, the government has begun to adjust fuel prices monthly. From June 2016 until March 2017, fuel transportation prices were increased by nearly 30%, and diesel prices by about ten prevent.[366]

[361] Ibid; For an excellent analysis of energy subsidies in the UAE, see, Jim Krane and Francisco Monaldi, *Oil Prices, Political Instability, and Energy Subsidy Reform in MENA Oil Exporters*, Center for Energy Studies (June 2017)
[362] Robin Mills, "Appetite and Innovation: Natural Gas in the UAE" in (ed) *The Future of Gas in the Gulf: Continuity and Change* (OIES 2019). p.123
[363] Cafiero, G. (2016, March 1). Qatar cuts spending to cope with low oil prices. Middle East Institute.
[364] *Energy Price Reform in the GCC: Long Road Ahead*, APICORP Energy Research, Vol. 1, No. 4 (Jan. 2016). p.2.
[365] Ibid. Jim Krane and Shih Yu Hung, *Oil Prices, Political Instability, and Energy Subsidy Reform in MENA Oil Exporters* (June 2017) p. 18.
[366] Ibid. *Energy Pricing Reforms in the Gulf: A Trend but Not (Yet) a Norm*, Global Subsidies Initiative (Jan. 2018). p. 13

The Qatari government announced that it would set future prices on a formula that includes global prices, production, and distribution costs within Qatar and the Gulf region. [367] However, Qatar will likely continue to allocate free power to its citizens and provide low-cost natural gas to its industries as power generation represents a relatively minor portion of its natural gas production, i.e., 7%, with nearly 80% of it exported. The natural gas production cost is extremely low, with condensates and LPG covering any differences between production and domestic gas price.[368]

The International Gas Union (IGU) Wholesale Price Survey 0f 2021 reported that Qatar's total gas price in 2020 was approximately $1.20/MMBTU (the same as in Saudi Arabia, and increased from around $.90/MMBTU), with only Algeria, Venezuela, Libya, and Turkmenistan having lower prices. [369] However, Qatar does not experience financial losses by allocating gas at this price in contrast to its neighbors.[370]

6.5 Gulf Alternative Energy Deployment

The Gulf governments now view alternative energy (renewables, and nuclear in Saudi Arabia and the UAE) as a partial solution for their countries to reduce their dependence on domestic hydrocarbon consumption and to drive forward carbon emissions reductions while facilitating a progression from allocative economies to productive ones.[371] As of the early 2020s, regional power generation is still primarily based upon oil and gas, besides consuming a large share of domestically produced oil and gas (thereby incurring an opportunity cost), the growth in power demand also increases regional carbon emissions. Combined heat and power generation is the single most significant cause of carbon emissions. And, as stated in Section 6.3, the high-power consumption rates are both caused and are exacerbated by the low administrative pricing of electricity and hydrocarbons.

[367] Ibid; Moiz Bohra and Nilay Shah, *Optimizing Qatar's Energy System for a Post-Carbon Future*, Energy Transition (2019). P. 7

[368] Jim Krane and Shih Yu Hung, *Energy Subsidy Reform in the Persian Gulf: The End of the Big Oil Giveaway*, Baker Institute for Public Policy, Issue Brief (April 28, 2016). p. 4

[369] *Global Wholesale Gas Price Survey 2021*, International Gas Union (July 8, 2021). p.36; Howard Rogers, "Qatar: LNG Expansion Following the Ending of the Northfield Moratorium" in (ed) *The Future of Gas in the Gulf: Continuity and Change* (OIES 2019). p.18

[370] Assuming that condensate and LPG yields are fairly high, then $0.90/MMBTU is a viable price. Ibid.

[371] The term, "alternative energy" in this work comprises renewable energy, in addition to nuclear.

The administrative pricing regime of hydrocarbons is one of the most significant barriers to the broad deployment of renewable energy regionally. Renewables, as discussed in this section, particularly solar, have proven to be a low-cost method of power generation in the region.[372] However, slowing power demand, global economic uncertainty, and increased investments in non-associated natural gas that have proven to be successful towards the end of the 2010s could still potentially stifle solar investment.

These factors, when combined alongside energy efficiency policies that reduced per capita power demand, could cause the need for solar investment to be less pressing than before. However, Saudi Arabia and the UAE are continuing to telegraph their commitment to renewable energy production and are consequently progressing with solar power investments. As stated previously, while renewable energy investment was principally geared to reduce domestic hydrocarbon demand, the Gulf governments view it as being a bedrock of their economic diversification efforts with a multitude of benefits that accrue beyond its electricity generating potential.

Regional energy pricing reform was a focus of regional governments in the mid-to-late 2010s, but much of the initial momentum has stalled, with further reforms moving at a snail's pace. There is still much work to be completed and obstacles to be overcome. Yet, as previous sections have illustrated, alternative energy is becoming much more attractive to the regional governments because it is potentially less expensive than the incremental gas from complex and non-associated fields (between $5-8 per MMBTU) and would require less domestic price adjustment,[373] as well as reduce their respective hydrocarbon demand and carbon emissions (See Figure 6.2 for the regional historical and projected power generation energy mix and Table 6.1 for the levelized cost of solar power in Saudi Arabia and the UAE). Solar powered generation prices under 3 ¢/kWh-which have been consistently realized in the Gulf since 2016 and 2017-are considered the first "tipping point" for solar to be more economically viable than coal, LNG imports and incremental complex natural gas for new generation capacity.[374]

---

[372] W.E. Alnaser and N.W. Alnaser, *The Impact of the Rise of Using Solar Power in GCC Countries* (Aug. 31, 2019).

[373] "Less domestic price adjustment" refers to the fact that as higher cost complex natural gas fields come online, in order for electricity tariffs to meet the cost of production from incremental fields, they would have to be increased. Solar power generation costs are typically on a downward trajectory.

[374] Ibid; *DEWA Announces Selected Bidder for 800 MW Third Phase of the Mohammed bin Rashid Al Maktoum Solar Park.* Dubai Electricity and Water Authority (2016)

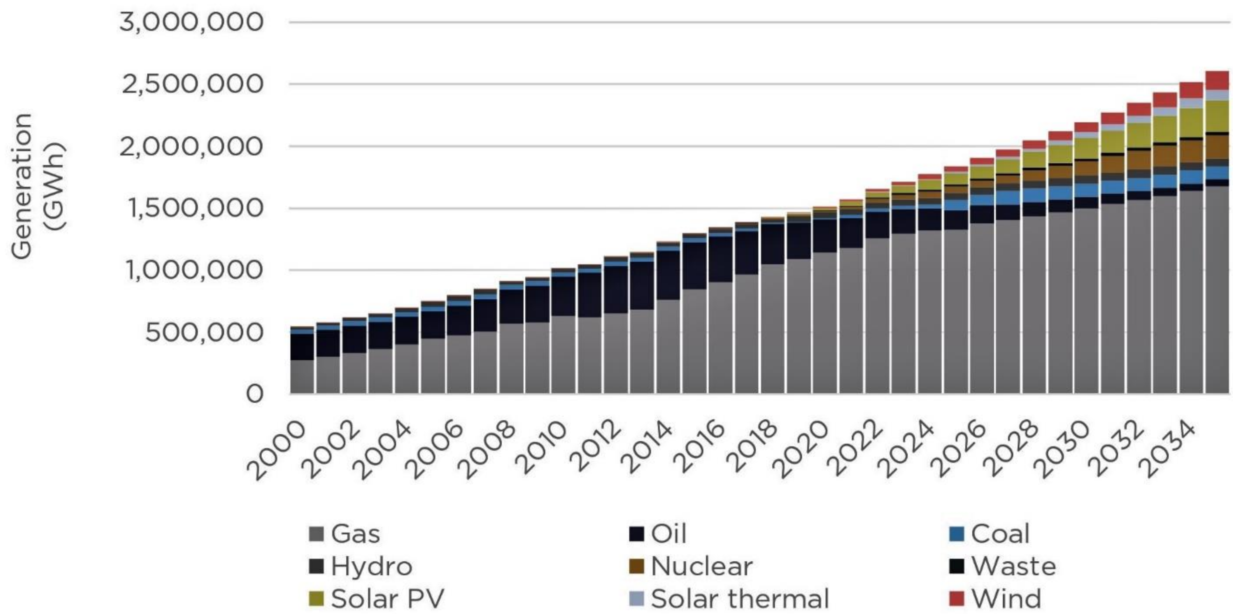


Figure 6.2 Middle East Historical and Projected Power Generation by Method **Source:** Robin Mills, *Under a Cloud: The Future of Middle East Gas Demand*, Columbia (April 2020)

Since about 2016, the Gulf region has established itself as a global leader in photovoltaic deployment and pricing. From between 2015-2020, nearly 7 GW of solar power capacity have been ordered in the region under long-term power purchase agreement frameworks that have continually set new pricing records.[375] The Gulf region has become the global template for solar power generation investment and deployment and as the canary in the coal mine for potential future developments in the solar power market.

[375] Matteo Chiesa, *et al*, "What is Going On with Middle Eastern Solar Prices, and What Does it Mean for the Rest of Us?," *Progress in Photovoltaics*, Vol. 29, Issue 6 (June 2021) pp.638-9

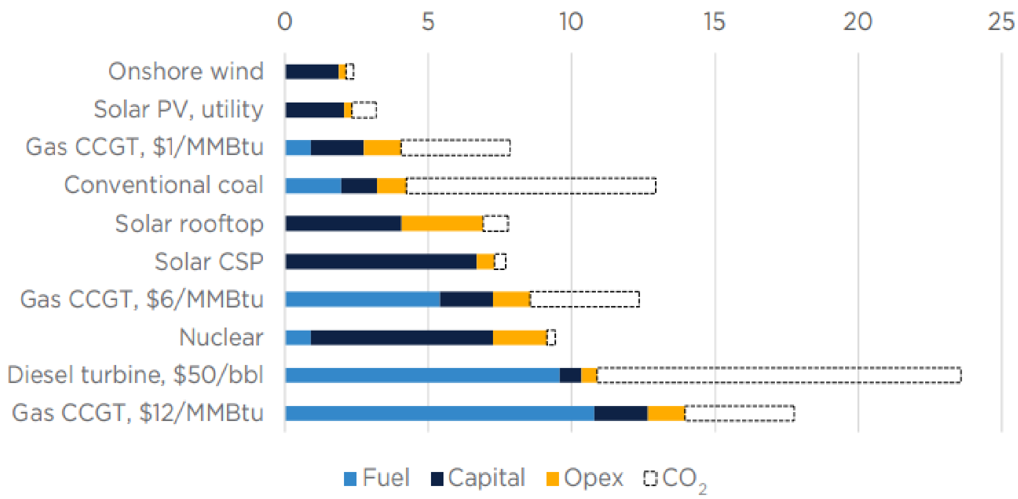


Figure 6.3 Power Generation Costs (LCOE) Under Typical Middle Eastern Conditions: ***Source:*** *Robin Mills, Under a Cloud: The Future of Middle East Gas Demand, Columbia (April 2020)*

And in the region, solar power generation has a lower cost structure than the domestic associated and complex non-associated natural gas (when considering the total cost basis including capital investment and operating costs) or LNG imports (See Figure 6.3).[376]

These prices do not include the significant opportunity cost that these countries accrue from supplying their domestic markets at the production cost of oil and natural gas instead of supplying the international market at prices which are severalfold higher. Therefore, it is important to not just consider the cost differential between hydrocarbon power generation and renewable energy generation, it is also essential to broaden the analysis to understand the impact of supplying oil and natural gas to the domestic market for power generation as opposed to exporting them, which makes solar and even more attractive option.

Initially, there was widespread skepticism towards the viability of solar investment in the Gulf region, with the common belief that many of the low prices were only achieved due to substantial embedded subsidies hidden from public view that could not be emulated in other jurisdictions.[377] However, that is not the case as there have been secular, structural factors that have led to the record low solar prices, such as steadily declining solar technology prices,

[376] The Saudi Arabian company, Acwa Power, submitted a tariff of 1.69 ¢/kWh for the 900MW fifth phase of Dubai's Mohammed bin Rashid Al Maktoum Solar Park. *DEWA Receives World's Lowest Bid of $1.69 per kW/h for 900MW 5th Phase of MBR Solar Park*, Emirates News Agency (Oct. 15, 2019)

[377] Matteo Chiesa, *et al*, "What is Going On with Middle Eastern Solar Prices, and What Does it Mean for the Rest of Us?," *Progress in Photovoltaics*, Vol. 29, Issue 6 (June 2021) pp.638-9

local standard business environments, and the provision of generous, but financially viable, terms.[378]

If artificial barriers are removed, then the adoption of alternative energy would occur rapidly as the region has significant solar capital available year-round. Solar power investment is likely to be the most effective option for Gulf countries to reduce domestic or imported natural gas dependence. And, as will be discussed below, Saudi Arabia, the UAE, and Qatar are each engaging in billion-dollar alternative energy development strategies.

Overall, there has been a new pricing regime that has been realized in the Gulf were PPAs are consistently awarded for prices significantly below 2 ¢/kWh, including the 2-GW Al Dhafra solar project which has a PPA price of 1.35 ¢/kWh.[379] This pricing point is important because it is the "second tipping point" that has been illustrated by various studies where solar power is rapidly becoming more economically favorable than existing fossil-fuel capacity.[380]

6.5.1 Saudi Arabia: Moving Ahead with Solar Investments

Saudi Arabia has attempted to craft an alternative energy policy in fits and starts over the past few decades. Historically, this was never taken seriously until the current Crown Prince, Mohammed Bin Salman, initiated a comprehensive renewable energy policy to transform

---

[378] That this phenomenon is not limited to the Gulf is evident by the observation that global average prices for utility-scale capital expenditures in the solar market have dropped precipitously to the levels present in the Gulf region as of the beginning of the 2020s. Ibid; M. Bolinger, J. Seel, D. Robson "Utility-Scale Solar: Empirical Trends in Project Technology, Cost, Performance, and PPA Pricing in the United States–2019 Edition," 2019.

[379] Matteo Chiesa, *et al*, "What is Going On with Middle Eastern Solar Prices, and What Does it Mean for the Rest of Us?," *Progress in Photovoltaics*, Vol. 29, Issue 6 (June 2021) pp.638-9; *EWEC Announces Partners to Develop the World's Largest Solar Power Plant*, Masdar, Abu Dhabi (2020) *EWEC, Abu Dhabi Power Corporation Announces Lowest Tariff for Solar Power in the World* Abu Dhabi: Emirates Water & Electricity Co. (2020).

[380] PE, Brockway, *et al*, "Estimation of global final-stage energy-return-on-investment for fossil fuels with comparison to renewable energy sources," *Nat Energy*, 2019;4(7):612-621; *Powering down coal: Navigating the economic and financial risks in the last years of coal power*, Carbon Tracker (2018).

the country's position from simply being a crude oil producer/exporter to a clean energy titan in the global marketplace. Yet, many hurdles must be overcome as Saudi Arabia is still the largest oil-consuming country in the MENA region. Saudi Arabia's domestic hydrocarbon consumption incurs a significant opportunity cost for oil that could be exported at international prices.

Domestic oil consumption in the Kingdom increases at 5.6 % per annum, with Saudi Arabia consuming nearly one million barrels per day in power plants.[381] And Saudi Arabia obtains almost three-fifths of its power generation from oil. Saudi Arabia's crude oil consumption increased rapidly over the decades due to rapid industrial development, rising population, and subsidized energy and power prices.

If the trends in expanding domestic consumption continue, then internal energy consumption would be greater than national energy generation capacity. The country possibly could have to import oil sometime within the next decade.[382] That is one of the primary reasons solar power has become so attractive to the Saudi government as its utilization could produce a third of Saudi Arabia's domestic power supply and allow the country to export an additional 300,000 barrels of oil per day. This scenario would result in tens of billions of dollars in additional export revenue.[383] Additionally, domestic energy policies have resulted in high carbon emissions. Ultimately, the Saudi leadership recognized that if it desires to create a sustainable economic policy, foster private sector growth, and reduce greenhouse gas emissions, alternative energy is a critical pillar in that process.

Significant plans were laid when in 2012, the Saudi government announced somewhat ambitious plans for a $109 billion investment in renewable energy investments, which would create a solar industry that would ostensibly produce nearly a third of domestic power by 2032.[384] By 2020, Saudi Arabia's largest solar farm in operation (a 10 MW PV project) is

---

[381] Jim Krane, *Energy Governance in Saudi Arabia: An Assessment of the Kingdom's Resources, Policy and Climate Approach*, Center for Energy Studies (Jan. 2019).
[382] Ibid.
[383] Ibid. p. 10 But, this would be theoretical at the moment, because as of the early 2020s, Saudi Arabia still adheres to the OPEC quota framework.
[384] This would comprise 41 gigawatts of solar power and another 21 gigawatts of geothermal and wind power. By 2018, below one % of Saudi energy supply was derived from renewables. *Saudi Arabia Plans $109 Billion Boost for Solar Power*, Bloomberg (May 11, 2012).

located in Aramco's parking lot, which generates just enough power for a nearby office block.[385]

But, by 2015, the government announced that it would delay the target date by eight years, i.e., 2040, as it studies what technologies it would implement.[386] And, by 2016, the Saudi government reduced its renewable energy targets for implementation in power generation from 50% to 10%. Instead, it increased the proportion of natural in the energy mix.[387] However, after the delays and reduction in renewable energy targets, the Saudi government renewed its commitment to renewable energy deployment when it launched the Saudi Vision 2030, which focused on reducing its oil dependence and economic diversification. In 2018, Saudi Arabia announced a plan to seek investment of up to $7 billion to supply about 10% of its power demand (9,500 MW) from renewable sources by 2023.[388]

In January 2017, Saudi Arabia officially unveiled its first global tender for solar power projects. The government combined its various natural resource-oriented ministries into the Energy, Industry, and Mineral Resources Ministry to streamline and fast track the decision-making processes. To bolster its renewable energy manufacturing capability, in the first quarter of 2019, Ajlan & Bros and China's Hanergy Thin Film Power Group (the most prominent global thin-film solar power technology company) signed a memorandum of understanding to construct the first solar thin-film industrial park in the MENA region at a total investment cost of more than $1 billion.[389]

Still, renewable energy deployment has had a somewhat difficult inception as various high-profile projects have been delayed and canceled. For instance, the Saudi government canceled the $200 billion, 200-gigawatt solar plant planned by the Saudi Public Investment Fund and Softbank announced in March 2018. The parties developed the erstwhile deal haphazardly. Many senior Saudi officials were excluded from negotiations amid other concerns on integrating the project into the national grid.[390]

---

[385] For information about this solar park, see, *Parking Lot: Dhahran*. Available at https://www.sma.de/fileadmin/content/global/Products/Documents/Referenzanlagen/EN_ARAMCO.pdf

[386] Anthony DiPaola, *Saudi Arabia Delays $109 Billion Solar Program Eight Years*, Bloomberg (Jan. 21, 2015).

[387] Wael; Nereim Mahdi, Vivian, "Saudi Arabia Scales Back Renewable Energy Goal to Favor Gas," World Oil

[388] Mike Scott *Saudi Arabia Plans to Source 10% of its Power from Renewable Energy Within Five Years*, Forbes (Jan. 18, 2018).

[389] *Hanergy To Set Up Region's First Thin-Film Solar Power Industrial Park in Saudi Arabia*, Technical Review Middle East (February 4, 2019).

[390] Jeff St. John, *Saudi Arabia and Softbank's 200-Gigawatt Solar Plan Offers 'So Many Questions, So Few Details,'* Greentech Media (March 28, 2018).

Additionally, the memorandum of understanding did not detail how export tariffs would be estimated, nor how the scaling up logistics and manufacturing capacity would be resolved in a country with fewer megawatts of electricity installed, i.e., 50 megawatts, than Kyrgyzstan or the state of Louisiana.[391] A further complication is that Saudi Arabia seeks to become a regional hub of renewable energy manufacturing-and perhaps a global exporter of renewable energy technology-to have between 60 to 80% of solar power components manufactured domestically as part of its National Renewable Energy Program.[392] To further develop this aim, it has imposed local content rules for domestic projects. But, even Saudi officials recognized a trade-off between stimulating local job growth, low project bidding costs, and growth in Saudi know-how with somewhat strict local content rules.

However, photovoltaic solar generation costs have been declining in Saudi Arabia, with levelized costs expected to reach around 7 ¢/kWh by 2025.[393] As stated in Section 6.5, it is essential to remember that the solar energy generation costs are significantly lower than the current administered domestic power tariffs from between 18-32 ¢/kWh (See Table 6.2). And when considering that Saudi Arabia supplies nearly 39% of its power generation with fuel oil, there are also significant opportunity costs associated with this domestic allocation as opposed to its export at international market rates.

While Saudi Arabia's renewable energy development goals are a transformation from its prior reticence to comprehensively engage in the renewable energy sector, there are still significant barriers in place for a full realization, such as a strong carbon lock-in, lack of environmental awareness, a power/energy subsidization framework, limited technical knowledge of renewables among the Saudi leadership and population, and lack of supporting institutions for innovation (e.g., intellectual property rights).[394] Therefore, progress is incremental, and without strong leadership to develop enabling factors, it is

---

[391] Ibid.; See the total installed solar capacity of Louisiana in 2018 at, the *Solar Energy Industries Association*. Available at https://www.seia.org/state-solar-policy/louisiana-solar

[392] See, *National Renewable Energy Program*, KSA Climate website. Available at https://ksa-climate.com/making-a-difference/nrep/

[393393] Hassan Z. Al Garni, *et al*, "Design and economic assessment of alternative renewable energy systems using capital cost projections: A case study for Saudi Arabia," *Sustainable Energy Technologies and Assessments*, Volume 48, 2021.

[394] Yasser M Al-Saleh, "An Empirical Insight into the Functionality of Emerging Sustainable Innovation Systems: The Case of Renewable Energy in Oil-Rich Saudi Arabia," *International Journal of Transitions and Innovation Systems* 1, no. 3 (2011).

unlikely that Saudi Arabia would reach its stated renewable energy targets within its indicated timeframe.

6.5.2 Investing in the Atom: Saudi Nuclear Energy Development

In December 2006, the six members of the GCC announced that the council would commission joint research on the development of the peaceful utilization of nuclear energy.[395] 2006 was a pivotal year for nuclear-related issues. On April 11, Iran announced that it had enriched uranium for the first time. On October 9, North Korea announced the successful detonation of a nuclear device.[396] Some observers suggested that the GCC interest in nuclear energy announced that year was the direct result of the reverberations mentioned above in the geopolitical arena.[397]

In February 2007, the six Gulf states agreed upon a framework with the International Atomic Energy Agency to have Saudi Arabia lead a feasibility study on a regional nuclear power and desalination program. [398] However, Saudi Arabia determined that it would begin an independent inquiry into domestic nuclear energy development in August 2009, when the government stated that nuclear energy was necessary for its future energy sustainability goals.[399] In a stark illustration of the importance of nuclear energy to Saudi Arabian strategic goals, even after the 2011 disaster at the Fukushima Daiichi nuclear power plant in Japan, Saudi Arabia held fast while other countries began to scale back their preliminary nuclear power development.

[395] Both France and Iran pledged assistance on this project. See, generally, Laura El Katiri, *The GCC and the Nuclear Question*, Oxford Energy Comment (Dec. 2012).

[396] *Iran's Nuclear Program: Status*, Congressional Research Service (Oct. 9, 2019) Available at https://fas.org/sgp/crs/nuke/RL34544.pdf

[397] Ibid.

[398] Ibid.

[399] In April 2010, the Saudi government launched a royal decree that stated, “"The development of atomic energy is essential to meet the Kingdom's growing requirements for energy to generate electricity, produce desalinated water and reduce reliance on depleting hydrocarbon resources." *Nuclear Power in Saudi Arabia*, World Nuclear Association (April 2019).

Saudi Arabia has the second most developed nuclear energy program in the Arab world, after the UAE. In order to facilitate its nuclear energy goals, the Saudi government established the King Abdullah City for Atomic and Renewable Energy (KA-CARE) in Riyadh to create a strategy to attempt to reduce hydrocarbon consumption and as the primary governmental agency to manage nuclear energy treaties signed by the kingdom. Ka-Care is also responsible for nuclear energy and radioactive waste project supervision. Saudi nuclear energy assessments announced in April 2013, planned for nuclear construction in 2016, with Ka-Care projecting 17 GWe of nuclear capacity by 2032 out of a total of 123 GWe. [400] The plans stated that the Saudi government would construct sixteen nuclear power reactors over the following twenty years at the cost of more than $80 billion, generating nearly 20% of Saudi electricity needs.[401] However, due to various delays, the nuclear target date was modified to begin in 2040. Riyadh started soliciting proposals to construct two initial reactors in November 2017 and initiated discussions with China, France, South Korea, The United States, and Russia.

Furthermore, since Saudi Arabia is uniquely placed to produce solar power at a much lower cost than nuclear energy production, further doubts arise about its nuclear end goal. Ultimately, it appears that Saudi Arabia will progress with its nuclear energy ambitions, even though it currently resides underneath a cloud of suspicion.

[400] 16 GWe would be solar PV, 25 GWe solar CSP and 4 GWe from geothermal, and waste. Ibid.
[401] Ibid.

6.5.3 UAE: Ahead of the Pack with Renewable Energy Deployment

The UAE has been a first-mover amongst its Gulf peers in renewable energy implementation and deployment. The country has also taken the unofficial role of global sustainability spokesman for the MENA region to showcase its renewable energy investments. The UAE's path towards renewable energy is not just predicated on environmental issues. The structural problems of declining low-cost conventional gas supply and rising power demand spurred the Emirati leadership to develop renewable energy.

In January 2017, Sheikh Mohammed bin Rashid Al Maktoum, the Emirati vice-president and prime minister, and the ruler of Dubai, announced the UAE Energy Plan 2050, which would increase alternative energy usage by 50 % and improve energy efficiency by 40 %.[402] And, by 2050, the Emirati government intends for the domestic energy mix to be composed of 44 % renewable energy, 38 % natural gas, 12 % coal, and 6 % nuclear.[403]

Renewable energy has become an attractive option for the UAE due to the convergence of several factors. Firstly, the UAE has an advantageous geographical placement, leaving it well-poised to implement solar energy technology. It receives an average of nearly ten hours of sunlight daily and approximately 350 days of sun per annum. Secondly, the UAE has placed climate change at the top of its agenda as it increased its renewable energy portfolio by 400% from 2010-2020.

The Emirati government also desires the reduction of carbon dioxide emissions by 70 %, in line with its Paris Climate Agreement goals (See Section 7.3.2). Thirdly, renewable energy costs had declined significantly over the mid-2010s, with record-low costs of solar photovoltaic projects.[404] Lastly, renewable energy is a vital pillar of the UAE's diversification goals, which aims to reduce the domestic consumption of natural gas to allow more export to the international market and allocation to the downstream sector, as well as develop an expansive renewable energy technology manufacturing base through FDI and technology transfer.

---

[402] *UAE State of Energy Report 2017*, UAE Ministry of Energy (2017). p. 12

[403] Ibid.

[404] Emiliano Bellini, *Dubai: Tariff for Large-Scale PV Hits New Low at $0.024/kWh*, PV Magazine (Nov. 5, 2018).

Since the beginning of the 2010s, the UAE has inaugurated multiple renewable energy projects and, thus far, has the largest share of renewable energy development in the MENA region.[405] Solar energy seems likely to be able to provide the majority of the UAE's incremental power needs, with Dubai hoping that renewable energy can meet 100% of its energy demand by 2050.[406] As a result, the Emirati government has placed solar energy as the cornerstone of its clean energy development strategy. It is estimated that, overall, the UAE could potentially have 50 GW of photovoltaic and concentrated solar power by 2035, with the LCOE of solar photovoltaic being significantly lower than most other generation options by that date.[407]

The UAE has been investing substantially in solar energy development with its first solar project, the 100 MW Shams 1 CSP plant in Abu Dhabi, coming online in 2014.[408] The Shams CSP project cost $600 million with a consortium of international banks financing it.[409] Shams 1 is the largest Concentrated Solar Power (CSP) plant outside Spain and the United States and was the first CSP plant in the MENA region. Two more CSP plants, Shams 2 and Shams 3, are to be constructed as well.

Abu Dhabi, meanwhile, constructed the Sweihan PV solar project that set a new price floor at the time, having acquired extremely low bids from Marubeni (Japan) and Jinkosolar (China). The Abu Dhabi government initially planned plant capacity to be at 350MW; however, when the consortium submitted a bid of $0.024/kWh, which was the lowest ever levelized cost of electricity bid for solar power at the time in September of 2016, ADWEA increased the plant's capacity to 1.18 GW.[410]

---

[405] *Renewables in the Arab World: Maintaining Momentum*, APICORP Energy Research, Vol. 3 No. 08 (May 2018).

[406] In 2021, Dubai's power demand increased by 9.8%, to 50,202 GWh from 45,712 GWh in 2020. However, Dubai's renewable energy production is meeting an increasing share of its demand growth with renewable energy production comprising 11.38% of Dubai's energy production in 2021, an increase from 9% in 2020. By mid-2022, it is forecast that renewables will meet 13.3 percent of Dubai's demand. Overall, by 2025, the UAE is well on track to expand its solar energy production fourfold, principally from four solar projects: the Al Dhafra (2GW), Abu Dhabi PV3 (1.5GW), and the fourth (950MW) and fifth (900MW) phases of the Mohammad bin Rashid Al Maktoum (MBR) solar facility. Jules Scully, *UAE Solar Capacity to Increase Fourfold by End of 2025 Thanks to 'Robust' Development Pipeline,* PV-Tech (Feb. 10, 2022); *Dubai's Energy Demand Climbs 9.8% as Renewables Gain Bigger Share*, S&P Global Platts (Jan. 24, 2022).

[407] Robin Mills, *Under a Cloud: The Future of Middle East Gas Demand*, Center on Global Energy Policy (April 2020). p. 36

[408] From its inauguration in 2014 until second quarter 2018, it produced enough electricity to power approximately 110,000 homes for a year and displaced more than 720,000 metric tons of carbon dioxide. *Masdar Celebrates Fifth Anniversary of Shams 1*, Emirates 24/7 (March 23, 2018).

[409] Ibid. p. 3

[410] *Renewables in the Arab World: Maintaining Momentum*, APICORP Energy Research, Vol. 3 No. 08 (May 2018). p.3;

The Dubai Electricity and Water Authority (DEWA) launched the Mohamed Bin Rashid Al Maktoum Solar plant development on October 22, 2013. By 2030, it is planned that the plant will have a capacity of 1000 MW, produce enough power for 30,000 single-family residential units, and displace 460,650 tons of carbon emissions per year.[411] The project, created under the build-own-operate mode, will be the largest solar power plant in the Middle East. The project was registered under the UNFCCC CDM with an initial crediting period of seven years in November 2016. [412] The Mohamed Bin Rashid Al Maktoum Solar plant is central in assisting Dubai in achieving 25% of its power generation by renewable energy by 2030 and 75% by 2050.[413]

They were initially designed in three phases. First Solar constructed phase one, a 13 MW solar farm.[414] A consortium led by ACWA Power and the Spanish company TSK constructed the second phase of a 200 MW photovoltaic plant. The second phase was completed ahead of the scheduled time of April 2017 and came online on March 22, 2017.[415] Dewa awarded the third phase of the project to a consortium led by Masdar in June 2016, with a completion date of 2020.[416] The Silk Road Fund, Shanghai Electric, and ACWA Power are jointly developing the fourth stage, which is planned to generate 700 MW and host the world's tallest solar tower.[417] As demonstrated in Section 6.5, solar generation costs are rapidly declining in the UAE and across the Gulf, which illustrates that solar power generation is reaching the point where it could likely become more economically viable than existing fossil fuel generation.

6.5.3.1 The Emirati Nuclear Sector and Coal Development

In contrast to the misgivings hovering over the Saudi nuclear program, the Emirati nuclear sector has fully complied with the IAEA from its inception. The Emirati decision to engage in nuclear power development began in 2006 and followed an in-depth assessment of the

Sweihan Photovoltaic Independent Power Project, Abu Dhabi, Power-Technology. Available at https://www.power-technology.com/projects/sweihan-photovoltaic-independent-power-project-abu-dhabi/

411 *Mohammed Bin Rashid Al Maktoum Solar Park Phase II*, Dubai Power-Technology (2019).

412 Ibid.

413 Ibid.

414 *State of Energy Report, Dubai 2014*, UNDP (2014). P. 35

415 The total cost of the second phase was $320 million. *Mohammed Bin Rashid Al Maktoum Solar Park Phase II*, Dubai Power-Technology (2019).

416 Ibid.

417 Ibid.

UAE's predicted future energy requirements in 2007. The 2007 study projected that the annual domestic peak power demand would likely increase to more than 40,000 MW by 2020, representing a yearly growth rate of approximately 9% from the initial assessment.[418] The projected power demand alarmed Emirati officials as it was well beyond their then-current capacity.[419]

Upon reviewing the projected power demand, the Emirati government promulgated an additional study to determine the best available technologies for power generation to meet the demand increases. The results indicated that: [420]

1) The natural gas that could be readily available would not be sufficient to meet future power demand.
2) Utilizing liquid fuels (crude oil and/or diesel) could be viable, but it would be economically costly and ecologically damaging.
3) Coal-fired power generation would likely be less expensive but environmentally unviable and potentially vulnerable from a security of supply vantage point.
4) Lastly, while renewable energy would be desirable, it would likely only meet six to 7% of projected energy demand by 2020.

Therefore, due to the above assessment, nuclear power "emerged as a proven, environmentally promising and commercially competitive option which could make a significant base-load contribution to the UAE's economy and future energy security." [421]

To alleviate any concerns about a Middle Eastern and Arab nation developing nuclear power, the Emirati government explicitly announced its peaceful objectives in a policy document released in April 2008 entitled, *Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy*.[422] And, to further illustrate its peaceful intentions, the Emirati government promulgated domestic legislation to permanently forego the ability to enrich uranium and reprocess plutonium, as well as signed the 2009 123

[418] *UAE Country Nuclear Power Profiles*, IAEA (2019). Available at https://cnpp.iaea.org/countryprofiles/UnitedArabEmirates/UnitedArabEmirates.htm
[419] Ibid.
[420] Ibid.
[421] Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy Available at https://www.uae-embassy.org/sites/default/files/UAE_Policy_Peaceful_Nuclear_Energy_English.pdf
[422] Ibid.

Nuclear Nonproliferation Cooperation Agreement with the U.S.[423] Additionally, the UAE made certain to become a member in good standing with all relevant nonproliferation treaties, regimes, and organizations. Often, the UAE is referred to as setting the "gold standard" precedent for nuclear energy newcomers.[424]

Yet, despite, or perhaps, because of all its nonproliferation confidence-building measures, the UAE will require a significant degree of foreign assistance and some time to meet its pledges. A "commitment-compliance gap' may arise where the Emirati government may not have the full institutional capacity to meet its commitments.[425] There is some concern regarding that fact as, historically, the UAE has been a central transit area for illicit transactions with Iran and other countries.[426]

While the international concerns about Saudi nuclear activities related to nonproliferation, as the schism with Qatar broadened, the Qatari Ministry of Foreign Affairs wrote to the IAEA claiming that the Emirati plants would pose an issue to regional stability and the environment and requested that the IAEA promulgate a framework to ensure the safe operation of nuclear energy in the Gulf region.[427]

In December 2009, the Emirates Nuclear Energy Cooperation (ENEC) announced that it had selected a tender from a Korea Electric Power Corporation (KEPCO)-led consortium to build four APR-14000 reactors at one site, with the last ones to be constructed by 2022. Unit 1 of the Barakah complex was to come online in 2017. Still, some delays caused it to begin loading fuel in May 2018 finally and therefore becoming the Arab world's first operational commercial reactor when it came online in April 2021.[428] The second unit came online

---

[423] *U.S.-UAE Agreement for Peaceful Nuclear Cooperation (123 Agreement)*, U.S. Department of State (Jan. 15, 2009). Available at https://2001-2009.state.gov/r/pa/prs/ps/2009/01/114262.htm

[424] The UAE joined the Treaty on the Non-Proliferation of Nuclear Weapons in 1995, signed a safeguards agreement with the IAEA in 2003, and acceded to the IAEA Additional Protocol in 2010. *United Arab Emirates*, Nuclear Threat Initiative (Oct. 2018).

[425] Ibid; Bryan R. Early, *Export Control Development in the United Arab Emirates: From Commitments to Compliance,* Belfer Center for Science, and International Affairs at the Harvard Kennedy School, (July 6,2009) p. 7.

[426] Ibid. Dubai was a known trafficking area for the A.Q. Khan network which smuggled nuclear weapons technology to Libya, Syria, Iran, and North Korea. Catherin Collins and Douglas Frantz, *The Long Shadow of A.Q. Khan*, Foreign Affairs (Jan. 31, 2018).

[427] Qatar's concerns, which the UAE firmly rejects, is that any accidental discharge from Emirati plants would send radioactive material to Doha within hours.
Geert De Clercq, *Exclusive: Qatar Asks IAEA to Intervene Over "Threat" Posed by UAE Nuclear Plant*, Reuters (March 20, 2019).

[428] Some startup delays occurred due to a combination of safety issues and quality assurance problems with some of the components and systems. *More Delays for UAE's Barakah Project*, Nuclear Engineering International (July 6, 2018).

shortly after that, in August 2021. In terms of construction, commissioning, and fuel loads for the four plants, the contract's total value was $20.4 billion, with most of the contract being offered under a fixed-price arrangement. [429] In total, nuclear power is expected to generate a quarter of the Emirati power requirements by 2022/2023.

Additionally, Dubai is constructing the 3.6 GW ultra-supercritical Hassyan clean coal power station Saih Shuaib.[430] This $3.4 billion plant began construction in November 2016, with operations planned to come entirely online by 2023.[431] It is anticipated that the plant would eventually provide a 25 % increase of power generation to Dubai's grid capacity. While the Hassyan plant would have advanced carbon capture equipment to reduce its carbon emissions, it would not wholly mitigate carbon emissions.[432] It will also be the first coal-fired plant in the region upon its completion.[433] However, while there has been criticism leveled at Dubai for constructing a coal plant, the regulatory authorities set stringent standards for carbon emissions which are based on the same guidelines for natural gas plants, as well as complying with carbon emission guidelines from the World Bank Finance Corporation, and exceeding the EU standards for carbon emissions from coal plants.[434]

For its part, Ras Al Khaimah announced in 2016 that it would construct its own 1800 MW clean coal plant that would cost nearly $3 billion. However, while initially due to come online in 2021, the project was delayed and placed on hold as it required a construction transmission line. There was a bureaucratic reorganization that contributed to the delay as the Federal Electricity and Water Authority (FEWA) was absorbed in the Abu Dhabi Water and Electricity successor agency, the Emirates Water and Electricity Company (EWEC). In addition, the Emirati authorities were concerned as Asian coal export prices increased

[429] Ibid. *UAE Country Nuclear Power Profiles*, IAEA (2019).
[430] Hassyan IPP, Acwa Power Webpage. Available at: https://acwapower.com/en/projects/hassyan-ipp/
[431] *Hassyan Clean Coal Project, Dubai*, Power and Technology (2020)
[432] Coal was chosen at that time because coal was perceived to be a much less expensive option than renewables. However, at the time of writing, renewable energy is projected to be the less expensive option until the mid-to-late 2020s.
[433] The UAE's national energy strategy states that its power generation and emission-reduction targets for 2050 will include approximately 11.5 GW of ultra-supercritical coal plants that are compatible with carbon, capture and storage technology and will incorporate other highly efficient technologies to mitigate carbon emissions. *Countries In and Around the Middle East are Adding Coal-Fired Power Plants*, U.S. Energy Information Administration (May 11, 2018).
[434] The emissions factors for coal have a fair amount of variance among various coal sources (i.e., whether bituminous, subbituminous, ignite or anthracite) or geographic origin, therefore, the emissions factors cannot be determined at this point until Hassyan purchases its coal. For a detailed analysis of the carbon dioxide emissions factors for coal, please see, B.D. Hong and E.R. Slatick, *Carbon Dioxide Emissions Factors for Coal*, U.S. Energy Information Administration. Available at https://www.eia.gov/coal/production/quarterly/co2_article/co2.html

significantly, which factored in the decision.[435] It appears that the Hassyan plant would likely be the last coal-fired plant constructed in the region as when the agreement with Acwa was signed in 2016, the electricity prices agreed upon were less than 5 cents per kWh; however, by 2020, solar power costs declined substantially, reaching below 2 cents.

As Krane noted, while the UAE's drive to construct coal-fired plants is at odds with its clean energy image, the country views its investments in the context in furthering an American style "energy independence," driven by the goal of being able to diversify its energy mix and not have to depend upon its neighbors for natural gas imports in the future, such as Iran and Qatar.[436] This is part and parcel of the 2011 Integrated Energy Strategy and 2015 Clean Energy Strategy, transitioning Dubai from a near-total gas dependence to 61 % gas, 7 % clean coal, 7 % nuclear, and 25 % solar by 2030. This energy diversification is poised to allow Dubai to create a more robust fuel mix to become "anti-fragile," able to withstand Black Swan events that occur every so often, from the environmental to the geopolitical. In the aggregate, despite potential higher emissions from coal,[437] the integration of nuclear energy, renewables, and improved energy efficiency would likely lead to a structural decline in carbon emissions from the Emirati power sector throughout the 2020s (See Figure 9.1 in Chapter 9).[438]

[435] Rod Morrison, *Coal IPPS on Hold*, Project Finance International, Reuters (Feb. 21, 2019).

[436] Jim Krane, *Dubai's Coal Push Upends Abu Dhabi's Clean Energy Strategy*, Middle East Petroleum and Economics Publications (Aug. 28, 2020).

[437] "Clean coal" has had a checkered history in delivering sustained pollution emissions reductions. In the US, for instance, power plants utilizing refined coal-backed by billions of dollars of government subsidies-tended to emit more pollutants, such as NOx, from treated coal. Tim McLaughlin, *U.S. Clean Coal Program Fails to Deliver on Promised Smog Cuts*, Reuters (Dec. 2, 2018). There have also been many criticisms leveled at the use of carbon capture storage (CCS) technology in coal-fired plants. The crux of these claims is that CCS technology is not scaleable, and at the only largescale CCS coal-fired plant in operation as of 2022, i.e., SaskPower's Boundary Dam Project in Canada, the power plant experienced numerous technological and operational issues that impeded its functioning. Carlos Anchondo, *CCS 'Red Flag?' World's Sole Coal Project Hits Snag*, Energy Wire (Jan. 10, 2022).

[438] The UAE has already reduced its carbon dioxide emissions through an emphasis on renewable energy generation, greater power plant operational efficiency and more fuel switching to natural gas in its power plants. For instance in 1990, the UAE 32.6 tonnes of per capita carbon dioxide emissions per annum, twenty years later, that dropped to 21.9 tonnes. And, in Dubai, emissions declined by 33% in 2020. This decline was more than double the target set in the official *Dubai Carbon Abatement Strategy 2021.* As more renewable energy and the remaining nuclear power plants come online, carbon emissions are destined to drop even further. *Dubai Reduces 33% of its Carbon Emissions in 2020*, Khaleej Times (Feb. 6, 2022); *The UAE's Response to Climate Change*, The United Arab Emirates Government Portal Available at https://u.ae/en/information-and-services/environment-and-energy/climate-change/theuaesresponsetoclimatechange#:~:text=Due%20to%20better%20technology%20and,tonnes%20per%20person%20per%20year.

6.5.4 Qatar's Renewable Energy Goals

Amongst its GCC peers, Qatar has encountered no problems with natural gas production shortfalls, and consequently, it has not been as interested in developing renewable energy. Nevertheless, Qatar does have several enabling factors to assist it in its renewable energy drive. Daily sunshine of approximately 9.5 hours on average, with low-cloud cover and large land expanses, falls on the peninsular nation.[439] However, at the same time, Qatar has taken a leading role in the global climate change discussions and seeks to reduce its usage of hydrocarbons for domestic energy consumption. Since 2005/6, Qatar has been assessing the potential role of renewable energy in its national energy mix.

The country's official recognition of renewable energy promotion arose in three basic articulations. Initially, in 2008, Qatar's National Vision 2030 stated environmental protection and sustainable consumption of hydrocarbons as the twin pillars driving the country's future development.[440] In this, the Qatari government developed a somewhat vague environmentally conscious strategy that merely indicated that ecological protection was an important goal for which to strive. But the government did not create firm targets and benchmarks, which raised queries regarding its seriousness.

In the second iteration, the Ministry of Development, Planning, and Statistics (MDPS) launched its first National Development Strategy in 2010 for 2011-2016, which further expanded upon renewable energy's role in fostering economic development. However, an underlying assumption of the document was that it would be necessary for renewable energy technology to become more cost-efficient. Due to this, the Qatari government created the National Renewable Energy Committee to forge a national renewable energy policy as part of this strategy.[441] Then, on March 14, 2018, the MDPS launched a second NDS for the period between 2018-2022, where it directly addressed renewable energy promotion. The

---

[439] For Qatar's climatic conditions, see, *World Weather and Climate Conditions*, available at https://weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,doha,Qatar

[440] See, generally, *Qatar National Vision 2030*. Available at https://www.gco.gov.qa/en/about-qatar/national-vision2030/

[441] *Qatar National Development Strategy 2011-2016*. Available at https://www.psa.gov.qa/en/knowledge/Documents/Qatar_NDS_reprint_complete_lowres_16May.pdf

document recognized that Qatar had made relatively limited gains in renewable energy production despite holding a significant renewable energy potential.[442]

As a result, in 2017, the Ministry of Energy and Industry, Qatar General Electricity and Water Corporation (Kahramaa), and various other stakeholders began to develop the country's first renewable energy strategy 2017. In October 2018, Kahramaa had announced that it prequalified sixteen international power firms to construct a 500-MW first utility-scale photovoltaic solar project in Qatar, christened the West Doha Solar Project. In 2019, Kahramaa received five bids from international developers to build the first PV solar project, utilizing the public-private partnership framework.[443] With the West Doha Solar project, the two primary power sector organizations, Qatar Electricity and Water Company (QEWC) and Qatar Petroleum (QP), formed Siraj Power, a joint venture between both organizations.[444]

The West Doha Solar project represents the first considerable step that Qatar is taking for renewable energy promotion, yet, there have been other smaller research-focused and pilot projects over the years. For example, Chevron invested $20 million from 2009-2014 in the Qatar Science and Technology Park (QSTP) to build the Sustainable Energy Efficiency Center, a research-oriented think tank focused on renewable power and energy efficiency development.[445] The center's strategic focus was developing lighting and cooling applications applied in the scorching Middle East climate. The other research focuses on dual-pronged to foster the next generation of Qatari scientists and engineers while deploying advanced renewable energy technologies.[446]

---

[442] *Qatar National Development Strategy: 2018-2022*, Ministry of Planning, Development and Statistics webpage. Available at: https://www.mdps.gov.qa/en/knowledge/Documents/NDS2Final.pdf

[443] This West Doha Solar project will have an estimated total capacity of at least 700 MW. Kahramaa plans an initial 350 MW to be connected to the grid by the first quarter of 2021, with the commercial operation beginning in the first quarter of 2022. It will incorporate the public-private partnership model, whereby Kahramaa will review and evaluate the legal, technical, and commercial offers.

[444] QEWC and QP will hold 60% and 40%, respectively. *Qatar Develops a 500-MW Solar Plant*, Oxford Business Group (The Report Qatar 2019).

[445] *Chevron to Establish Sustainable Energy Efficiency Center in Qatar*, Chevron Website, Available at https://www.chevron.com/stories/chevronto-establish-sustainable-energy-efficiency-centerin-qatar

[446] Ibid.

6.6 Conclusion

As discussed in depth in Chapter Seven, the Gulf countries eventually abandoned their stern opposition to climate change issues in 2012 and are progressing towards embracing decarbonization by utilizing energy price reformation and deployment of alternative energy. And, it may be witnessed that the alternative energy drive is finally bearing fruit in the region, although some countries, such as Bahrain and Kuwait, are still behind their neighbors.

Even though Saudi Arabia, Qatar, and the UAE implemented some form of natural gas pricing reformation, progress has stalled since the mid-2010s. It is still challenging to reform energy pricing directly (e.g., energy subsidies and below-market pricing natural gas inputs) because of powerful social, political, and economic forces. These forces are related to the still festering pressures from the so-called Arab Spring and the prevalent notion of the Arab Social Contract, which are still buffeting the region.[447] But there has been much more progress in power price liberalization which can be considered as a proxy for natural gas pricing reform, to a certain degree. And the levelized cost of solar power generation has been declining significantly in the UAE and Saudi Arabia, where prices have reached below 2 ¢/kWh and 11 ¢/kWh, respectively. Solar power generation is now competitive with conventional natural gas-powered generation across the Gulf.

Still, there are also clear national security implications involved if countries in the region do not implement sustainable economic growth which provides intergenerational equity for future generations through durable energy policy reform.

While Saudi Arabia, the UAE, and Qatar have many similarities in their policies towards energy pricing reform, there are many differences. As with the other Gulf countries, Saudi Arabia has experienced decades of natural gas demand growth, but its demand-side reduction policies and power/natural gas pricing reform will lower its overall energy demand. The Saudi leadership has taken advantage of the decline in renewable energy costs and has built grand policies upon its edifice. Yet even though its renewable energy targets

[447] Simply put, the so-called Arab Social Contract is an understanding that has bound together rulers and citizens since independence. The basic tenets are that if the governments provide low priced energy and generous government subsidies under an all-encompassing welfare system, then the citizens will grant the government/ruler ultimate fealty. For a good rendition of the evolving nature of the social contract in the Middle East, see, generally, Mehran Kamrava, *Beyond the Arab Spring: The Evolving Ruling Bargain in the Middle East* (Oxford University Press, 2014).

are unlikely to be met by the early 2020s, its renewable energy capacity will begin to reduce the percentage of natural gas utilized in the power sector in the mid to late 2020s.[448]

In terms of the UAE, the government focuses on energy efficiency and increasing the share of coal and alternative energy production (nuclear and solar power, in particular). At the same time, the Emirati government sees a future in expanding its oil and gas production as it approved a five-year, $132 billion investment plan in 2018 to raise its oil production from approximately 3.5 million bpd to 5 million bpd by the end of 2030. In addition to this, ADNOC's gas policy is to achieve self-sufficiency and significantly expand its LNG exports and broaden its gas-to-chemicals opportunities while sustaining LNG output. Solar power offers a distinctive advantage for the UAE as record low prices have been attained in Dubai and Abu Dhabi. In Sharjah, promising gas and condensate reservoirs were discovered as well in 2020.[449] And, it appears that Emirati gas demand has peaked in 2020/2021 and may have begun to plateau as new coal and solar projects come online. Until 2025, LNG imports are likely to continue but may cease at the end of the 2020s.

Political and economic issues have obstructed potential pipeline development from Iran, but the blockade against Qatar has thus far not impacted the Dolphin Project gas imports.[450] But, overall, the gas/power pricing reform, demand-side reduction, domestic gas finds will allow the UAE to moderate and potentially reduce its domestic gas demand in the 2020s.

Qatar's situation differs from Saudi Arabia's and the UAE's as it is the world's largest LNG producer as it was able to profit from North Field production successfully. Although much of Qatar's initial LNG strategy was built upon exports to the U.S., it successfully transitioned its exports to the lucrative Asian-Pacific market. Even though there has been the rise of LNG rivals globally, Qatar still has several core advantages, such as physical location and the high yield of liquids produced alongside its gas, which indicates that it will still have the world's lowest-cost base, and the most competitive breakeven price for gas in most markets.[451] Even though there is increased competition in the LNG market and coordination between Asian buyers, which places sustained downward pressure on prices, Qatar will still benefit from Asia's long-term demand growth potential.

---

[448] (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change* (OIES Press: 2019) p. 219

[449] Deena Kamel, *Sharjah Reveals First New Onshore Natural Gas Discovery in Three Decades*, The National (Jan. 28, 2020)

[450] Ibid. P. 219

[451] Ibid. P. 216.

Overall, despite the stated intentions of the three selected countries, there are still institutional obstacles they are managing as their alternative energy investments proceed apace. The lack of indigenous technical know-how is a substantial detriment for the successful implementation of alternative energy. Nonetheless, the funneling of billions of dollars into alternative energy development and the reform of domestic energy pricing frameworks in the three selected countries do herald a fundamental psychological shift, or perhaps, a transformation, in the future regional economic development contours.

Chapter Seven: The Pathway to Gulf Carbon Emissions Reductions Plans

7.1 Introduction: Climate Change and the Gulf Region

Introduction: Climate Change and the Gulf Region

The Gulf region has faced a host of challenges for decades, comprising a range of internal and external threats.[452] The Gulf countries now recognize that climate change potentially gave birth to a new host of systemic threats, such as desertification, food insecurity, internal conflict, extreme heat waves, domestic population displacement, and a host of other destabilizing forces.[453] The Middle East as a region arrived at the awareness that climate change offers unparalleled threats to its way of life and potential opportunities to transform their economies into dynamic growth engines as they engage in macroeconomic diversification.[454]

[452] Some of the external threats emanated from the 'revolutionary' Middle Eastern countries of Libya, Syria Iraq, and to a lesser extent, Algeria, that attempted to spread pan-Arab nationalism in the more conservative monarchical states in the Gulf. Iraq, for instance, posed a significant threat to the region with its invasion of Kuwait in 1991. Iran as well posed, and still poses, both an external military threat and an internal threat by its promotion of external Shiite political sectarianism throughout the region. Additionally, Arab nationalist parties and cells during the 1950s-60s caused bouts of instability, while the advent of domestic Shiite political agitation in the 1970s, and then the rise of various Islamist organizations during the 1990s until the present, are still issues of concern for the Gulf monarchies. See, generally, Justin Dargin, *Desert Dreams: The Quest for Arab Integration from the Arab Revolt to the Gulf Cooperation Council* (Republic of Letters, 2012).

[453] According to a 2013 study by John Waterbury, decreased rainfall that occurred prior to 2011 led to desertification in agricultural areas in eastern Syria, which resulted in the death of at least 85% of the livestock. This stimulated a mass internal migration of villagers to the larger cities where they formed communities of underpaid workers. The large internal migration is not thought to have cause the Syrian civil war. But it is thought to have been a major contributing factor in overall disenfranchisement and the initial outbreak of violence. It is also considered that the vast increase in food prices in the Middle East during the mid-to-late 2000s was exacerbated by climate changes and was, again, a major contributing factor in the Arab Spring in 2011. John Waterbury, 'The Political Economy of Climate Change in the Arab Region' (2013) Arab Human Development Report: United Nations Development Programme.

[454] The Arab Forum for Environment and Development conducted a pan-Arab survey in 2009 that discovered 98% of respondents believed that the climate had changed. And 89% believed that this was anthropogenic in origin. See, (ed) Mostafa K. Tolba and Najib W. Saab, 'Arab Environment: Climate Change: Impact of Climate Change on Arab Countries' (2009) Report of the Arab Forum for Environment and Development 2. The leaders of Saudi Arabia and the UAE have sought to position themselves as taking advantage of economic opportunities associated with decarbonization. As representative of the region's changing outlook, Sheikh Mohammed bin Rashid Al Maktoum, vice president and prime minister of the United Arab Emirates and Ruler of Dubai, announced that, 'We are committed to seize the opportunity to cement our leadership on climate change within our region and take this key economic opportunity to drive development, growth and new jobs as we pivot our economy and nation to net zero.' See, Reuters, 'The UAE Launches Plan to Achieve Net-Zero Emissions by 2050' (October 7, 2021).

The significant multibillion-dollar investments in renewable energy production are positioned as a pathway to allow the countries to meet their rising power demand and preserve more of their hydrocarbon inputs for downstream expansion, such as in petrochemicals, fertilizers, and the energy-intensive industries. The region, indeed, has come a long way from believing that climate change science was a hoax perpetrated by Western countries to obstruct their economic development to becoming major participants in multilateral climate conferences.[455] In a significant departure from its earlier stances, the Saudi Crown Prince, Mohammed Bin Salman, announced an unequivocal link between climate change and the health of the Saudi citizenry.[456]

This chapter analyzes Qatar, Saudi Arabia, and the UAE's positions toward climate change and their decarbonization efforts to critically understand how the Gulf region, and the broader Middle East by extension, intended to manage the complexities of climate change. Qatar, Saudi Arabia, and the UAE are currently implementing policies designed to limit their hydrocarbon consumption, mostly of natural gas, to meet their respective energy-related challenges. These countries are also taking steps to limit their carbon dioxide emissions as the reduction of carbon emissions also leads to a decline in hydrocarbon consumption. Among these steps are (1) the introduction of energy efficiency measures, (2) the incremental reconfiguration of their respective domestic energy pricing regimes, (3) the introduction of policies that require fuel switchovers from more carbon-intensive oil to natural gas and renewable/alternative energy, and (4) signing international agreements to reduce carbon emissions.

[455] This belief was not limited to the Gulf energy-rich countries, China and India at various times promulgated the same theory. The so-called 'Climategate,' which involved hacked emails from the University of East Anglia prior to the 2009 climate negotiations in Copenhagen, was hailed as irrefutable evidence by the Saudi negotiating team and other developing countries that there was, 'No relationship whatsoever between human activities and climate change.' Mohammad Al-Sabban, the lead Saudi climate negotiator, stated that, 'The volume and the size of those sacrifices must be predicated on a sound scientific basis and must be built on a secure foundation of information, which is what we found now is not true and that our high level of trust had suffered,' Richard Black, Climate E-Mail Hack 'Will Impact on Copenhagen Summit' (2009) BBC News; Saudi Arabia Tries to Stall Global Emissions Limits, NPR (Dec. 10, 2009).
[456] Michael Safi et al, So What Has the Rest of the World Decided to Do about Climate Change? The Guardian (London April 19, 2021).

Before the Durban Platform in 2011, the energy-rich Gulf countries viewed climate change as a hoax and that global decarbonization would negatively impact their economic growth. The Gulf countries considered that international decarbonization efforts were merely a stratagem perpetrated by the developed countries to forestall the economic development of the Global South. However, as with the widespread gas allocation shortages and the geopolitical repercussions after the Arab spring, Saudi Arabia, Qatar, and the UAE considered that decarbonization could improve their economic health by forcing them to engage in economic diversification instead of harming their economic growth and reduce their dependence on their mono-exporting status.

This chapter seeks to delineate the contours of the multilateral climate negotiations to illustrate for the reader how Saudi Arabia, Qatar, and the UAE, as well as the Gulf as a region, approached the discussions and how their respective positions evolved over time with them becoming signatories to the Paris Agreement in 2015. Additionally, the chapter will assess the relative robustness and effectiveness of the three countries' Nationally Determined Contributions (NDCs) to foster decarbonization and meet their Paris Agreement pledges.

In terms of the structure of this chapter, Section 7.2 analyzes the Gulf countries positions during the Paris Climate Change Conference of 2015 and of COP26 held in Glasgow in November 2021, where the Gulf countries not only agreed that global warming was a collective threat to humankind but pledged to implement changes in their macroeconomic posture to combat it. This agreement heralded a profound shift from denying the reality of climate change to accepting the basic tenets of decarbonization.

Section 7.3 discusses the COP26 negotiations and analyzes the positions of the Gulf countries against their latest pledges. Section IV supplies a detailed analysis of the three selected countries' NDCs; greenhouse gas reduction pledges submitted prior to the Paris Climate Negotiations in 2015 and will assess the updated NDCs submitted at COP 26 held in Glasgow in November 2021.[457] This section utilizes the World Resources Institute's (WRI)

[457] INDCs were submitted prior to the Paris Climate Negotiations. Subsequent to that, the participants ratified their

methodology to assess NDCs by a three-point matrix of equitability, transparency, and ambition. Section 7.4 concludes the chapter with an overall assessment of the respective decarbonization postures of Saudi Arabia, Qatar, and the UAE and provides recommendations on how they may create successful decarbonization policies to meet their Paris Agreement commitments and COP26 updated pledges

7.2 The Evolution of the Negotiating Positions of Saudi Arabia, Qatar, and the UAE in the Global Climate Accords[458]

7.2.1 The Gulf and the Development of a Carbon Consensus

The global community attempted in 1992 to address the externalities associated with unbridled carbon emissions through the Earth Summit in Rio de Janeiro (Rio Earth Summit), which promulgated the United Nations Framework Convention on Climate Change (UNFCCC). The Convention's primary objective was to create a model that would stabilize greenhouse gas emissions in the atmosphere for the long term at "a level that would prevent anthropogenic interference with the climate system."[459] Moreover, the UNFCCC established a voluntary framework for developed countries to reduce their emissions to 1990 levels by 2000, which most signatories were nevertheless unable to achieve. Saudi Arabia, Qatar, and the UAE, utilizing OPEC as a vehicle, expressed concern that fossil fuels would be unduly (and unjustly in their view) focused upon as the leading cause of global warming. With the view to discrediting the new consensus, OPEC issued a statement calling for "extensive studies on the causes and effects of global warming."[460]

---

pledges which then became Nationally Determined Contributions (NDCs).

[458] Some of the information contained within Section 7.2 is from when I was employed at OPEC as a legal analyst and during my employment at a subsidiary of an Aramco research arm during the period of international climate negotiations in the 2000s and early 2010s.

[459] The UNFCCC entered into force on March 21, 1994. Currently, 191 countries have ratified the Convention. See, United Nations Framework Convention on Climate Change website, Available at http://unfccc.int/essential_background/convention/items/6036.php

[460] *OPEC Fears Attack on Oil Trade at Earth Summit*, China Daily (April 25, 1992); OPEC does not participate in international climate negotiations directly, but its member states do individually. While the positions of other OPEC

Through the joint leadership of Saudi Arabia and Kuwait, OPEC sought to circumvent the formulation of binding global greenhouse gas limitations with a fixed timetable.[461] As Dessai illustrated, their approach was to bring into stark relief the scientific uncertainty about climate change and highlight the perceived flaws in the economic analyses used to assess the impact of proposed climate change remedies.[462] OPEC's primary strategy was to undermine the formulation of any mandatory obligations associated with greenhouse gas emissions reductions.[463] OPEC further insisted that any decisions under the auspices of the Protocol should be by consensus. It should be noted that OPEC customarily promoted consensus agreements during global environmental conferences to maintain veto power over the negotiations.[464]

At the time of the Rio Earth Summit, the issue of anthropogenic climate change was just arriving at the public consciousness. It had only been a mere four years earlier when the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC).[465] Even though the Rio Earth Summit had an ambitious goal of uniting the world community in understanding the dire threat of climate change and mitigating its effects, it failed to achieve its aspiration of stabilizing carbon emissions to the 1990 baseline.[466] Consequently, it was challenging for the parties to agree upon three essential issues inherent

---

member states have fluctuated over time, Saudi Arabia, supported by the hydrocarbon producing states of the UAE, Qatar, and others, had held to a relatively consistent position over time. While there are various secondary issues of concern to Saudi Arabia and the Gulf OPEC member states, the fundamental concern is that the measures undertaken by Annex One countries to limit greenhouse gas emissions would injure the economies of countries that are dependent on hydrocarbon exports.

[461] During the initial global climate negotiations, the representatives of Saudi Arabia and Kuwait promoted the interests of OPEC member states. Saudi Arabia has the most influence over OPEC policymaking, but its interests are not necessarily fully aligned with the national interests of other OPEC member states. National priorities differ within the organization and are much more varied than merely obtaining the highest amount of revenue from oil exports to the global market. However, Saudi Arabia, Qatar, and the UAE tend to have interests, that, at least during prior climate negotiations, align quite closely.

[462] Suraje Dessai, *An Analysis of the Role of OPEC as a G77 Member at the UNFCCC*. World Wildlife Fund (2004)

[463] Ibid.

[464] Ibid.

[465] The IPCC assessments are intended to guide governments to assist in the development of policies to understand and perhaps mitigate climate change. See, *The IPCC Fact Sheet: What is the IPCC*, The International Panel on Climate Change Website at http://www.ipcc.ch/news_and_events/docs/factsheets/FS_what_ipcc.pdf

[466] For a concise analysis of the myriad reasons the Rio Summit failed to reach its objective, see, generally, (ed) Irving M. Mintzer, J. Amber Leonard, *Negotiating Climate Change: The Inside Story of the Rio Convention* (Cambridge University Press, 1994).

in any multilateral environmental treaty, i.e., what should be done, when should it be done, and by whom (See Table 7.1 in the Annex for a detailed listing of the Gulf countries core climate negotiating positons).[467]

And, as will be discussed further below, the factors that tend to doom any international agreement on greenhouse gas emissions to failure are the lack of a credible enforcement mechanism and the absence of mandatory targets.[468] Perhaps the ultimate *success* of the Rio Earth Summit could be attributed to the fact that it brought the importance of climate change mitigation to the world stage and set forth the core principle that greenhouse gas emissions limits should be implemented globally at some future point in time.

In recognizing the necessity to chart a more focused course to reduce global carbon emissions effectively, the international community negotiated the Kyoto Protocol, which set mandatory carbon emissions targets at 5.2 % below 1990 levels by 2012. The Kyoto Protocol created legally binding emissions targets for the developed countries that ratified it, i.e., so-called Annex One countries. The Kyoto Protocol was adopted in 1997 and came into force in 2005, with the first commitment period set for 2008-2012.[469] With the Kyoto Protocol and its firm, mandatory targets, national self-interest came to the fore.

Many environmentalists pointed out what they perceived as being one of the primary deficiencies with the Kyoto Protocol, i.e., that there was a carveout for large emitters, such as China and India, which claimed developing country status (non-Annex One countries) and, therefore, not have to adhere to binding targets.[470] The Kyoto Protocol only covered emissions limitations from the wealthy nations, the Annex One signatories. The non-Annex One countries were the developing countries at the time and not bound to

[467] According to Geoffrey Palmer, the "failure" of the Rio Earth summit was that it lacked political leadership, vision, and commitment. And he believes that perhaps too much was promised, in that the rhetoric did not match any subsequent action. For a detailed analysis of the hurdles that policymakers encountered at the Rio Earth Summit, see, Geoffrey Palmer, *The Earth Summit: What Went Wrong at Rio?*, Washington University Law Review, Vol. 70, Issue 4. (1992).
[468] However, as is often argued, it would be exceedingly difficult to obtain the agreement of the global community for a global climate change pact if it had credible enforcement mechanisms and mandatory targets. And, the lack of an enforcement mechanism, outside of "naming and shaming," is one of the standard criticisms leveled at the Paris Agreement.
[469] Mustafa Babiker, *et al*., *The Kyoto Protocol and Developing Countries*, MIT Joint Program on the Science and Policy of Global Change, Report No. 56 (Oct. 1999).
[470] Ibid.

emissions limitations.

Several hydrocarbon-producing countries expressed concern that the Kyoto Protocol would significantly reduce their petroleum export revenue and that climate change mitigation efforts would unfairly impact them.[471] On average, the Gulf OPEC member states had reserves-to-production ratios (during the 1990s) that would endure for nearly a century.[472] And they, understandably, viewed any carbon emissions limitations as detrimental to their countries' economic and political stability (See Box 7.1).[473] After COP-2, OPEC member states undertook a new strategy to garner more support within the Group of 77 (G-77) for their position. They tabled the proposition that a global compensation fund should be created as a critical part of the Kyoto Protocol negotiations.[474] Even though this suggestion was encompassed within the official Group of 77 (G77) position in 1997, it did not receive the necessary support from developed countries.[475]

Therefore, OPEC member states responded by insisting that Articles 2.3 (minimization of adverse economic impacts) and 3.14 (funding of renewable energy and technology transfer) be included in the Kyoto Protocol and 4.8 as a quid pro quo for their support. Article 4.8 held that:

> Article 4.8 of the UNFCCC commits Parties to give full consideration to what actions are necessary, including actions related to funding, insurance, and the transfer of technology, to meet the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures, especially on... countries whose economies are highly dependent on income generated from the production, processing,

---

[471] N.H Linden NH van Der, *et al.*, *Analysis of the Impact of the Kyoto Protocol on the Export Revenues of OPEC Member States*, Netherlands Energy Research Foundation (ECN) (2004) p.9.

[472] C. van der Linde, *Dynamic International Oil Markets: Oil Market Developments and Structure 1860-1990* (Springer Science & Business Media, 2013) pp. 160-62

[473] Reserves to Production Ratio (R/P) is the remaining amount of a non-renewable resource, articulated in time. The reserve portion of the ratio, as expressed by the numerator, is the quantity of a resource known to be in an area able to be economically produced (proved reserves). However, R/P does not consider potential future reserves growth. For a detailed discussion of R/P, please, see, M. Feygin and R. Satkin, "The Oil Reserves-to-Production Ration and its Proper Interpretation" *Natural Resources Research* (2004) 13: 57.

[474] Mohammed Barkindo, *The Clean Development Mechanism: Is it Meeting Expectations?* OPEC (September 19-20, 2006).

[475] Ibid.

and export, and/or on the consumption of fossil fuels...[476]

Viewing it through the prism of the methodological approach of New Institutional Economics (NIE), the OPEC member states were attempting to mitigate any potential market failure in the global economy that could ostensibly develop by an international climate treaty constraining their ability to export their fossil fuels, as well as the overall cost to implement carbon abatement measures in their countries, or in other words, the transaction costs.[477] Furthermore, the OPEC member states were highly concerned with equity and fairness, not just efficiency, in combatting global warming. The principle of equity is related to both procedural and consequential issues. Procedural issues are embedded in the process of how decisions are made. And the two aspects of procedural equity involve the operative participation in the decision-making processes and the process itself, which is the fundamental principle of equal treatment before the law.

This was developed within Law and Economics, and anchored in NIE, by Coase's social cost model.[478] Coase assumed that there was equal bargaining power among the participants and equal distribution of the costs of making the bargain related to the internalization of externalities.[479] Consequential equity relates to the outcome of decision-making and the distribution of the advantages and costs of mitigating climate change (including future emissions rights) while also managing climate change impacts and adaptation (See Table 7.1).[480] This has a significant effect on burden-sharing amongst countries.

OPEC member states felt that they lacked procedural and consequential equity during the multilateral climate negotiations. In terms of the multilateral climate negotiations between OPEC member states and the Western countries, there was an imbalance of scientific information, institutional capacities, financial assets, and human resources on the bargaining process that the OPEC member states perceived created a lack of procedural

---

[476] It is of note that while "adverse effects" and "impacts of response measures" were linked as being complementary concerns, they are intrinsically different.
[477] See, generally, Jon Barnett, *The issue of 'Adverse Effects and the Impacts of Response Measures' in UNFCCC*, Tyndall Centre for Climate Change Research (July 2001).
[478] Ronald Coase, "The Problem of Social Cost", *Journal of Law and Economics*, The University of Chicago Press, Vol. 3 (Oct. 1960): 1–44
[479] Ibid
[480] *Decision Making Frameworks: Working Group III*, Intergovernmental Panel on Climate Change Website, Available at http://www.ipcc.ch/ipccreports/tar/wg3/index.php?idp=445

equity.[481] And OPEC member states also felt that they were unfairly targeted in the global bid to mitigate climate change as their hydrocarbon-dependent economies would undertake a perceived unfair burden. (See Table 7.2 Appendix A for general equity principles and burden sharing rules) .

[481] Luke Tomlinson, *Procedural Justice and Climate Change: Defining Who Should Be Included in Decision Making Processes of a Climate Change Negotiation*, University of Oxford (2011); Banuri, T., K. Goran-Maler, et al. *Equity and Social Considerations. Economic and Social Dimensions of Climate Change: Contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change* in ed. J. P. Bruce, L. Hoesung and E. Haites. Cambridge (Cambridge University Press.1995).

The wealthy hydrocarbon-producing countries in the Gulf tended to have a contradictory position in the G77. The wave of decolonization during the mid-twentieth century witnessed the emergence of a collective "Global South" identity midwifed through the political ideology known as Third-Worldism. This somewhat unwieldy philosophy failed to paper over the genuine differences that arose after the end of colonialism and the rise of distinct (and sometimes conflicting) national interests in the developing world.[482]

Notwithstanding, the G77 agreed on several fundamental principles when it came to multilateral climate change negotiations. They maintained that climate change is predicted to be so severe as to likely overcome the ability of the relatively weak institutions in their member states to manage the outcomes. Additionally, most G-77 member states believe that developed countries have been principally responsible for the high carbon concentrations in the atmosphere since the industrial revolution. Therefore, the onus and the cost should be borne primarily upon by them as from the principles of "historical responsibility," "equity," and "climate justice" (See Table 7.2 for the various burden-sharing tenets).[483]

Indeed, as will be discussed in depth below, this last principle of historical responsibility harkens back to a fundamental maxim in environmental law, i.e., the polluter-pays principle.[484] The polluter-pays principle is a broadly accepted legal and economic concept that allocates the externalized costs of pollution. It has been incorporated in the environmental liability context as the "wrongdoer," i.e., the polluter, who is under a

[482] Third-Worldism is a political ideology that emerged in the 1940s and 1950s that attempted to unify developing countries that did not join in common cause with either the United States nor the Soviet Union. The political ideologues of this concept argued that the actual issue of geopolitical importance in the world was not the East- West divide, but rather the North-South divide. The Gulf countries faced a somewhat precarious role during the late twentieth century, they were stalwart Western (principally American) allies, and firmly capitalistic, in a group that tended towards anti-Westernism and socialism. For a broad exposition on this theory, please see, (ed) Mark T. Berger, Heloise Weber, *Rethinking the Third World: International Development and World Politics* (Palgrave Macmillan, 2014).
[483] However, the UNFCCC has incorporated the notion of "common but differentiated responsibilities" formalized in the United Nations Framework of Convention on Climate Change (UNFCCC) of the Earth Summit in Rio de Janeiro, 1992. The main issue with many developing countries is how wealthier nations interpret it within the context of carbon emissions reductions.
[484] The Polluter-Pays principle was an organic part of the legal codes in the industrializing countries of the nineteenth century.

legal obligation to rectify any damage done.[485]

The fact that the essential elements of the polluter-pays principle erected the primary hurdles between the G77 and developed countries during multilateral climate negotiations may be recognized in the four central questions that even today customarily shape multilateral climate talks. These questions are:

1) What constitutes pollution?
2) Who are the polluters?
3) How much must the polluters pay?
4) To whom must they make the payment?

The first question, i.e., what constitutes pollution, in this case, greenhouse gas emissions, was articulated during the negotiations. And the answer to the second question, who are the polluters, is less defined but still relatively distinct, i.e., fossil-fuel consuming/greenhouse gas emitting countries. However, the third and fourth issues embedded in the polluter-pays framework remained the principal impediments to the OPEC/G-77 negotiations.

Still, even though the polluter-pays principle has a well-established pedigree, it evolved with imprecise origins. For instance, the early application of the principle can be traced to the Greco-Roman period and efforts to adequately address pollution in the commons since private property law operated in a very restricted scope.[486] Subsequently, the concept became more firmly rooted with the development of private property rights law in Western jurisprudence. Today, the polluter-pays principle lies at the heart of the fundamental philosophical conflicts in international climate negotiations between developing oil-

[485] The origin of the principle was born of the earlier belief that the utilization of resources was free for all. And, the degradation of resources, such as through environmental pollution, was imposed on future users of the resource in question. This was considered an improper cost allocation, or a market failure, that externalized environmental pollution costs. In summary, it provides for the internalization of environmental externalities. This concept was cited as early as ancient Greece whereby in *The Dialogues of Plato: The Laws*, Plato stated the celebrated passage: "If anyone intentionally spoils the water of another…let him not only pay for damages but purify the stream orcistern which contains the water." Plato, *The Dialogues of Plato: The Laws*, 4th ed. Benjamin Jowett, (Oxford: Clarendon Press, 1953, vol. 4.) p.21

[486] Ulrich Beyerlin, "Different Types of Norms in International Environmental Law Policies, Principles and Rules" in (ed) Daniel Bodansky, *et al*., *The Oxford Handbook of International Environmental Law* (Aug. 2008).

producing states and the developed West.

Even though OPEC member states eventually acquiesced to the Kyoto Protocol, which involved Qatar, Kuwait, the UAE, and Saudi Arabia pledging in 2007 to establish a $750 million fund for advanced research into climate change, abiding concerns prompted several legal challenges from oil-producing states.[487] These concerns were related most specifically to Article 2.3, which calls upon Parties to minimize the impact of any policies and measures on "international trade…on other parties, especially developing country Parties…."[488]

Article 3.14 forged a broad consensus between the OPEC member states and the developed world. More specifically, this article calls upon developed countries to "strive to implement" their obligations to minimize adverse social, economic, and environmental impacts on developing country Parties, especially those specified in Article 4.8.[489] The high hydrocarbon demand rates in Annex One countries were critical for OPEC because these countries formed the highest group of consumers for OPEC's output at the time of negotiations.[490]

Many of the impasses were overcome in the Bonn Agreement and the following Marrakesh Accord to the UNFCCC at COP-7.[491] The members of the UNFCCC agreed upon the creation of a special climate change fund, aid for least developed countries to assist in adapting to climate change impacts, limiting the growth of their carbon emissions, and acquiring renewable energy technology.[492] Additionally, Article 3.14 of the Marrakesh Accords required that, during the implementation process of the Kyoto Protocol, developed

---

[487] The opening of the OPEC Summit in Riyadh announced the creation of this fund in November 2007. The purpose of this fund was to focus research upon carbon capture and storage and the development of clean oil technology. *OPEC Annual Report 2007*, Organization of Petroleum Exporting Countries (OPEC) (2008). p.49

[488] For instance, Saudi Arabia challenged OECD climate policies at the WTO's Committees on Trade and Environment and the Non-Agricultural Market Access Negotiating Group. *Energy taxation, Subsidies, and Incentives in OECD Countries and their Economic and Trade Implications on Developing Countries, in Particular Developing Oil Producing and Exporting Countries* (2002). Submission by Saudi Arabia to the World Trade Organization (WTO). WT/CTE/W/215/TN/TE/W/9.

[489] Ibid. Kyoto Protocol

[490] Oil demand in industrialized countries peaked in 2005, reaching approximately 50 million barrels per day. Due to changing demographics and increasing automobile fuel efficiency standards, OECD oil demand will not likely reach that level again. Thomas Helbing, *et al.*, *Oil Scarcity, Growth and Global Imbalances*, International Monetary Fund (April 2011).

[491] The Marrakesh Accord formalized an agreement on the operational rules for global emissions trading, the Clean Development Mechanism, and Joint Implementation, as well as creating a compliance regime and specific accounting procedures. Jon Barnett and Suraje Dessai "Articles 4.8/4.9 of the UNFCCC: The Adverse Effects and the Impacts of Response Measures" *Climate Policy* 2 (3), 2002. pp. 231–239; Suraje Dessai, *The Climate Regime from The Hague to Marrakech: Saving or Sinking the Kyoto Protocol?* Tyndall Centre Working Paper No. 12. The University of East Anglia, Norwich (2001). pp. 231-239

[492] *Governments Adopt Bonn Agreement on Kyoto Protocol Rules*, United Nations (July 23, 2001).

countries produce annual information on what action they are taking to reduce adverse social, environmental, and economic impacts on developing countries.[493]

7.2.2 Copenhagen Accord: The Gulf Countries Agree to Disagree

As stated earlier, the negotiating position of the Gulf States did not fully correspond with others in their developing country alliance. In the eyes of the global community, the Gulf States are the purveyors or the principal cause of climate change, i.e., they are significant fossil-fuel exporters. Additionally, their collective wealth makes it difficult for them to be viewed sympathetically by other developing countries. Still, Gulf countries consider their choice as between Scylla and Charybdis. On the one hand, they face potential economic disaster if the global community enacts robust decarbonization policies and an era of long-term low oil prices ensues.[494] But, on the other hand, there would be an environmental catastrophe if unimpeded carbon emissions continue, especially regarding their fragile ecosystems.

As the lead negotiator for OPEC and the Gulf states, Saudi Arabia was the chief detractor during the Copenhagen negotiations. Saudi Arabia demanded economic aid for oil-producing countries if a new global climate agreement required reductions in global fossil-fuel consumption.[495] In any regard, economic aid would be one possible solution for the Green Paradox. The Green Paradox is the observation by the German economist Hans-Werner Sinn that any environmental policy that becomes progressively stricter over time

---

[493] Saudi Arabia considered this a significant feat. However, Saudi Arabia also desired that this information be placed under the purview of the enforcement branch of the compliance committee. This did not occur due to developed country resistance, and instead fell under the mandate of the facilitative branch. *The Marrakesh Accords and the Marrakesh Declaration*, UNFCCC (Nov. 11, 2001). Available at http://unfccc.int/cop7/documents/accords_draft.pdf

[494] As the period of low oil prices from 2014-2017 illustrated, the Gulf States are still inordinately impacted by global hydrocarbon prices and are not economically diversified enough to be able to absorb the inevitable budgetary deficits that would result from global decarbonization. For example, between 2014-2016, Gulf oil exporting States lost nearly $1 trillion in (potential) hydrocarbon revenue due to the decline in global oil and natural gas prices. See, Gomez Agou, *et al.*, *Financing Fiscal Deficits in Selected MENAP and CCA Oil Exporters*, International Monetary Fund (Oct. 2016).

[495] While most developing countries supported the overall stipulation of financial assistance, most of them criticized Saudi Arabia for demanding that OPEC members should be compensated as well, as this would put them in competition for aid with much more impoverished countries, in particular, the Alliance of Small Island States (AoSIS). See, Suraje Dessai*, An Analysis of the Role of OPEC as a G77 Member in the UNFCCC*, World Wildlife Fund (December 2004). Pp.22-4

operates as an announced expropriation for the producing companies or countries, thereby encouraging them to accelerate resource exploitation, which, of course, would increase overall pollution.[496]

For its part, Saudi Arabia urged that carbon capture and sequestration (CCS) technology be at the centerpiece of ongoing negotiations on the grounds that, despite its oil wealth, it is economically one of the most vulnerable countries.[497] It was noteworthy that Saudi Arabia viewed adaptation not merely as applying to a changing environment but as reconfiguring its economy to adapt to global climate policies.[498] Moreover, Saudi Arabia and its Gulf allies posited that fossil fuel taxes should focus on carbon intensity rather than the energy source, per se (See Table 7.1 Appendix A).[499]

Saudi Arabia and the Gulf states demanded an end to biofuel subsidies claiming they increased global food prices and injured the environment.[500] Overall, Saudi Arabia and its Gulf allies urged that any carbon emissions reductions incorporate the principle of common but differentiated responsibilities and enable developing countries to undertake Nationally Appropriate Mitigation Action (NAMA) voluntarily (See Table 7.2 Appendix A).[501] And most significantly, the Saudi position urged that the adoption of NAMAs be contingent on technology transfer and financial support.[502]

As climate-related policies were the centerpiece of the Obama Administration, it became apparent in the months after the Copenhagen conference that the U.S. pressured Saudi Arabia to associate itself with the accord.[503] Ultimately, Saudi Arabia remained noncommittal, even though its Minister of Petroleum, Ali bin Ibrahim Al-Naimi, was

---

[496] See, generally, Hans-Werner Sinn, *The Green Paradox: A Supply-Side Approach to Global Warming* (MIT Press, 2012)
[497] Gerard Wynn, *U.N. Climate Talks Threaten Our Survival: Saudi Arabia*, Reuters (April 8, 2009).
[498] Additionally, Saudi Arabian negotiators utilized the release of hacked emails from the University of East Anglia in 2009 to argue that climate science was far from settled and that there was evidence to illustrate that there was no relationship between human activities and climate change. Richard Black, *Climate E-Mail Hack 'Will Impact on Copenhagen Summit,'* BBC (Dec. 3, 2009).
[499] Saudi Arabia and the Gulf states prefer this method of assessing carbon intensity because it would privilege oil and natural gas in comparison to coal.
[500] Ibid.
[501] *View of Saudi Arabia with Regards to Climate Change Negotiations*, Saudi Arabia Permanent Mission to the United Nations (2009). Available at http://www.saudimission.org/attachments/043_climate%20change.pdf
[502] Ibid. Also, it appears that at the time of the Copenhagen Conference, the U.S. embassy surmised that Saudi Arabia had not adequately studied the various potential demand scenarios of global decarbonization efforts and felt at a loss as to what position should be taken. *Two Faces of Saudi Arabia's Climate Negotiating Position*, Public Library of US Diplomacy, Wikileaks (Feb. 12, 2010).
[503] Lisa Friedman, *Leaked Cables Show U.S. Pressured Saudis to Accept Copenhagen Accord*, New York Times (Nov. 30, 2010).

instrumental in crafting the final document. And, although the country officially indicated that it was "satisfied" with the agreement.[504]

In contrast to Saudi Arabia, the UAE somewhat embraced the Copenhagen Agreement and became the first OPEC member and the first Gulf State to officially associate itself with the agreement.[505] This early acceptance set the UAE apart from Saudi Arabia. Instead of obstructing the negotiation process, the UAE decided to craft climate change negotiations to its advantage by forging stipulations that would assist its ability to diversify economically. Moreover, the UAE, while accepting the basic tenets of carbon emissions reductions, urged that the principle of common but differentiated responsibilities be observed and that any future treaty should seek to limit the potential impact that economic dislocation would have on hydrocarbon exporting countries. The UAE argued that the U.N. should make market mechanisms available to support CCS technology and provide financial support for nuclear energy.[506]

Qatar had shown little interest in previous climate change negotiations, Relying on its immense patrimony of natural gas. As stated, Saudi Arabia, supported by Kuwait and the UAE, typically led negotiations.[507] Qatar differed from its Gulf neighbors as it was not only the least economically reliant on oil revenue, but it had successfully parlayed its abundant natural gas resources into dynamic economic growth.[508] But, Qatar ended up acquiescing to the Copenhagen Agreement.

Qatar also stressed that natural gas should serve as a bridge fuel while the world transitions to lower carbon emissions.[509] After that, Qatar pressed the U.S. and the E.U. to place increased emphasis on natural gas as an abundant low carbon fuel source.[510] In contrast to

[504] Richard Black, *Copenhagen Climate Deal "Satisfies" Saudi Arabia*, BBC (Jan. 4, 2010).

[505] During climate negotiations, the UAE often offered the contrast of moderation as compared to what was often viewed as "obstructionist" Saudi negotiating tactics. See, Joanna Depledge, *Striving for No: Saudi Arabia in the Climate Change Regime*, Global Environmental Politics 2008 8:4 pp.9-35

[506] The official letter of acceptance from the UAE's Minister of State for Foreign Affairs, available at < https://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/uaecphaccord.pdf

[507] Qatar's lead negotiator, Ali Hamed Abdulla Ali Al-Mulla, when asked about Qatar's position was in international climate negotiations, stated merely that, "We study other countries' positions." Lisa Freidman, Qatar and Some Other Persian Gulf Nations Begin to Walk Their Climate Talk, E&E News (Nov. 26, 2012). Suraje Dessai*, An Analysis of the Role of OPEC as a G77 Member in the UNFCCC*, World Wildlife Fund (December 2004). P.16

[508] Qatar oil production had reached its peak of 845,000 b/d in 2007 and has been declining since. *The Report Qatar 2015*, Oxford Business Group (2015) p.128; For a history of Qatari economic growth, generally see, Zuhair Ahmed Nafi, *Economic and Social Development in Qatar* (Bloomsbury Publishing, 2013)

[509] The Oil & Gas Year Qatar 2010, WildCat Publishing (2010) p. 53

[510] Joshua. Meltzer, *et al.*, *Low Carbon Energy Transitions in Qatar and the Gulf Cooperation Council*, The Brookings

other Gulf energy-rich countries, Qatar argued that global decarbonization could grow its natural gas exports as larger economies transitioned away from coal and oil towards more gas consumption.[511] Qatar also decided that a cap-and-trade system was the most efficacious method to reduce carbon emissions while supporting the global development of CCS technology and deployment.[512]

7.2.3 The Road from Cancun to Durban

After the 2010 Copenhagen Agreement, the concerned nations convened in Cancun, Mexico (COP 16). However, in contrast to the elevated expectations that preceded the Copenhagen Conference, the Cancun attendees held their hopes in check and promoted less ambitious goals. Negotiators used this opportunity to attempt a balanced package of climate protection measures that would, at the same time, avoid the contentious issue of mandatory emissions reduction commitments. Moreover, the parties showed greater willingness to compromise and a greater reluctance to employ the zero-sum brinkmanship that characterized prior negotiations in Copenhagen.

These attendees were able to agree upon a set of collective documents that became known as the Cancun Agreements. Somewhat surprising in retrospect, many of the essential demands of Saudi Arabia, the UAE, and Qatar were met in principle, among them the establishment of a green climate fund that was previously pledged in Copenhagen.[513]

The agreement included a new technology transfer mechanism to facilitate global technology sharing and included provisions on monitoring, reporting, and verification (MERV).[514] More importantly to Saudi Arabia, Qatar, and the UAE, the attendees agreed

---

Institution (Feb. 2014) p.7

[511] Ibid.

[512] Qatar originally intended to create a domestic cap-and-trade system, but the global financial crisis of 2008 hindered its plans.

[513] The guidance outlined in the Cancun Agreements stipulated the policies for administering the aid, which covered both mitigation and adaptation. As a critical compromise, since many developing countries viewed the World Bank as being controlled by Western interests, the fund was to be managed for three years by the World Bank and after that by an agreed upon long-term manager. Nathan Hultman, *The Cancun Agreements on Climate Change*, The Brookings Institution (Dec. 14, 2014).

[514] Ibid. In the Cancun Agreements, countries that domestically funded mitigation efforts would not be subject to

that CCS was officially supported by the Clean Development Mechanism (CDM).[515]

After Cancun, the negotiators met in Durban, South Africa, for the CoP 17 and launched the Durban Platform for Enhanced Action (The Durban Platform). The Durban Platform was a turning point in global climate change negotiations because it recognized the necessity of effectively managing climate change more permanently. The Durban negotiators sought to implement, by 2020, at the latest, a new legally binding global climate treaty. In fact, however, the Durban Agreement was an "agreement to agree" by 2015 on a new treaty that carried with it the force of law. [516]

The Durban Platform achieved what was once thought impossible. It persuaded the Gulf countries, which were (and are) the highest per capita carbon emitters globally and the holders of about 40% of the global oil reserves and about 23% of the world's natural gas, to accept a legally binding climate regime. After stiff eleventh-hour resistance, the Gulf countries finally acquiesced to a global carbon limitation accord.[517] Having been accepted by all 194 nations that took part in the negotiations, the Durban Platform set a deadline for talks in 2015 and a 2025 deadline for a finalized treaty. The Durban Platform was particularly meaningful in that it was crafted to nullify the gaps of the Kyoto Protocol that exempted from its provisions a number of rapidly growing emerging economies, including the Gulf countries and India/China. This is notable because, in the aggregate, these exempted nations are responsible, in the early 2020s, for approximately 63 % of carbon emissions.[518]

The Durban Platform represented an understanding that the Gulf countries, relying on industrialization policies predicated on energy-intensive industries, and being the world's primary energy-exporting countries, realized that the "post-oil age" was upon them and

---

international monitoring, reporting, and verification. Only nations that received international funding would be subject to those mentioned above.

[515] Tim Dixon, Gregory Leamon, Paul Zakkour, Luke Warren, "CCS Projects as Kyoto Protocol CDM Activities," *Energy Procedia*, Volume 37, 2013, Pages 7596-7604,

[516] There was considerable debate as to the legal status of the international climate accord to be drafted by 2015. An early draft of the Durban Platform utilized the term, "legal instrument," while another document indicated that it would be a relatively weaker, legally speaking, "protocol." Ultimately, it was agreed upon that it would be an "outcome with legal force." See, *Durban: Towards Full Implementation of the UN Climate Change Convention*, United Nations Framework Convention on Climate Change. Accessed on 3/12/2017

[517] John Broder, *Climate Talks in Durban Yield Limited Agreement*, New York Times (Dec. 11, 2011).

[518] *Developing Countries are Responsible for 63 % of Current Carbon Emissions*, Center for Global Development (Aug. 15, 2015). Available at https://www.cgdev.org/media/developing-countries-are-responsible-63-%- current-carbon-emissions

acted accordingly.[519] Indeed, as discussed below, Gulf countries began to take a more proactive role in climate change talks after the Durban climate negotiations. The actions of the Gulf States are driven by enlightened self-interest, as these countries were experiencing an energy allocation crisis with an average of 6 to 8 % of natural gas demand growth per annum during the 2000s and 2010s.[520] These actions of the Gulf countries are also undergirded by the realization that their region could potentially be uninhabitable within the next several decades, if not sooner.[521] Therefore, comprehensively, reducing carbon emissions represents an impetus to develop coherent solutions to bridge problems that inhere in the climate and energy domains.

7.2.4 Qatar Takes the Driver's Seat: The Doha Negotiations

The global community intended that the 2012 United Nations Climate Change Conference (COP 18) be a steppingstone to the 2015 negotiations that hopefully lead to a binding international climate treaty. However, the Doha negotiations, held in December 2012, were a watershed moment in their own right. Doha was the first time that multilateral climate negotiations were hosted in the Middle East. It represented the occasion when Gulf negotiators embraced climate change negotiations as potentially beneficial to their countries on multiple levels.[522] Moreover, the Doha negotiators agreed to extend the Kyoto Protocol (then set to expire at the end of 2012) until 2020. Further, Doha affirmed the Durban Platform so that a successor document to the Kyoto Protocol could be developed by 2015 and put into force by 2020.[523]

The Doha talks did not discuss actual carbon emissions reductions. But a key concession was made by developed countries in acknowledging that they could be obligated to

---

[519] Justin Dargin, *A Model in Preparation for a 'Post Oil world*, Alexander's Gas and Oil Connections (Mar. 20, 2009)

[520] For a broad examination of the rate of gas demand growth in the Gulf region, see, Amy Myers Jaffe, *et al.*, *The Gulf Cooperation Council Natural Gas Conundrum: Geopolitics Drive Storages Amid Plenty*, Belfer Center: Harvard University (Oct. 2013).

[521] Jeremy S. Pal, Elfatih Eltahir, "Projected Temperature in Southwest Asia Projected to Exceed a Threshold for Human Adaptability," *Nature Climate Change* 6, 197-200 (2016).

[522] However, the fact that Qatar, the world's largest greenhouse gas emitter per capita hosted the conference, was criticized by some quarters. Robin Mills, *Doha Climate Talks Will Turn Spotlight on Gulf Countries*, The National (Dec. 6, 2011).

[523] Doha Amendment to the Kyoto Protocol, availableat http://unfccc.int/files/kyoto_protocol/application/pdf/kp_doha_amendment_english.pdf

compensate developing countries that are especially vulnerable to the adverse effects of climate change, including those affected by extreme weather events or the slow onset of increased temperatures.[524] This was significant because, until Doha, developed countries agreed only to finance developing countries' efforts to adapt to climate change and acquire renewable energy technology. The Alliance of Small Island States (AOSIS) especially supported the adoption of the Loss and Damage principle in the text because, from their perspective, the era of mitigation had concluded, and their countries are currently dealing with the detrimental effects of climate change which requires a focus on adaptation.[525]

There was a significant degree of last-minute resistance by Russia, Kazakhstan, Poland, Ukraine, and Belarus, which sought to utilize the 13 billion in remaining pollution permits, i.e., Assigned Amount Units (AAUs) granted during the first Kyoto commitment period.[526] This was resolved, however. Even though an agreement under existing Kyoto rules that allowed AAU carryover was unchanged, the countries that set a reduction target under the second commitment period were permitted to purchase up to 2 % of the AAUs they acquired from other countries during the first commitment period.[527]

Qatar, as host of the climate negotiations, faced significant international pressure to undertake a "grand gesture" that illustrated its commitment to the biosphere by pledging an ambitious carbon emissions reduction framework, by providing climate adaptation funding for impoverished countries or by making some other substantial contribution in the concerted action against global warming.[528] There was also significant criticism that not only as of the host of the CoP 18 proceedings but as its president, Qatar had not acted with transparency. This caused concerned observers to wonder at Qatar's motives for hosting

[524] See *Warsaw International Mechanism for Loss and Damage Associated with Climate Change Impacts*, United Nations Framework Convention on Climate Change Webpage. Accessed December 12, 2017, Available at http://unfccc.int/adaptation/workstreams/loss_and_damage/items/8134.php

[525] For a concise exposition of the position of the Alliance of Small Island States in regards to loss and damage due to climate change, see *Alliance of Small Island States (AOSIS) Declaration on Climate Change 2009*, Available at https://sustainabledevelopment.un.org/content/documents/1566AOSISSummitDeclarationSept21FINAL.pdf

[526] This issue was quite contentious as existing Kyoto rules allowed the carryover of unused AAUs into the following commitment period. The AAU surplus is known colloquially as, "hot air," because formerly managed economies initially chose fragile reduction targets during the first commitment period and consequently received millions of AAUs that were deemed by many observers as unnecessary. Romain Morel and Igor Shishlov, *Ex-Post Evaluation of the Kyoto Protocol: Four Key Lessons for the 2015 Paris Agreement*, Climate Report #44 (May 2014).

[527] See, *Outcome of the Work of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol*, United Nations Framework Convention on Climate Change (Dec. 8, 2012). p. 3. Available at http://unfccc.int/resource/docs/2012/cmp8/eng/l09.pdf

[528] Lisa Friedman, *Qatar Pressured to Cut Emissions as New Climate Talks Begin*, Scientific America (Nov. 26, 2012).

the conference and question its fundamental views on climate change.[529]

Ahead of the negotiations, and until the October preceding COP 18 when Qatar formed a team to study and craft a negotiating position, critics characterized Qatar's behavior as "lackadaisical."[530]

And, as with previous climate summits, one of the most contentious issues dealt with funding commitments promised to developing countries. Part of the agreements reached during the Cancun summit (COP 16) required that developed countries agree to pledge $30 billion over the period from 2010-2012 and Long-Term Finance pledges of $100 billion per annum by 2020.[531] In Doha, a key issue of contention concerned the funding commitments between 2012-2020, i.e., the mid-term finance period.[532] This was resolved with a final agreement that encouraged developed countries to grant $30 million over the mid-term period.[533] The reluctance of developed countries to provide concrete financial pledges resulted from their budgetary difficulties, compounded by the perception that their respective citizenries had aid fatigue and would not support spending billions of dollars in faraway lands.

However, there was a significant volte-face during the proceedings when the four Gulf countries of Saudi Arabia, Bahrain, the UAE, and Qatar transformed their long-held negotiating position during the Doha conference on the issue of emissions reductions commitments and pledged that they would be ready to submit NAMAs to the United Nations.[534] The four countries stressed that the UNFCCC's Bali Action Plan granted recognition of national plans that allow progress on combatting climate change through

---

[529] John Parnell, *COP 18: Qatar Emissions Pledge Could Soothe Climate Talks Tension*, Climate Home News (Nov. 27, 2012).

[530] Ibid. *Qatar Pressured to Cut Emissions as New Climate Talks Begin*

[531] However, there were still issues that developing countries brought up as to whether much of this financing was composed of new funding or was merely previous foreign aid commitments that were repackaged. *Summary of the UNFCCC Climate Change Conference in Doha, Qatar 26 November-7 December 2012*, United Nations Development Programme Climate Community (UNDPCC) (2012) p.5 Available at http://www.undpcc.org/docs/UNFCCC%20negotiations/UNDP%20Summaries/2012_12%20December%20Doha/UNDP%20COP18%20summary.pdf

[532] Ibid. Developing countries also proposed $60 billion per year by 2015.

[533] Ibid. Some developed countries (UK, France, Germany, Denmark, Sweden, and the EU Commission) did make concrete pledges that totaled nearly $6 billion up to 2015.

[534] The statement itself, however, was quite ambiguous. It did not state when they would formally submit NAMAs nor how ambitious would be their targets. See the official statement from the four Gulf countries at, *Submission from Bahrain, Saudi Arabia, Qatar and the United Arab Emirates*, United Nations Framework Convention on Climate Change: Conference of the Parties, Eighteenth Session (Dec. 7, 2012). Available at http://unfccc.int/resource/docs/2012/cop18/eng/misc02.pdf

economic diversification with mitigation co-benefits.[535] Even though these four Gulf countries were exceedingly vague on their plans to reduce carbon emissions, their collective action was historic. In a sense, the past resistance to climate change as a principle was overturned, and the pivotal issue would not be whether climate change exists, but how the Gulf nations should reduce emissions and by what amount.[536]

This was illustrated by a Saudi climate negotiator, who indicated that in contrast to the past Saudi position, the current Saudi view is that "Based on scientific evidence on climate change, the world needs to take action."[537]

7.2.5 The Paris Agreement: The Gulf Agrees to Carbon Emissions Reductions

Even though progress generally occurs in fits and starts, the Paris negotiations (CoP 21) held from November 30-December 12, 2015, reconfigured the pathway of past climate negotiations and brought a comprehensive agreement on greenhouse gas reductions. The consensus reached during the Paris Agreement reflected that the representatives of 196 nations agreed to keep increases in the 'global average temperature to well below 2 percent Celsius above preindustrial levels.'[538] On April 21, 2017, the parties further agreed for each

---

[535] Ibid, The Bali Action Plan was formulated at COP 13, which was convened in Bali, Indonesia. The Bali Action Plan did not create binding greenhouse gas reduction limitations but did include language that allowed economic diversification and sustainable development to manage global warming. And it also envisioned global action on technological development, green financing, and adaptation.
See, generally, *Bali Action Plan*, available at https://www.env.go.jp/earth/ondanka/10year/cp_bali_action_plan.pdf

[536] The former Saudi Oil Minister, Ali al-Naimi, reiterated the fundamental principle of Common but Differentiated Responsibilities when he stated at the Doha conference that, "We believe that all people, and all governments, share this responsibility and each and every one of us has a role to play, taking into account the need for developed countries to take the lead in this regard, based on their historical responsibility," Humeyra Pamuk, *Saudi Arabia Sees Need to Act on Climate Change*, Reuters (Dec. 5, 2012).

[537] Ibid. This contrasted with the official Saudi position a mere three years earlier when the lead Saudi negotiator, Mohammed Al-Sabban stated at the Copenhagen conference that," Climate is changing for thousands of years, but for natural and not human-induced reasons." Richard Black, *Climate E-Mail Hack 'Will Impact on Copenhagen Summit*,' BBC News (Dec. 3, 2009).

[538] This is in the preamble of the Paris Agreement. This was followed by the sentence, '... and to pursue efforts to limit the temperature increase to 1.5 degrees C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.' However, of note was that even though the text of the Paris Agreement indicates that if all the signatories adhere to their pledges, the world is still expected to surpass the critical two degrees of warming threshold. And, as small island nations noted during the proceedings, even keeping a rise to two degrees Celsius would still likely submerge their countries. Roger McLean et al, 'Small islands. Climate Change 2007: Impacts, Adaptation and Vulnerability' (2007) Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. It is expected that subsequent agreements will create broader and deeper carbon reductions. The full text of the Paris Agreement is available at: <http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>

nation to sign the agreement officially.

Most countries arrived at the Paris conference with a voluntary carbon emissions reductions pledge, and the Paris Agreement codified those pledges and created a framework for the signatories to implement those reductions starting in 2020. Each country individually determines its contribution, which the Agreement's language characterizes as 'nationally determined contributions (NDCs).'[539] But as 2020 was the deadline for the signatories to the agreement to create and submit a plan for longer-term carbon emissions reductions, the Covid-19 pandemic caused a disruption, and the target date had not been met in 2020 for many of the signatories. In that sense, the Paris Agreement is an evolving document insofar as the submitted pledges must be re-evaluated and registered every five years to the UNFCCC Secretariat[540] in a collective effort to transition the world closer to the target temperature rise of between 1.5-2 degrees Celsius.[541]

The Paris Agreement did not set a firm target date for the goal of net-zero emissions of greenhouse gases. Still, it stated that by approximately 'mid-century,' any greenhouse gases emitted must be balanced out by removing an equivalent amount from the atmosphere.[542] However, while Covid-19 did cause a fair amount of confusion with many countries unable to meet their submission targets, the pandemic also acted as an impetus for both governments and businesses as they prioritized climate action as part of their Covid-19 recovery plans.[543] As of 2021, more than 100 countries have signed up to achieve net-zero commitments by 2050 in a climate alliance that the UN has been promoting.[544]

Nonetheless, while the pledged NDCs are binding upon the parties, several questions are

[539] Paris Agreement, Art 3.
[540] Paris Agreement, Art 4.9. The initial pledges at the Paris Conference, known as the Intended Nationally Determined Contributions, unless otherwise specified, are to be considered the initial Nationally Determined Contributions.
[541] Paris Agreements S 3 Art 23 states, 'Urges those Parties whose intended nationally determined contribution according to decision 1/CP.20 contains a time frame up to 2025 to communicate by 2020 a new nationally determined contribution and to do so every five years after that under Article 4, paragraph 9, of the Agreement.' The Paris Decision Text is available at <http://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf>
[542] Paris Agreement Art 4.1
[543] UN, 'Commitments to Netzero Double in Less than a Year' (2020) UN Climate Press Release.
[544] Megan Darby and Isabelle Garetsen, Which Countries have a Net Zero Carbon Goal, Climate Home News (June 14, 2019).

raised about their obligations, which will necessarily depend upon the interpretation rendered to the text of the language in each provision. Some provisions of the Agreement contain categorical obligations, for example, language that provides that each party is obligated to pursue domestic mitigation measures.[545] Other provisions are less categorical, such as those relating to developing countries' transition to emissions reduction targets.[546] And yet other provisions have enabling characteristics that merely seek to induce coordinated action on a global scale, one example being the requirement for the joint implementation of Parties' mitigation obligations.[547] In that vein, the operational framework of the obligations in the Paris Agreement will depend upon how they are termed and the interpretation of those provisions during implementation.

However, suffice it to say, there is no apparatus to enforce implementation of the treaty's provisions if, for example, a country fails to set a target in their NDC by a specific date or if a pledged period in the NDC is delayed or otherwise not forthcoming. The global community, as of the early 2020s, only has the tools to 'name and shame' if a country deviates from compliance.[548] The lack of a robust compliance mechanism and transparency requirements make a consensus of this type especially fragile, particularly given the lack of legal consequences for a wilful failure or an inability to perform.

Moreover, the departure of several countries could kindle the exit of even more countries in a vicious circle, thus, causing the entire schema to collapse.[549] This would represent a tragedy of the commons scenario because multilateral environmental agreements depend on consensus and unanimity of the agreement and on the perception that other countries are upholding their obligations in good faith.[550]

[545] Paris Agreement, Art 4.2.
[546] Paris Agreement, Art 4.4.
[547] Paris Agreement, Art 6.
[548] Catherine Martini, 'Transparency: The Backbone of the Paris Agreement' (2016) Yale Center for Environmental Law and Policy.
[549] Bryan Druzin, 'A Plan to strengthen the Paris Agreement' (2016) Fordham Law Review 18.
[550] Wagner and Wietzman suggested that a potential solution to the free rider issue of international climate treaties would be to form a 'climate club.' This group of nations that adhere to climate treaties would impose border adjusted taxes on countries not following their obligations, See, Gernot Wagner and Martin L. Weitzman, Climate Shock: The Economic Consequences of a Hotter Planet (Princeton University Press 2015); William Nordhaus, 'Climate Clubs to Overcome Free-Riding' (2015) Issues in Science and Technology 4; However, as Ostrom suggested, a polycentric approach of overlapping local, regional and global frameworks could be an effective and comprehensive method to combat climate change. See, generally, Elinor Ostrom, 'A Poly-centric Approach for Coping with Climate Change' (2009)

While at previous climate negotiations, the UAE, Saudi Arabia, and Qatar presented a united front on most critical issues, the Paris conference illustrated some variances in negotiating positions (See Table 7.1 Appendix A for the core climate negotiating positions of the Gulf countries). However, what was apparent is despite economic concerns about the impact of decarbonization on the Gulf countries, these respective nations appeared to accept the reality of climate change finally, and each presented varying levels of efforts at participation.

Overall, the evolution of understanding the impact of climate change was most dramatically illustrated by the Islamic Declaration on Global Climate Change issued by influential Islamic theologians on August 18, 2015, ahead of the Paris Conference, that stated the world's 1.6 billion Muslims and Muslim majority governments have the religious duty to reduce greenhouse gas emissions.[551]

At previous environmental conferences, other participants accused Saudi Arabia of attempting to 'wreck' the summit to protect its hydrocarbon exporter status.[552] Before the Paris Conference, however, Saudi Arabia had submitted an INDC that pledged to achieve mitigation co-benefits of up to 130 million tons of carbon dioxide equivalent a year by 2030.[553] Yet, as discussed below in Section 7.3.1, the Saudi pledge contained numerous caveats.[554] Saudi Arabia not only failed to provide figures or forecasts of future emissions growth, but it also stressed that its plans to deploy renewable energy and implement its energy efficiency goals depend upon strong economic growth from oil exports.[555] During the negotiations, Saudi Arabia opposed any mention of 1.5 degrees Celsius as the more

---

World Bank Policy Research Working Paper No 5095.

[551] While this declaration holds neither legal nor political power to compel countries nor individuals, it does illustrate the changes occurring in the Islamic world as it relates to environmental issues. And this is part of a general trend of the major global religions taking a theological stance that an important aspect of human stewardship of the earth is to mitigate climate change. Pope Francis published a papal encyclical letter that declared the science behind climate change was clear and that the world's 1.2 billion Catholics have a moral duty to protect the environment from global warming. See, 'The Islamic Declaration on Global Climate Change' <http://www.ifees.org.uk/declaration/>; Encyclical Letter, Laudato Si of the Holy Father Francis on Care for Our Common Home, Libreria Editrice Vaticana (May 24, 2015).

[552] Suzanne Goldenberg, 'Saudi Arabia Accused of Trying to Wreck Paris Climate Deal' The Guardian (London, December 8, 2015).

[553] The Intended Nationally Determined Contribution of the Kingdom of Saudi Arabia Under the UNFCCC <http://www4.unfccc .int/submissions/INDC/Published%20Documents/Saudi %20Arabia/1/KSA-INDCs%20English.pdf>

[554] For instance, it was also the last G20 country to submit its INDC ahead of the Paris Conference.

[555] Alex Pashley, 'Saudi Arabia Submits Climate Pledge to UN Deal' The Guardian (London, 10 November 2015); (n 24).

ambitious global warming target temperature and objected to 2050 being the decarbonization target date for its economy. Other negotiators criticized Saudi Arabia's opposition to periodic reviews of its greenhouse gas reduction plans. The Saudi negotiator simply stated that 'it is unacceptable for developing countries, like my own, to be asked to participate in this so-called ratchet mechanism.'[556]

A Saudi delegate also stated that his country did not have the administrative structure to adhere to specific provisions requiring updating figures and forecasts. Instead, he pled, 'we developing countries don't have the capacity to do this every five years. We are too poor, we have too many other priorities. It's unacceptable.'[557] Furthermore, Saudi Arabia insisted that only developed countries should contribute to the Green Climate Fund.[558] Moreover, the Saudi delegation argued that if the Loss and Damage mechanism were to compensate small island states, Saudi Arabia should also be protected from the loss of future oil revenue by receiving financial aid to invest in renewable energy technology.[559] While many of these positions were not new, the standard negotiating position of even some of Saudi Arabia's closest conference allies diverged from its position (and negotiating style) starkly.[560]

However, Saudi Arabia's role during the Paris Conference somewhat obscures the significant fact that Saudi Arabia, while objecting to several ambitious stipulations in the Agreement, ultimately agreed to the central premise that action must be taken to combat global warming. This fundamental reconfiguration of the Saudi position is illustrated by the announcement of the former Saudi Oil Minister, Ali Al Naimi, in May 2015, when he declared, 'in Saudi Arabia, we recognize that eventually, one of these days, we are not going

[556] (n 26).
[557] Saudi Arabia currently ranks as the world's fifteenth largest economy; (n 26).
[558] ibid.
[559] ibid.
[560] Saudi Arabia's insistence on its position also caused some discord with other Arab League members. Egypt has officially supported the 1.5-degree Celsius target at the onset of negotiations, while Morocco, was the first Arab country to submit its INDC, and as one of the region's most proactive Arab nation on climate change issues hosted the 2016 Marrakesh Climate Change Conference. And Jordan, Morocco, and Tunisia submitted INDCs that are more progressive than Saudi Arabia's. However, as a bloc, due to Saudi Arabia's influence in the organization, the Arab League was the only group opposing the 1.5 degrees Celsius target. Many Arab countries are wary of dissenting from the Saudi position as they often depend upon the Kingdom for political stability in the region and intermittent aid infusions when they have economic crises. The issues of regional political security and foreign aid became even more critical after the Arab Spring in 2011.

to need fossil fuels. I don't know when, in 2040, 2050, or after that,'[561] Saudi Arabia's newfound perspective on climate change contrasted with the position of the Trump Administration, which sought to increase fossil-fuel exports and withdraw from the Paris Agreement. And Saudi Arabia, the most influential OPEC member, led the organization to embrace the Paris Agreement in February 2016.[562] Utilizing highly nuanced language, a Saudi delegate noted that 'we need to recognize that the climate issue is a global issue. This process is resilient enough to move forward....'[563] Suffice it to say, Saudi Arabia will follow the prevailing trends and would be extremely unlikely to withdraw from the Agreement.

During the Paris negotiations, the UAE and Qatar proved to be much more flexible and ambitious in their negotiating positions than the Saudis. For instance, ahead of the Paris conference, the UAE, while tardy, submitted one of the more ambitious INDCs, which seeks to reduce carbon emissions by generating 24% of its power from renewable and nuclear energy by 2021.[564] And, before the conference, the Emirati director of energy and climate change at the Ministry of Foreign Affairs announced that 'the UAE is prepared to work with other nations to combat climate change.'[565] He stressed that 'the UAE is fully committed to the negotiation process...and...we firmly believe that through global partnership and domestic policy, we can overcome climate challenges and turn them into opportunities to build a more diversified and sustained economy.'[566]

The difference in opinion between Saudi Arabia and the UAE relates to how each country views the potential impact of the global effort to decarbonize. For instance, Saudi Arabia, until recently, regarded any movement to reduce global carbon emissions as damaging to its economy. As a significant oil exporter, the UAE viewed decarbonization similarly during previous negotiations. Subsequently, it recognized that it could leverage prevailing global trends to restructure its economy and aid its diversification efforts in fundamental ways.

[561] Pilita Clark, 'Kingdom Built on Oil Foresees Fossil Fuel Phase-Out This Century' Financial Times (London, 21 May 2015)
[562] OPEC Bulletin, 'The Organization of Petroleum Exporting Countries' (2016) 2.
[563] (n 32).
[564] The UAE submitted its INDC on October 22, 2015. Intended Nationally Determined Contribution of the United Arab Emirates, United Nations Framework Convention on Climate Change ((ct. 22, 2015) 2. Available at <http://www4.unfccc.int/ndcregistry/ PublishedDocuments/United%20Arab%20Emirates%20First/UAE %20INDC%20-%2022%20October.pdf>
[565] Naser Al Wasmi, 'UAE's Environment Goals Set Out Ahead of Crucial Paris Conference' (2015) The National.
[566] ibid.

Therefore, while the UAE would still desire to benefit from the fossil-fuel economy for as long as possible, it recognizes the inherent benefits that it could acquire from becoming a first mover.[567]

Qatar, which has one of the highest per capita carbon emissions globally, reaching nearly 50 metric tons per person, diverged from both the UAE and Saudi Arabia. This divergence was a particularly contentious issue for many attendees. As mentioned previously, Qatar tended to have a quietist perspective during climate negotiations and allowed Saudi Arabia to set the general tone as the lead Arab negotiator. However, after having hosted CoP 18 in 2012, Qatar has become one of the most proactive countries in bringing climate change issues to the forefront of Arab consciousness.

Much like the UAE, Qatar recognizes how much it stands to benefit (being the world's largest producer of LNG and third largest holder of conventional natural gas) from global decarbonization because natural gas is positioned to be a transition fuel while the world moves away from coal and oil.[568] At the same time, Qatar recognizes its extreme vulnerability to climate change. A sea-level rise of less than five meters would flood 18.2 % of its land area.[569] This scenario would have a disastrous impact on Qatar as 96 % of its population lives in coastal areas.[570] Given the shallow depths of its marine waters, even relatively slight temperature increases would have a disproportionate impact. Recent studies have also concluded that by 2100, many areas of the Gulf could become intolerable for human life because of higher temperature levels.[571]

Therefore, the prospects of economic benefits and apprehensiveness regarding ecological catastrophe led Qatar to take a non-antagonistic stance toward global decarbonization

---

[567] Jo Lo, 'UAE Sets Net-Zero By 2050 Target, Promises Renewable Investments' (2021) Climate Change News.

[568] A bridge fuel is a low carbon-intensive energy source that can be utilized instead of coal or oil that will allow the world time to develop/deploy other reduced or non-carbon energy alternatives. For a cogent discussion of the role of natural gas as a bridge fuel, see, Steve Weissman et al, 'Natural Gas as a Bridge Fuel' (2016) Center for Sustainable Energy.

[569] Abdulhadi Nasser Almarri, 'Climate Change in Qatar' (2016) 4 QScience Proceedings 4.

[570] Owen Mulhern, 'Sea Level Rise Projection Map-Qatar and Bahrain' (2020) <https://earth.org/data_visualization/sea-level-rise -by-2100-qatar-and-bahrain/> accessed 1 December 2021.

[571] Jeremy Pal and Elfatih A. B. Eltahir, 'Future Temperature in South-west Asia Projected to Exceed a Threshold for Human Adaptability' (2016) Nature Climate Change 6, 197-200.

efforts. When Qatar submitted its pledge to CoP 21, it stated that 'Due to Qatar's dependence on the export of oil and gas, there is an uncertainty from the potential impact of the implementation of response measures to climate change that may negatively impact the strength of Qatar's economy and potentially the quality of life of its residents.'[572] As discussed in Section IV.3, Qatar's INDC did not contain any firm targets. Still, it highlighted that it is in the process of deploying its available resources to achieve energy efficiency and is, therefore, investing substantial sums in other natural resources such as solar energy.

Qatar's INDC disclosed that it has contributed 'indirectly to global efforts to mitigate climate change by exporting Liquified Natural Gas as clean energy.'[573] Because the INDC lacked clear and defined carbon reduction targets, Brazilian Environment Minister, Izabella Teixeira, singled out Qatar and other wealthy developing countries for submitting INDCs that did not commit to an absolute carbon emissions reduction.[574] Nonetheless, this criticism does not negate the proactive stance that Qatar has had overall during the negotiations, which was a stark departure from its earlier apparent lack of interest.

7.2.5 COP 26: The Establishment of Enhanced Frameworks

In order to strengthen the agreements made in Paris, the world came together again in Glasgow for COP 26. Ministers from all over the world agreed that firmer efforts should be made to submit more robust 2030 emissions reduction targets to close the gap to limiting global warming to 1.5 degrees Celsius.[575]

Adaptation figured high on the program as ministers agreed that developed countries should funnel more resources to assist developed countries more at risk to extreme climatic events to adapt to the changing world, which could witness ever-in-creasing devastating storms and lower crop yields, droughts, and population dislocation.

[572] INDC Qatar, 6
[573] INDC Qatar, 2
[574] Alex Pashley, 'Brazil Minister Calls Out Emerging Economies Over Weak Climate Pledges' (2015) Climate Home News.
[575] In the COP 26 decision, it states that countries, resolve to pursue efforts to limit the temperature increase to 1.5 degrees C.' As a result, this gives much greater focus on the lower temperature threshold than even the Paris Agreement.

Many environmentalist groups questioned the legitimacy of COP 26 for what was perceived as being unduly restricted participation by observers representing hundreds of environmental, academic, indigenous, women's rights, and climate justice groups.[576] However, that does not negate the fact that some successes arose from the negotiations, which made progress in many areas.

At the conclusion of COP 26, 151 countries had submitted updated NDCs to further trim their carbon emissions by 2030. However, the UN analyzed the NDCs and calculated that if these plans are collectively adopted as in, then the world temperature will increase by 2.5 degrees Celsius.[577]

A number of countries announced fresh net-zero emissions commitments to be reached around mid-century, including Saudi Arabia and the UAE, as discussed in Section 4.0. Yet, many environmental groups consider that some major emitters have undefined 2030 targets, resulting in unclear pathways to achieve their net-zero targets.[578] As a result, the Glasgow decision calls upon countries to 'revisit and strengthen' their 2030 targets by the end of 2022 to further align them with the Paris Agreement's temperature increase targets.[579] The COP26 decision also requested that countries submit long-term strategies to 2050, which would help facilitate a low-carbon transition by mid-century.

Additionally, the COP26 decision requested that countries consider implementing policies to reduce other greenhouse gases, such as methane, and introduced language to 'phase down unabated coal' and 'phase-out fossil fuel subsidies.'[580] Therefore, while it is widely considered that more work has to be done, Glasgow did set the groundwork for the collective decarbonization momentum. OPEC Secretary-General, Mohammad Barkindo, dubbed

---

[576] Nina Lakhani, 'COP26 Legitimacy Questioned as Groups Excluded from Critical Talks' The Guardian (London, 8 November 2021).

[577] This increase is considered much better than the 4 degrees Celsius track that the world was headed on prior to the Paris Agreement, but climatologists still consider this increase significantly dangerous; World Resources Institute, 'COP26: Key Outcomes from the UN Climate Talks in Glasgow' (2021).

[578] Ibid.

[579] ibid; UN, 'COP26 Keeps 1.5 C Alive and Finalises the Paris Agreement' (2021) UN Climate Change Conference UK 2021.

[580] This was the first time in international climate negotiations that negotiators included direct language to transition away from coal and phasing out hydrocarbon subsidies.

these talks a 'wake-up call' because even though the global oil and gas industry did not suffer any significant disruption from specific pledges-as there were no decisive plans to phase out hydrocarbons-the talks did formally set the hydrocarbon industry in its sights as needing to be focused upon.[581]

In addition to its language to phase down coal and phase out hydrocarbon subsidies, COP26 also seemed to serve as a harbinger of a post-oil world with the establishment of the first country-led effort to accelerate the global shift away from oil and gas production/consumption to low-carbon energy. The Beyond Oil and Gas Alliance, unveiled by the governments of Costa Rica and Denmark, seeks to drive an equitable global transition from fossil fuels to achieve the Paris Agreement goals of limiting global temperature rise to 1.5 degrees Celsius.[582] The establishment of the Beyond Oil and Gas Alliance signaled a conceptual shift in international climate negotiations, which sought to move the conversation away from merely focusing on GHG emissions to assessing the sources of those emissions, such as oil, gas, and coal.[583]

Meanwhile, the Gulf countries attempted to influence the language to make it more amenable to their hydrocarbon-based macroeconomic postures. The Gulf countries, joined by other major developing economies, intervened to soften the language to change the proposed wording of 'phasing out' of unabated coal power' to the more flexible term, 'phasing down.' The US and EU backed the incorporation of language phasing out fossil-fuel subsidies and coal-fired power, but many major hydrocarbon producers resisted it. Additionally, countries like South Africa and Nigeria, which significantly rely upon coal and oil consumption, objected to a non-nuanced rejection of fossil-fuel subsidies.[584]

But, it is not lost on the major hydrocarbon producing countries that there is likely to be more significant pressure placed on them and their primary exports throughout this decade

[581] Robert Perkins, 'COP26 Cranks Up Pressure on Oil, Gas Despite Dodging Closer Scrutiny' (2021) S&P Global Platts.
[582] Additionally, the alliance counts France, Greenland, Ireland, Sweden, Wales and the Canadian province of Quebec as full members, and California and New Zealand are associate members. Together, the group accounts for .8 percent of global oil production. Italy announced itself as a 'friend' of the organization as well.
[583] The Paris Agreement does not bear any mention of fossil fuels, which, collectively, are responsible for approximately 90% of anthropogenic carbon emissions.
[584] Ibid.

as the International Energy Agency (IEA) predicts that global oil demand would need to start declining immediately to reach the 1.5 degrees Celsius target, and must collapse by 75% over the next three decades, for the world to be on a secure pathway to net-zero emissions by 2050.[585] OPEC entered the negotiations arguing that global GHG emissions could be slashed without hard limits on oil and gas production. The Saudi Arabian Energy Minister, Prince Abdulaziz bin Salman Al-Saud stated that, 'it is imperative that we recognize the diversity of climate solutions, and the importance of emissions ... without any bias towards or against any particular source of energy'". [586]

The positions of the Gulf countries, led by Saudi Arabia, promoted the notion that carbon capture and sequestration technology holds the promise of allowing continued hydrocarbon consumption without unduly penalizing hydrocarbon at the expense of other fuel sources. However, many climate activists argued that promoting such technology is not a viable means of reducing carbon emissions because the technology is expensive, not yet scalable, and would only allow carbon-intensive industries to continue operating without restriction.[587]

Fundamentally, for the Gulf countries, what the argument boiled down to was an appeal for economic self-interest, in the sense that an abrupt shift away from oil and gas will shut off the majority of the energy mix without any comparable energy source to rapidly take its place. And, as a corollary to the argument, the Gulf countries put forth the position that if such a move were to be made, it would cause immense spikes in energy prices. They argued that if this were to occur, not only would it retard the tenuous global economic recovery taking place in the wake of the pandemic but would also negatively impact consumers in developed countries.[588]

Yet, although the Gulf countries continued support for hydrocarbon production during the negotiations, the UAE and Saudi Arabia announced, somewhat surprisingly, prior to the meeting in Glasgow, that they would implement net-zero targets. Saudi Arabia plans to

[585] ibid; See, generally, International Energy Agency, 'Net-Zero by 2050: A Roadmap for the Global Energy Sector' (2021).
[586] Shadia Nasralla, 'OPEC Makes Case for Fossil Fuels at UN Climate Conference' (2021) Reuters.
[587] Ibid.
[588] Ibid.

achieve it by 2060, while the UAE pledged to reach net-zero by 2050. However, these announcements did not come with any detailed plans.

7.3 Analysis of the Nationally Determined Contributions of Saudi Arabia, the UAE, and Qatar

The NDCs of Saudi Arabia, Qatar, and the UAE have mostly been criticized for indicating a reliance, albeit a somewhat declining dependency, upon fossil-fuel exports for the long term.

The World Resources Institute has outlined three characteristics that would create a firm and robust foundation for an NDC, i.e., it must be ambitious, transparent, and equitable (See Table 7.3 Appendix A).[589] The subsections below will assess each of the three countries' NDCs according to these criteria.

When evaluating NDCs, there is a wide variance in submissions between developing and developed countries, considering both the coverage and scope of mitigation policies. Developed countries tend to state their contributions as a quantified macro-economic mitigation effort reported against a baseline year.[590] Developing countries, by contrast, generally create their climate pledges by utilizing carbon intensity or describing their reduction target against a business-as-usual scenario. Therefore, NDCs can either be constructed as a means or as desired outcomes.

Saudi Arabia, Qatar, and the UAE crafted their NDCs to follow the mitigation co-benefits model, which bases emission reduction on a nation's ability to reconfigure their respective macro-economies. Overall, the NDCs of the three countries are not significantly robust regarding quantifiable data on which to calculate future greenhouse gas emissions

[589] See, Kelly Levin et al, 'Designing and Preparing Intended Nationally Determined Contributions' (2015) World Resource Institute.
[590] Climate Observer, 'Assessing the INDCs: A comparison of Different Approaches' (2016).

reductions.

The NDCs of the three selected countries will be assessed according to the text without significantly comparing them against their undocumented carbon mitigation plans. With the above, it will be determined whether the three selected countries have and are in the process of making verifiable gains in achieving their respective NDCs and making progress in reducing carbon emissions and the implementation of decarbonization policies.

It is expected that by 2022, as requested by the COP26 decision, Saudi Arabia, Qatar, and the UAE will submit far more robust documents that track their national vision statements (national macro-economic diversification and renewable energy plans).

7.3.1 The Saudi Arabian NDCs

Many observers were somewhat astonished when Saudi Arabia submitted its climate pledges ahead of COP 21 (See Table 7.4 in Appendix A).[591] Saudi Arabia's pledge essentially revealed that one of the world's largest oil-producing countries agreed to reduce greenhouse gas emissions by approximately 130 million tons of carbon dioxide equivalent by 2030 through policies that would have the co-benefits of economic diversification and greenhouse gas emissions mitigation.[592] Prior to the COP26, Saudi Arabia submitted its updated NDC on October 23, 2021 (See Table 7.5 in Appendix A).

The Saudi submissions heralded a fundamental evolution in Saudi Arabia's core position on climate change. However, for other observers, Saudi Arabia's submission was an overly aspirational document that, while not obstructionist, was undoubtedly not substantial.[593] Saudi Arabia's NDC, as stated previously, highlights the Kingdom's strong dependence on the oil sector. As discussed below, the 2015 NDC set a target of emissions reductions of up to 130 MtCO2e, that many considered inadequate to meet the goal of keeping the global temperature rise below 1.5 degrees Celsius. In its updated NDC, Saudi Arabia increased its

[591] Craig Welch, 'The Good, the Bad, the Bewildering: 10 Countries' Climate Pledges' (2015) National Geographic (2015).
[592] Saudi Arabia INDC, 7
[593] For instance, Climate Action Tracker considers Saudi Arabia's INDC as 'inadequate'; Climate Action Tracker, 'The Paradox of Saudi Arabia's Climate Plans' (2015).

2030 emissions target to 278 MtCO2e.

But even assessing the progress to meet this goal has been exceedingly difficult as the government had neither published any official projections of its emissions nor defined the business-as-usual baseline against which progress is to be assessed. Due to the uncertainty of the NDC targets and the lack of available data, it is not yet possible to determine whether Saudi Arabia is on track to meet its goals.[594] Furthermore, as Krane stated, Saudi Arabia, somewhat paradoxically, finds itself in a multitude of positions; it is a major hydrocarbon producer, exporter, hydrocarbon subsidizer, and consumer.[595] Additionally, it finds itself significantly at risk to the threat of climate change.

Therefore, this illustrates two potential future scenarios. The first scenario (Scenario 1) delineates an environment in which oil-based revenue is utilized to diversify the country from dependence on oil exports and funnel revenue into renewable energy and the downstream hydrocarbon and value-added sectors.[596] The second scenario (Scenario 2) outlines a path whereby Saudi Arabia intends to utilize its hydrocarbon wealth to industrialize sustainably.[597]

And Krane furthermore illustrated two other potential pathways that Saudi Arabia could implement in multilateral negotiations, in that there would be a cooperative path, which would see the major oil producers coordinate policies so that international oil prices remain above the cost of production. Secondly, there could be the development of a more 'hostile' dynamic, in which hydrocarbon-producing countries would attempt to leverage their positions against countries that are committed to decarbonizing. As Krane wrote, this 'second pathway might be accompanied by a 'green paradox' conundrum, where low-cost producers maintain or even ramp up production, driving down oil prices and helping fossil fuels compete against alternatives.'[598] The preceding may already be occurring as Saudi

---

[594] See, Michel Den Elzen et al, 'Are the G20 Economies Making Enough Progress to Meet their NDC Targets?' (2019) Energy Policy 126, 244.
[595] Jim Krane, 'Climate Strategy for Producer Countries: The Case of Saudi Arabia' in (ed) Giacomo Luciani and Tom Moerenhout, When Can Oil Economies Be Deemed Sustainable? (Palgrave Macmillan 2021) 302-3.
[596] Saudi Arabia INDC, 2.
[597] Saudi Arabia INDC, 1.
[598] Jim Krane, Climate Strategy for Producer Countries: The Case of Saudi Arabia (Springer, 2020) 302; See, generally,

Aramco announced in October 2021, prior to the Glasgow conference, that it will increase its oil production capacity to 13 million barrels per day by 2027.[599]

However, it must be put in the context of the massive increase in Saudi Arabia's primary energy consumption that, as Wogan indicated, increased by a compound annual growth rate of 4.6% between 1990-2014 (more than double the 1.9% of the global average in 2017).[600] As a result, Saudi Arabian total carbon emissions grew three-fold, from 200 million tons in 1990 to approximately 600 million tons in 2014. Most of these gains were led by the manufacturing and industrial sectors.[601]

Saudi Arabia intends to create a baseline for carbon emissions reductions as an amalgam of both Scenario 1 and 2. The basic premise of the NDC is that Saudi Arabia expects to continue to consume, produce and export a high level of hydrocarbons for the mid-to-long term. The NDC's focus outlines how the Saudi drive for economic diversification would have mitigation co-benefits in carbon emissions reduction. To summarize, according to the Saudi NDC, Saudi Arabia does not intend to implement carbon emissions reduction policies for the near term directly; rather, the carbon reduction would inhere from the significant investments made in renewable energy. Instead, it reasons that carbon emissions reductions are a by-product of the principal national economic diversification strategy.[602]

It is noteworthy that Saudi Arabia is not attempting to limit carbon emissions beyond what 'could' result from economic diversification efforts. However, some of the mitigation co-benefits, such as transitioning from oil to natural gas in the power sector and increasing gasoline/power tariffs, are already having an impact as Saudi Arabia increased industrial

---

Aisha Al-Sarihi, 'Climate Change and Economic Diversification in Saudi Arabia: Integrity, Challenges and Opportunities' (2019) The Arab Gulf States Institute in Washington; Joanna Depledge, 'Striving for No: Saudi Arabia and the Climate Change Regime' (2008) 8 Global Environmental Politics: The MIT Press, 4.

[599] Offshore Technology, 'Saudi Aramco Commits to Reach 13 MMbpd Capacity by 2027' (2021).

[600] David Wogan et al, 'Policy Pathways to Meet Saudi Arabia's Contributions to the Paris Agreement' (2019) KAPSARC, 9.

[601] Ibid.

[602] Climate Tracker stated that if all countries were to follow Saudi Arabia's approach of economic diversification co-benefits to abate 130 MtCO2e, then the global temperature increase would exceed 4°C. Available at <http://climateactiontracker.org/ countries/saudiarabia.html>

power tariffs and gasoline prices by approximately 50% in 2015.[603] And, at the start of January 2018, prices rose a further 80%.[604] After price reforms, domestic crude oil demand declined approximately 3.5 % (to 2.21 million barrels per day) year-on-year in December 2016, as compared to the same period in 2015.[605]

Even though Saudi Arabia's abatement goal does not depend upon acquiring international financial support from developed countries, it is conditional to the extent that it depends upon continued economic growth and a 'robust contribution from oil exports revenues to the national economy.'[606] Saudi Arabia also premised its carbon reduction obligation upon the fact that '...the economic and social consequences of international climate change policies and measures do not pose a disproportionate or abnormal burden on the Kingdom's economy."[607] At the same time, Saudi Arabia announced that it would produce 9.5 gigawatts of power from alternative energy source (installed capacity), compromising approximately 60 projects by 2023.[608]

At the centerpiece of Saudi Arabia's decarbonization policy is the circular carbon economy (CCE) approach (See Figure 1). Championed by Saudi Arabia during its presidency of the G20, in 2020, the leaders of the G20 endorsed the CCE as a viable method to promote economic growth and manage emissions in all economic sectors.[609] As outlined in Saudi Arabia's NDC, the CCE focuses on developing a closed-loop system utilizing the 4Rs: reduce, reuse, recycle and remove (See Figure 7.1).[610] The remove aspect delineates the removal of carbon both at the combustion stage and directly from the atmosphere. Even though other technologies are currently being studied, the edifice upon which CCE rests is

[603] The 2015 price increase increased the price of 95 octane gasoline to 0.90 riyals ($0.24) per liter from 0.60 riyals. The government plans more incremental increases until 2023 when domestic gasoline prices should conform to international levels. Wael Mahdi and Vivian Nereim, 'Saudi Arabia Plans to Raise Prices by 80 Percent in January' (2017) Bloomberg.
[604] Ibid.
[605] BP 2016.
[606] Saudi Arabia NDC,10.
[607] Saudi Arabia's NDC does point out that its carbon reduction obligation is consistent with Art 3 para 2 and Art 4 para 8(h) and 10 of the United Nations Framework Convention on Climate Change.
[608] The projects would cost between $30-50 billion. In August 2017, the Saudi government announced that it would exceed its target that required that 9.5 gigawatts of power to be produced from renewable energy sources by 2023. The Saudi officials indicated that further details would be announced at a later date; Reuters Staff, 'Saudi Arabia Intends to Exceed Renewable Energy Target' (2017) CNBC.
[609] Chatham House, 'G20 Endorses a Circular Carbon Economy: But Do We Need It?' (2020).
[610] Saudi Arabia NDC, 8.

carbon capture use/storage (CCUS). Yet, while CCUS plays a prominent role in nearly all of the Paris Agreement compatible pathways, it is still criticized for being cost-prohibitive and unscalable (at the present moment) and for continuing the use of carbon-intensive fuel sources.[611] The Saudi goal lies in distinct contrast to the increasingly targeted goal of international climate negotiations to focus on emissions reductions and remove hydrocarbon's central role in the global economy.

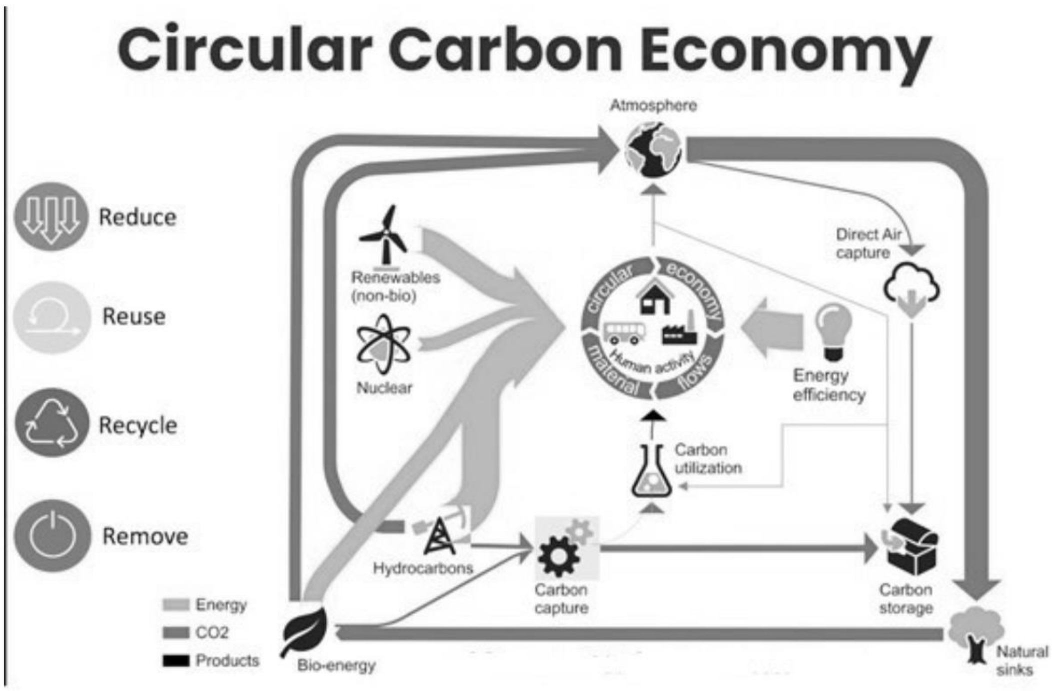


Figure 7.1: Representation of the Circular Carbon Economy

Saudi Arabia's NDC stresses that substantial amounts of investment would be required to diversify a hydrocarbon-dependent economy away from its export model should the world decarbonize in earnest. Beyond that, if successfully implemented, this diversification could have many mitigation co-benefits.

[611] IPCC, 'Special Report: Global Warming of 1.5 oC' <https://www .ipcc.ch/sr15/> accessed 1 December 2021.

a. Is the Saudi NDC Equitable, Transparent and Ambitious?

Using the methodological criteria outlined in Section 7.3 to analyze the robustness of NDCs, Saudi Arabia's NDC provides a transparent approach, but only to an extent as it lacks certain critical factors (See Tables 7.4 and 7.5 Appendix A). The Saudi NDC presents comprehensive descriptions of each mitigation co-benefits of their proposed economic diversification exertions. Energy efficiency and the transportation sector are outlined as especially critical priorities in Saudi Arabia's NDC. This may be expected given that Saudi Arabia, with nearly 30 million inhabitants, is the seventh-largest global consumer of refined petroleum products.[612] However, Saudi Arabia did not publish a business-as-usual range for its NDC targets. The Saudi NDC states that a 'dynamic baseline' will be developed from a combination of two scenarios,' i.e., whether a greater amount of petroleum is domestically consumed or whether it is exported.[613]

Moreover, the Saudi NDC is vague as to whether the Saudi government intends to place oil production within the category of domestic consumption or within the export framework, each of which might affect greenhouse gas emissions projections in numerous ways. The NDC indicates that greenhouse gas emissions would be low in a 'high export' scenario, along with higher economic growth. This would be compared or contrasted to a scenario with higher domestic oil consumption. The targets in the NDC are conditioned upon a high export scenario because Saudi Arabia is allowed under the treaty to modify its NDC if its oil-based foreign revenue were to decline.

Due to this, there is significant opaqueness surrounding Saudi Arabia's intended greenhouse gas emissions target. Therefore, the level of transparency regarding Saudi Arabia's NDC is 'low-medium.' Furthermore, Saudi Arabia's NDC may not be 'equitable' because if all countries followed the Saudi climate commitment in 2030, the global temperature increase would likely be above 4 degrees Celsius. Therefore, Saudi Arabia's approach may be neither 'fair' nor 'equitable' considering the Paris Agreement's long-term goal of keeping global temperature below a 2 degrees Celsius increase, let alone the more

[612] For the broad aspects of Saudi Arabia's domestic energy consumption see Glada Lahn and Paul Stevens, 'Burning Oil to Keep Cool: The Hidden Energy Crisis in Saudi Arabia' (2021) Chatham House.
[613] Saudi Arabia INDC, 1.

aspirational goal of the 1.5 degrees Celsius limit.

And lastly, whether Saudi Arabia’s NDC is ‘ambitious,’ it appears that under its current policy projections based on its NDC and other stated national policies, an observer could expect Saudi Arabia to experience an increase of carbon emissions from its 1990 levels. While Saudi Arabia, as the world's foremost oil exporter, undertook a significant step to sign and ratify the Paris Agreement, it is currently undergoing a broad-based macro-economic reconfiguration that is impacting every facet of its economy.

Therefore, Saudi Arabia has a vested interest in reducing its carbon intensity because a decline in carbon/energy intensity reflects a reduction in domestic energy consumption. Additionally, in October of 2019, Saudi Arabia announced that it would launch a carbon trading platform.[614] The Covid-19 pandemic has stalled those plans, and as of the time of writing, the Saudi government is still behind many other countries and has released no details on how low the carbon cap would be and how many credits it would release to corporations, as well as any additional guidelines for the carbon trading system.

And, before COP26 in Glasgow, in October, Saudi Arabia announced that it would commit to achieving net-zero GHG emissions in 2060.[615] However, even though this announcement was greeted with praise from most quarters, details were lacking. It was pointed out that the Saudi net-zero pledge only aims to reduce GHG emissions within its own jurisdiction while ramping up oil production for export. As the Saudi government stated, its transition to net-zero carbon emissions ‘will be delivered in a manner that preserves the kingdom's leading role in enhancing the security and stability of global energy markets.’[616]

More could be done, but considering the conceptual shift from its status as the world's foremost oil exporter to accepting that it must reduce its carbon emissions, Saudi Arabia’s NDC could be considered moderately ambitious, at least in its stated goals. However, much verifiable work would still need to be done.

[614] Rania El Gamal, ‘Saudi Arabia Plans to Launch Carbon Trading Scheme’ (2019) Reuters.
[615] Associated Press, ‘Saudi Arabia Pledges Net-Zero Greenhouse Gas Emissions by 2060’ (2021) NPR.
[616] Ibid.

7.3.2 United Arab Emirates NDC

Because the UAE submitted its INDC on October 22, 2015, and ratified the Paris Agreement on September 21, 2016, its INDC became its NDC (See Table 7.6 Appendix A).[617] And in December 2020, the UAE submitted its updated NDC (See Table 7.7 Appendix A). Much like Saudi Arabia, the UAE's greenhouse gas emissions reductions plans are based upon economic diversification that will yield mitigation and adaptation co-benefits.'[618]

The UAE announced its net-zero goal by 2050 in October 2021 as a component of its UAE Net Zero 2050 Strategic Initiative.[619] The UAE became the first country in the Middle East and Northern Africa (MENA) region to set a net-zero target. But, as of yet, there is still a significant lack of details concerning its targeted sectors, transparency, and scope. As a result, its emissions coverage remains uncertain and unclear. As of December 2021, the UAE had not submitted a long-term strategic implementation plan to the UNFCCC.[620] There is no GHG emissions mitigation target in the Emirati 2017-2050 National Climate Plan, and it only offers long-term abatement actions in the power sector.[621] However, to a certain degree, this illustrates the lack of congruence between the Emirati NDC and domestic decarbonization policies as the updated 2020 NDC outlines a 2030 emissions reduction pledge of 23.5% in GHG emissions relative to a business-as-usual scenario of 310 MtCO2e. The majority of the Emirati power supply is produced from natural gas and the Emirati government decided to build upon the 2021 alternative energy target of 24%, outlined in the UAE's first NDC.

The UAE is also investing significantly in nuclear energy by constructing the four-reactor Barakah nuclear power plant. The NDC states that by 2030, installed clean power capacity, including nuclear and solar, will reach nearly 14 GW, rising from almost 100 MW in 2005

[617] The Emirati INDC entered into force on November 6, 2016. The UAE Ratifies the Paris Climate Agreement, Gulf News (Sept. 22, 2016). Sources: UAE INDC (2016) and Climate Action Tracker http://climateactiontracker.org/countries/uae.html

[618] UAE INDC, 1.

[619] Permanent Mission of the United Arab Emirates to the United Nations, 'UAE Announces Net-Zero by 2050 Strategic Initiative' (2021).

[620] Climate Action Tracker, 'CAT Climate Action Update, UAE' (2020).

[621] The United Arab Emirates Government Portal, 'National Climate Change Plan of the UAE' <https://u.ae/en/about-the-uae/strategies -initiatives-and-awards/federal-governments-strategies-and-plans/ national-climate-change-plan-of-the-uae> accessed 1 December 2021.

and 2.4 GW in 2020.[622] As of 2020, approximately USD 40 billion has been invested in developing clean energy across the country. However, as of late 2021, the UAE has not set the NDC target in its national legislation.

In addition to the alternative energy benchmark, other stated efforts relate to the building/construction, energy/power tariff reconfiguration, transportation, and energy sector (See Tables 6 and 7 in Appendix A). These targets do not yet have any firm numbers related to potential emissions reductions. Dubai also created a localized carbon trading framework in December 2012, but this is not listed in the UAE's official NDC as of yet.[623]

The UAE has nevertheless announced highly ambitious plans. The Dubai Supreme Council of Energy unveiled the Dubai Clean Energy Strategy 2050 in early January 2017, which states that the Emirate would funnel approximately USD 163 billion to generate 75 % of Dubai's energy from alternative sources. This projection envisioned in the UAE's National Energy Strategy 2050 sets a target of 44% of renewables and 6% of nuclear energy in installed power capacity by 2050, while also reducing the nation-wide power demand.[624] At the same time, the 2050 strategy also maintains that there will be 12% of coal and 38% of natural gas-fired power production. This plan intends to reduce carbon emissions by seventy% and increase energy efficiency by 40% by 2050. Notwithstanding the above, the Dubai Clean Energy Strategy is not included in the UAE's NDC.

Further, while the UAE's greenhouse gas reduction plans are broad and far-ranging, fiscal and regulatory challenges could hinder its achievement. The UAE would have to prepare the domestic business market for the radical transition away from hydrocarbons to alternative energy to realize its climate pledges. This is important because, as planned, the UAE foresees the private sector with a more prominent role instead of relying on large-scale government-funded projects that would engage in clean energy promotion. The

[622] UAE NDC, 2.
[623] However, it is expected to that it will be included in the updated NDC by 2020.
[624] Climate Action Tracker, 'CAT Climate Action Update, UAE' (2020) <https://u.ae/en/about-the-uae/strategies-initiatives-and -awards/federal-governments-strategies-and-plans/national -climate-change-plan-of-the-uae> accessed 1 December 2021; UAE National Energy Strategy 2050, The United Arab Emirates Government Portal <https://u.ae/en/about-the-uae/strategies -initiatives-and-awards/federal-governments-strategies-and-plans/ uae-energy-strategy-2050> accessed 1 December 2021.

Emirati regulatory sector has not traditionally been oriented to smaller and more decentralized renewable energy production, such as roof-top solar panels for small businesses and private residences, which could pose future challenges.[625]

The implementation of feed-in tariffs (FiTs) should enable renewable energy generation to expand.[626] FiTs have a vital role when a country's solar industry is in its infancy, but deregulated, and market-driven power tariffs would provide a stimulating role for deployment over the long term. Moreover, the divergence between the levelized cost of electricity and the current average cost of electricity tends to create obstacles for the UAE's solar energy deployment.[627] For example, in Abu Dhabi, power tariffs would likely have to increase by about two-thirds before solar power investments and purchases become fiscally viable cost-saving strategies for small businesses and the residential sector.[628]

Furthermore, if Abu Dhabi develops an efficient regulatory framework, then solar power contractors would grant residential clients reduced rates. There are regulations in the UAE that prohibit sloped roofs, which add an additional barrier to deploying solar panels residentially.[629] Solar energy contractors also face a relatively long timeline to connect solar panels to the grid. Another issue that raises obstacles to renewable energy is the federal political structure of the UAE. Because each Emirate develops its own renewable energy policy, the risk that time lags may occur between the promulgation of federal policy and the enactment of a national legal framework becomes even more significant.

[625] Abhinav Banerji Das, 'A Guide to Solar Power Generation in the United Arab Emirates' (2014) Middle East Solar Industry Association.
[626] See generally, Daisuke Sasaki and Gun Matsuo et al, 'The Effect of Implementing a Feed-in Tariff in Abu Dhabi UAE' (2016) Applied Economics and Finance 4; J. Al-Amir and B. Abu-Hijleh. 'Strategies and Policies from Promoting the Use of Renewable Energy Resource in the UAE' (2013) Renewable and Sustainable Energy Reviews 26, 660–667.
[627] This is related to the subsidization of natural gas power generation.
[628] Natural gas-fueled power tariffs range between U.S 5.8-8.7 cents per KWH in Abu Dhabi and between 6.3-10.4 cents per KWH in Dubai for expatriates.
[629] IRENA, 'Renewable Energy Prospects: United Arab Emirates' (2015) 41.

a. Is the Emirati NDC Equitable, Transparent and Ambitious?

While the Emirati NDC sets out a multitude of methods to reach its greenhouse gas reduction goals, it remains unclear on several issues. The UAE’s 2016 NDC did not contain an emissions reduction target. It only had a clean energy target to be reached by 2021. However, when we view the 2020 NDC, it is clear that progress has been made (See comparison between the 2016 and 2020 NDCs in Table 7.8 Appendix A). The current target is a 23.5 % reduction in GHG emissions below the business-as-usual scenario in 2030. The NDC took 2016 as a baseline and did not incorporate the economic turbulence associated with the pandemic as it based the business-as-usual assumption on historical growth trends.

With regard to whether the Emirati NDC is equitable, the UAE’s climate pledges for 2030 would not work effectively towards keeping global warming to below 2°C, much less towards limiting a global temperature increase to 1.5°C.[630] Instead, if all countries were to incorporate the UAE's approach to global warming, temperatures would likely increase between 2 degrees Celsius and 3 degrees Celsius. Prior to the Covid-19 pandemic, the UAE’s GHG emissions were projected to reach 280-300 million tons (excluding LULUCF).[631] This would have been approximately a 46-58% increase compared to 2010 levels. However, with the current measures and the impact of the pandemic, the UAE would likely reach its emissions levels from the 24% clean energy target in the NDC. Overall, including the pandemic effects, 2030 emissions would likely only decline by 10-16%.[632] Therefore, the Emirati NDC may not be considered equitable in the sense of undertakings its fair share of emissions reductions to limit the global temperature rise at 1.5 degrees Celsius.

As to transparency, the UAE undoubtedly took steps to make its macroeconomic greenhouse gas reduction targets much more apparent. Its 2016 NDC only described various energy efficiency and building code frameworks that did not mention potential greenhouse gas metrics. However, in its updated 2020 NDC, as stated above, the UAE

[630] Climate Action Tracker, ‘UAE’ <http://climateactiontracker.org/ countries/uae.html> accessed 1 December 2021.
[631] Climate Action Tracker, ‘CAT Climate Action Update’ (2020).
[632] Ibid.

outlined a 2030 emissions reduction pledge of 23.5% in GHG emissions relative to a business-as-usual scenario of 310 $MtCO_2e$. And the delineated scope and coverage of GHG emissions reductions with its sectoral coverage are consistent with IPCC guidelines. The second NDC includes a more comprehensive list of mitigation strategies and policies in essential economic and industrial sectors. And it also announces the establishment of new federal and emirate level climate policy governance structures.

Yet, the NDC does not contain any long-term emissions reductions target, and there is a lack of transparency on the sources utilized to calculate the 2030 business-as-usual scenario and various other assumptions. Overall, this NDC enhanced clarity due to the GHG emissions reduction targets having been clarified. However, there is still uncertainty regarding the concrete steps that the UAE intends to undertake to meet its obligations. And, while the UAE announced a net-zero pledge before COP26, there have been no details released as to how it intends on meeting that goal. As a result, the Emirati NDC has low-to-moderate transparency.

Lastly, considering that the UAE is a significant hydrocarbon producing country and depends on oil for domestic consumption and export, the acceptance of the Paris Agreement is an important step. The announcement of its net-zero pledge is somewhat revolutionary in the sense of "breaking the mold" for the region. Additionally, the UAE made its 2020 NDC more robust by setting quantifiable 2030 targets for GHG emission reductions, and it increased the scope of the GHG gasses covered in its updated NDC to include methane, nitrous oxide, and perfluorocarbons. Compared to the 2016 NDC (see Table 7.8 Appendix A), it can be witnessed that the UAE is increasing the ambition of its decarbonization plans.

However, while the Emirati NDC has stated expanded goals to decrease its GHG reduction goals, it did set its business-as-usual scenario at 2016, and only takes into account the mitigation policies implemented at that time. Since 2016, Emirati natural gas consumption has plateaued as its energy efficiency policies, natural gas/power pricing reconfiguration and renewable energy projects came online. To that extent, while its on-the-ground deployment of renewable energy investment has proceeded, much of this progress has not been clearly noted in its NDC. It is possible that the UAE seeks, to a certain degree, to be held to a lower standard by the international climate treaty, while it still engages in significant clean energy investment.

But, as its NDC stands, it lacks the ambition to take any further steps outside of the promulgated internal energy/carbon Emirati policies of 2016. Its NDC may be classified as moderately ambitious, but with a trend for the UAE undertaking more ambitious goals moving ahead, especially in subsidiary projects not accounted for in its official pledges. It is worthwhile to note here that as with Saudi Arabia and Qatar, the UAE intends to drastically increase its oil production for export to the global market. Therefore, to a certain degree, some aspect of the domestic decarbonization policies will have the result, whether explicitly intended or not, of reserving more hydrocarbon export to the international market. However, this export posture is not considered in the assessment of its NDC.

7.3.3 The Qatari NDC

By submitting its INDC on November 19, 2015, i.e., almost a week and a half before COP 21 was inaugurated, Qatar became one of the last countries to submit its carbon mitigation plans.[633] More precisely, Qatar became the 150th Party to the Paris Agreement on June 20, 2017, and Qatar's INDC transformed into an NDC.[634] Qatar's first NDC (See Table 7.9 in Appendix A) focused upon several issues, including its vulnerability to climate change which impacts sea level rise. Ninety-six percent of Qatar's population resides in coastal areas.[635] This NDC also stressed that Qatar is home to unique flora and fauna that could face extinction with an increase in global temperature.[636] As Qatar is a small peninsular nation, it is nearly as vulnerable to climate change as most small island nations. It lacks potable water and has an average rainfall of only 82 mm per year.[637]

---

[633] UNFCC, Qatar INDC Report (2015) <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Qatar/1/Qatar %20INDCs%20Report%20-English.pdf> accessed 1 December 2021.

[634] Qatar's INDC entered into force on 23 July 2017. See, UNFCCC, 'Paris Agreement: Status of Ratification' <http://unfccc.int/paris _agreement/items/9444.php>

[635] Qatar INDC, 2.

[636] Ibid.

[637] A. A. Mamoon and A. Rahman, 'Rainfall in Qatar: Is it Changing?' (2017) Natural Hazards 85, 453.

If the average global temperature rises and there is a corresponding drop in rainfall, then Qatar's soil would experience significant moisture losses. Two critical issues must then be confronted, an increase in desertification and a surge in domestic water requirements. Therefore, in its first NDC, Qatar stressed the threat to human habitability from climate change and focused on adaptation measures, perhaps more so than Saudi Arabia and the UAE. This first NDC was promulgated with the intent to reflect that Qatar focused on adaptation, economic diversification, and mitigations that were all granted equal treatment as per Article 4.7 and Article 7 of the Paris Agreement.

Qatar submitted its second NDC in August 2021 (See Table 7.10 in Appendix A) and unveiled a new climate change action plan, which set a target of 25% GHG reductions by 2030, relative to a baseline scenario of business-as-usual, and to also reduce the carbon intensity of its LNG production infrastructure by 25% by 2030. Additionally, the updated NDC stressed that Qatar would redouble its efforts to deploy CCS usage at its LNG facilities. This updated NDC differed from the first in that Qatar sought to enhance its ambitions and reduce its overall GHG emissions as outlined in Article 4.4 of the Paris Agreement.

However, Qatar's GHG emissions have been rising, reaching 116 MtCO2 in 2019. And Qatar's carbon emissions from fuel usage have nearly risen by a factor of four since 2000, from 24 $MtCO_2$ to 88 MtCO2 in 2020.[638] In 2019, Qatar had the highest per capita CO_2 emissions in the world (33 $MtCO_2$ /capita). [639] Qatar has a delicate balancing act in its decarbonization drive as it seeks to increase its LNG production to 127 million tons/year 2027, from 79 million tons/year and thereby outstrip its closest LNG rivals.[640]

Even though Qatar has the highest ratio of GDP per capita in the world, its NDC stated that 'international climate change measures and policies shall be in line with the provisions of the of the United Nations Framework Convention on Climate Change, in particular, Article 3 paragraph 2 and Article 4 paragraph 8(h) and 10 and shall ensure the developing

[638] Enerdata, 'Qatar Aims to Reduce its GHG Emissions by 25% in 2030' (2021).
[639] Ibid.
[640] Andrew Mills, 'Qatar Targets 25% Cut in Greenhouse Gas Emissions by 2030 Under Climate Plan' (2021) Reuters.

countries' eligibility for finance, technology transfer, and capacity building.'[641] As the world's foremost LNG exporter, Qatar, with some accuracy, portrayed its LNG investments, as 'contributing indirectly to the global efforts to mitigate climate change'.[642]

As with Saudi Arabia and the UAE, Qatar sought to embed the principle of economic diversification through environmental/carbon mitigation co-benefits into its NDC. This core issue was arrived at through a national dialogue with a 'stakeholder consultation group' to develop an NDC that fairly represented Qatar's domestic interests. Further, Qatar collaborated with other countries for which economic diversification provides the most plausible path towards future sustainable development. Qatar's NDC also indicated that it seeks to increase the proportion of renewable energy, for example, by using solar in the domestic energy mix.[643] While Qatar's NDC does not delineate specific solar projects, a joint project between Qatar Electricity and Water Company and Qatar Petroleum began the initial work in 2017 on Qatar's largest solar power project.[644]

Qatar's first solar power plant, Al Kharsaah, started operations in 2021, and is slated to generate 800 MW. It is the country's first utility scale solar power plant intended to provide solar power for the upcoming Qatar 2022 World Cup. For the long-term, Qatar announced a target to produce up to 10 GW of solar energy by 2030. Qatar was criticized for its first NDC as it did not contain clear renewable energy and carbon mitigation targets.

However, its updated 2021 NDC rectified this and delineated a stated goal of a 25% GHG reduction for the year 2030, relative to a business-as-usual scenario based on 2019. However, in 2012 Fahad Bin Mohammed al-Attiya, Chairman of the organizers of the talks during COP 18, announced that 'Qatar is pursuing voluntarily a national initiative to reduce green-house gas emissions as long as they are in line with sustainable development.'[645] And, he explained that 'to Qatar, climate change represents double jeopardy.'[646]

---

[641] Qatar INDC, 2.
[642] Ibid.
[643] Qatar INDC, 3.
[644] It is a 200-megawatt project that will come online in 2020, and able to be expanded to 500 megawatts.
[645] Reuters, 'OPEC Member Qatar Says to Start Embracing Solar Energy' (2012).
[646] Ibid.

Along with statements issued by other Qatari officials, such anecdotal indications suggest that Qatar, and perhaps Saudi Arabia and the UAE, may have more extensive internal targets to limit carbon emissions and deploy renewable energy. Yet, facing the prospect of 'double jeopardy,' these countries initially appeared reluctant to be obligated in a multilateral document that carries the force of law. In a sense, they would prefer to 'overperform' in meeting their NDCs instead of setting overly ambitious targets and thereby 'underperform.'

a. Is the Qatari NDC Equitable, Transparent and Ambitious?

It is apparent that Qatar intends to continue its established policy of consuming its natural gas as a sizable proportion of its domestic energy mix for the foreseeable future and increasing its LNG production footprint. In its updated NDC (Table 7.10 Appendix A), Qatar formulated more definite plans by targeting GHG emissions reductions by 25% by 2030 (relative to a business-as-usual scenario). This indicates that Qatar foresees that it must take action to reduce its carbon emissions. But in consideration of whether Qatar's NDC is equitable, it must be assessed whether it is undertaking its fair share of climate mitigation and adaptation in line with other global commitments.

While Qatar is not historically as responsible for the rise in global temperature as the developed countries, over the past several decades, as discussed in Section II.1, it rose to have the highest per capita carbon emissions in the world, at 37 metric tons per person. But despite its high per capita carbon emissions, it has low aggregate emissions. The majority of its high carbon intensity is due to providing natural gas for the rest of the world. Natural gas is largely considered to be a bridge fuel in the transition to a low carbon global economy.

And, in line with the UNFCCC articles based on fairness and ambition as per national circumstances, Qatar adheres to the underlying principle that it is mainly dependent on hydrocarbon revenue for its economic health. Therefore, when considering its low aggregate carbon emissions, alongside its enhanced reductions in its latest NDC (2021), Qatar's climate pledges can be regarded as moderate-high equitableness when balancing its historical responsibility with its current obligations of supplying the world with lower carbon natural gas as a bridge fuel to a low-carbon transition.

As with the Saudi and Emirati NDCs, the Qatari NDC does suffer from a lack of transparency as there are no identifiable targets for either renewable energy generation or sectoral GHG reduction plans. However, its NDC was greatly improved by including specific sectors to be covered and baseline scenarios. As a result, it can be considered that the Qatari NDC is moderately transparent and can be improved when it responds to the COP26 request of the submission of strengthened pledges.

As to whether the document is ambitious, the Qatari document is aspirational to a measurable extent. However, it contains several essential caveats to the effect that if its economy is unduly impacted by climate change mitigation, it reserves the right to modify its NDC. Qatar's NDC also indicates that its renewable energy deployment progress depends on that country's access to Western technology. However, when balanced against the large-scale carbon reduction and energy efficiency initiatives the country is undertaking across its LNG production value chain, it has made a firm initial step to reduce its GHG emissions.

But Qatar can still do much more in terms of investment in renewable energy for its domestic power generation. Qatar, in contrast to the UAE and Saudi Arabia-as well as many other developing countries-did not announce a net-zero goal. And given Qatar's prodigious wealth and its number one position in global per capita carbon emissions (35.77 tons per person), its carbon emissions reduction commitments are not as ambitious as some of its peers.

Overall, the Qatari NDC is moderately ambitious with clear goals to reduce carbon emissions but lacking precise renewable energy investment targets.

7.4 Conclusion

As discussed above, it was a circuitous route for Saudi Arabia, the UAE, and Qatar to accept the reality of climate change and take the necessary steps to restructure their macro-economies. However, eventually, the realization dawned upon them that it was in their self-interest to reduce the carbon intensity of their economies to promote economic diversification in the face of rising domestic energy consumption. Overall, the three selected Gulf countries' NDCs are vague to a certain degree and do not state their total planned or implemented carbon reduction and alternative energy deployment strategies.

Many of their mitigation policies have already been implemented or announced, but in the majority of cases, have not been delineated in their NDCs. However, it is of particular importance to note that Saudi Arabia and Qatar were to update their respective NDCs in 2021, but the Covid-19 pandemic delayed progress on that front, except for the UAE, which submitted its second NDC in December of 2020. Saudi Arabia and Qatar signaled that they intend to submit more thorough NDCs to explain how they intend to reduce greenhouse gas for the rest of the decade. These updated NDCs will likely incorporate their already significant investments in alternative energy sources and energy efficiency plans.

What is apparent from the analysis is that while the three selected Gulf countries lack certain robustness in their NDCs, that defect should not be taken to mean that there is also a lack of resources or on-the-ground policy implementation to promote energy efficiency and renewable energy deployment. As discussed in Chapter Six, there are currently billion-dollar renewable energy and energy efficiency plans in operation in the three selected countries. Gulf policymakers will likely detail these plans in their updated NDCs.

This is significant because governments often cannot create and deploy carbon mitigation instruments without accounting for certain political realities despite the theoretical literature on carbon abatement instrument design. Therefore, Chapter 8 will delineate the process by which the EU and China implemented their carbon trading markets and the challenges they had to overcome. In assessing the EU and China's obstacles, we can better understand how the Gulf region would approach carbon mitigation frameworks. Considering the above dynamics, it is now even more pertinent that researchers and scholars delve deeply into this topic.

Chapter Eight: Carbon Abatement Lessons from the EU and China

8.1 Introduction

Most forms of carbon abatement are predicated on the principle of applying a cost to specific quantities of carbon emissions, whether it is a carbon price, a tax, or a financial penalty. However, there are additional means such as Command and Control (or direct) regulation (see Chapter Two, Section 2.2), energy efficiency regulations, subsidy removals (See Chapter Six), building regulations, and "smart" programs utilizing software to reduce energy usage (See Chapter Nine). The forgoing is discussed and analyzed in more depth in said chapters. It should be mentioned, though, that policymakers should attempt to avoid the dampening effect of other carbon mitigation policies. For instance, carbon trading regimes are particularly vulnerable to the "waterbed effect," whereby other climate policies, such as energy efficiency regulations or renewable feed-in tariffs/subsidies, are so successful in specific sectors that they reduce carbon permit demand.[647] As a result, these policies would tend to undermine the efficacy of the carbon market, i.e., price formation, and mitigate the incentive to reduce emissions.[648] Additionally, as discussed extensively in Chapter 9, free allocation of permits also undermines the functioning of a carbon market as it is akin to granting emitters "windfall profits" if not adequately managed.[649]

And since the U.S. developed some of the first ETSs, other countries have followed suit. As of 2020, 61 carbon pricing mechanisms are in operation or planned worldwide.[650] These schemes comprise 31 carbon markets and 30 carbon taxation regimes, covering

[647] *Pricing Carbon to Achieve the Paris Goals*, Carbon Market Watch (Sept. 2017) p. 7
[648] Ibid. It is important to create a degree of price certainty, such as through a minimum auction floor price.
[649] Nonetheless, while many countries have placed or are placing a price on carbon, and further progress is expected, energy-efficiency measures and subsidy removal have been utilized more to date than carbon pricing as a means for carbon emissions reductions.
[650] *Implementing Effective Emissions Trading Systems, Lessons from International Experiences*, IEA (2020). p.13

approximately 12 gigatons of CO_2e or nearly 22 % of global GHG emissions.[651] International carbon market development is currently driven by Asia and North and South America. Consequently, between 2017-2020, eight new carbon emissions schemes at the national and sub-national levels have been launched in the Americas, utilizing either carbon taxes or hybrid systems.[652]

And by early 2021, 102 countries are considering implementing carbon trading or pricing schemes as part of their Paris Agreement commitments.[653] Many of these plans have been created as most jurisdictions around the world adopt more stringent and ambitious mitigation targets as 2020 and 2021 are crucial for countries as they position themselves to meet their emissions reductions pledges under the Paris Agreement. As a result, in 2019, many countries, regions, subnational jurisdictions, and cities declared "climate emergencies."[654] Although beyond the scope of this thesis, it should be noted that the Paris Agreement explicitly supports the ongoing development of carbon markets transnationally.[655] However, the divergent nature of many of the national climate pledges creates new complications for forming any global carbon trading mechanism.

However, as China launched its national ETS in December 2017, it became the world's largest carbon market site. China, over several years, sent its officials to various countries, particularly the EU and the U.S. (California), to learn best practices and avoid the problems that these markets, especially the EU ETS, experienced during initial implementation. From an assessment of the data of various carbon markets, one consistent theme becomes apparent, and that is the requirement for robust data. Data quality has overarching importance, as without it; a viable cap cannot be constructed. The lack of a credible cap leads to low prices and ultimately an underperforming market unable to meet carbon

[651] This represented an increase when compared to 2019, whereby ETSs and carbon taxes covered 20 % of global GHG emissions. The expansion of the GHG emissions coverage occurred principally due to the Mexican pilot ETS, the New Brunswick carbon tax being legislated and launched, as well as the upcoming implementation of the Germany ETS and Virginia ETS. *State and Trends of Carbon Pricing 2020*, World Bank Group (May 2020) p. 18-19
[652] Ibid.
[653] *State and Trends of Carbon Pricing 2020*, World Bank Group (May 2020) p. 18-19
[654] Ibid.
[655] Article 6 has two paragraphs that concern the details of developing carbon markets to reduce carbon emissions, and one paragraph discussing "non-market" carbon reduction frameworks. *What Are Market and Non-Market Mechanisms*, United Nations Climate Change (No Date).

reduction targets.

This chapter is structured as follows. Section 8.2 analyzes the historical development of the EU ETS and reviews its successes and failures to glean valuable lessons that could potentially be applied to the three selected Gulf countries as they fashion carbon reduction policies as obligated under the Paris Agreement. Section 8.3 reviews China's experience with developing carbon trading and its potential challenges. Section 8.4 concludes with a summary of what lessons may be applied to the three selected Gulf countries from the EU ETS experience.

8.2 How to Quantify Success and Failure: Lessons from the EU

Developing a carbon trading platform does not require Gulf states to "reinvent the wheel" as there are existing carbon trading mechanisms from which they could learn. It is of immense importance to assess the preexisting conditions that impacted the genesis and gestation of the EU ETS, of necessity, but these would be different than those that would apply to the design and deployment of a potential Gulf carbon market. Furthermore, the Chinese experience in operating pilot schemes and transitioning to a national ETS is instructive and will be discussed in Section 8.3.

The multinational aspect of the EU is salient in so far as these various-and sometimes fractious- countries were able to agree as to the design and operation of the EU ETS. Still, while the EU (through its predecessor, the European Coal and Steel Community) has been in existence much longer than the GCC, the GCC is currently attempting to increase the sophistication of its regulatory codes and allow more harmonization at the regional level. But, given that, as of the early 2020s, the Gulf countries likely would not initially consider creating linked carbon emissions abatement policies, it removes a substantial hurdle that the EU initially experienced.

The EU ETS was the first large-scale and transnational emissions trading scheme in the world. It was, notably, christened "the new grand policy experiment" and "a fundamental systems change in environmental governance."[656] The principal goal of the EU ETS is delineated in Article 1 of the EU Emissions Trading Directive that holds, "This Directive established a scheme for greenhouse gas emissions allowance trading with the Community… to promote reductions of greenhouse gas emissions."[657] Implementing the EU ETS was a formidable challenge as the initial creation of the scheme dealt with limited data availability and various levels of ambitiousness amongst the member states. To a certain extent, an ETS had to be chosen as the primary means to reduce carbon emissions as the EU had no formal transnational taxation regime to apply to carbon emitters.

The formation of the EU ETS was a long and exacting road and still had (and has) certain difficulties in finding points of agreement amongst the various member states. In understanding how the GCC states may be able to create their own domestic carbon abatement models, it is essential to review the early history of the EU ETS and understand how the EU could overcome its initial difficulties. The EU ETS is intimately connected to the Kyoto Protocol but also exists somewhat independently from it. The EU implemented the EU ETS before the Kyoto Protocol became legally binding in international law, but it also would have come into being even had the Kyoto Protocol not come into force in February of 2005.[658] For instance, the initial trading period from 2005-2007 was entirely external to the Kyoto Protocol (See Table 8.1), even though EU policymakers initially conceived of it as assuring that the EU would remain compliant with the Kyoto Protocol during 2008-2012 (the second trading period of the EU ETS). And, despite whether the Kyoto Protocol ultimately succeeded or not, the EU indicated that it remained committed to reducing its carbon emissions.[659]

[656] Joseph Kruger and William Pizer, *The EU Emissions Trading Directive: Opportunities and Potential Pitfalls.* RFF Report DP 04-24. (Resources for the Future, 2004)) p. 1; *Greenhouse Gas Emissions Trading in Europe: Conditions for Environmental Credibility and Economic Efficiency*, CEPS Task Force Report (2002) no.43 p.6.
[657] Article 1, Directive 2003/87/EC Establishing a Scheme for Greenhouse Gas Emissions.
[658] A. Daniel Ellerman, *et al*, *The European Union's Emissions Trading System in Perspective*, Massachusetts Institute of Technology (May 2008). p.1
[659] Ibid.

The EU ETS phases

	1. (2005-2007)	2(2008-2012):	3rd (2013 to 2020)
„seriousness"	pilot	1st Kyoto CP	2nd Kyoto CP
coverage	power generators and energy-intensive industrial sectors	also aviation from 2012, also some nitrous oxide	some more sectors and gases; 45% of total greenhouse gas emissions from the 28 EU countries
grandfathering / auctioning	almost completely	at least 90%	progressive rise of auctioning (from 40% in 2013 to 100% by 2027), free allowances allocation under consideration of carbon leaking risks
price	total allocation of EU ETS allowances exceeded demand by a sizeable margin	economic crisis 2008 depressed emissions -> demand -> prices	back-loading as response to low prices (2014: 400 million certificates less)
JI and CDM	yes, but overallocation anyway and inability to bank international credits, no LULUCF	1.4 billion tonnes of CO2-equivalent, no LULUCF	varying percentages for different market participants, difficult to assess percentage, no LULUCF
cap	national	national	EU-wide

Table 8.1: The EU ETS Phases: Source European Commission http://ec.europa.eu/clima/policies/ets/

One of the critical features of the EU ETS that allowed the EU to overcome a certain amount of resistance from some member countries was the decentralization of the initial cap-setting framework. This is a bit of a departure from the classic cap-and-trade (CaT) model, which presupposes a centralized authority to set caps. In the case of the EU ETS, there was not a centrally determined cap; instead, each of the various member states submitted their own separate decisions regarding the absolute number of European Union Allowances they could distribute to the respective industries. However, the submitted quantity was subject to approval by the European Commission as per the procedures and criteria in the EU Emissions Trading Directive. [660]

[660] Ibid. p.2.

The fact that the EU ETS is a transnational European creation is an essential feature to consider when assessing how it has performed thus far. Each EU member state cedes some decision-making authority to Brussels, but they maintain significant sovereignty and authority. Each state has control over its own energy policy, although it must adhere to certain EU standards, but the framework is becoming more and more centralized. Each member state also maintains its own domestic energy policy foreign and has individual seats in the United Nations.

It took a process of many years for the EU to develop its emissions trading scheme. In particular, a sophisticated legal/regulatory regime (the acquis) could settle disputes and implement decisions and court judgments. Even though the acquis was able to ferment over a period of years with a robust institutional framework behind it (the Commission), there still was significant resistance to creating a regime that could fulfill its original purpose of reducing carbon emissions amongst the EU member states. As discussed in Chapter Seven, the origin of the EU ETS may be found in the 1997 Kyoto Protocol of the UN Framework Convention on Climate Change (UNFCCC). The Kyoto Protocol created mandatory carbon emissions targets for the thirty-eight Annex B countries, which comprised the world's developed countries and some countries in transition (generally of the former Eastern Bloc).

As a means to reduce compliance costs, the Kyoto Protocol had what was termed "flexible mechanisms," which were project-based mechanisms of the Clean Development Mechanism (CDM) and Joint Implementation (JI). During the period of international negotiations, the EU did not support their inclusion. But this was due to the ideological conflict that arose during the first years of the global climate negotiations.[661] At that time, the U.S. promoted a market-based approach while the EU supported a more policy-oriented regulatory approach of joint policies and measures.

After the world community agreed upon the Kyoto protocol, European policymakers began to accept the notion of a market-based approach to carbon mitigation efforts and developed

[661] Sonja Butzengeiger and Axel Michaelowa, "Greenhouse Gas Emissions Trading in the European Union-Background and Implementation of a "New" Climate Policy Instrument," in *Intereconomics* (May/June 2004). p.116

a carbon trading scheme. The first reason that drove the EU policymakers to become amenable to a market-based platform was the failure to come to an agreement at the 6th conference of Parties to the UNFCCC in the Hague in late 2000.[662] This failure occurred because of what was generally ascribed to as a lack of flexibility on the part of the environmental ministers of Germany and France to not agree upon a deal with the U.S. that the U.K brokered. [663] The second reason was when then U.S. president, George W. Bush, rejected the Kyoto Protocol.

With these two events, the EU realized that if they did not accept market-based mechanisms, or, in other words, a Coasian approach to carbon abatement, then the Kyoto Protocol would not come into being. Domestically, since 1992, the EU began to doubt the efficacy of the Pigouvian approach to carbon emissions regulation, such as the implementation of a carbon tax. During the 1990s, EU attempts to create a carbon taxation regime failed because of vocal British opposition. [664]Therefore, the highest levels of EU policymaking began to recognize that no other policy instrument could effectively reduce carbon emissions with political feasibility in mind other than deploying a carbon market.[665]

As is likely to affect the Gulf countries if they were to create a regional carbon market, the issue that proved to be the most contention in the EU was the negotiations to develop member state emissions caps. Given the lack of institutional cohesion and the current political rivalries between Gulf countries (especially the lingering distrust arising from Qatar's 2017-2021 embargo), it is doubtful that a regional Gulf carbon trading mechanism would be realized within the mid-term, i.e., before ten years. Despite that, it does not mean that such a linked market could not arise at some point after that when carbon markets become more normalized globally, and national carbon markets in other jurisdictions begin to implement transboundary linkage.

Perhaps one of the most important lessons that may be gleaned from the EU ETS is the need

[662] Ibid.
[663] Ibid.
[664] Ibid. p.117
[665] Ibid.

for verified and accurate emissions data to base carbon caps under a comprehensive monitoring, evaluation, reporting, and verification (MERV) system. The lack of verifiable baseline data for the EU ETS Phase One made it extremely difficult for EU policymakers to forecast a feasible "business as usual accurately" scenario that would establish an effective cap. The first phase of the EU ETS (2005-2007) triggered widespread castigation for ostensibly granting multi-billion-dollar windfalls to industry.[666]

Since the launch of the EU ETS, it also faced criticism for two early missteps: overallocation of emission allowances and the free allowance disbursement to power plants. The EU over-allocated carbon emissions by approximately 150 million tons. Because the overall emissions cap exceeded actual emissions, the market experienced a price collapse in May 2007. This overestimation caused the nascent carbon market to become much too "liquid."[667] Furthermore, the emissions allowances released in the first tranche of the EU ETS Phase One were notoriously undervalued. Because of these endemic market imbalances, permit prices fell to nearly zero within two years after the EU initiated the CaT scheme.[668] Even though the allowances were freely given to emitters, the utilities continued to pass costs on to consumers, reaping billions of dollars in profits in the interim.

Therefore, as discussed in Chapter Nine, creating a viable allowance allocation method is essential when discussing how a country may develop a carbon market feasibly. As occurred with Phase One of the EU ETS, an initial lack of data (the first batch of data became available in May 2006) led to overallocation during that period. And, what made matters more complex was that the European Commission then announced that it would not allow the banking of allowances. When Phase One concluded, spot prices were only a few cents.[669]

Yet, by Phase Two (2008-2012), there were policy enhancements to attempt to correct

---

[666] Jos Sijm, *et al*, *CO2 Cost Pass Through and Windfall Profits in the Power Sector*, CWPE 0May 2006).

[667] For a detailed discussion of the causes behind the price volatility in the EU ETS, see, generally, Maria Sanin and Francesco Violante, *Understanding Volatility Dynamics in the EU-ETS Market: Lessons from the Future*, ECORE Discussion Paper (2009).

[668] Ibid; Timothy Gardner, *U.S. Cap and Trade Plans Risk European Mistakes*, Reuters (May 15, 2009).

[669] Stefano De Clara and Kordula Mayr, *The EU ETS Phase IV Reform: Implications for System Functioning and for Carbon Price Signal*, The Oxford Institute for Energy Studies (Sept. 2018). p. 3.

for the previous phase's deficiencies. The overall cap was reduced by 6.5 % compared to 2005; verified data from Phase One granted the Member States the ability to set their caps on actual emissions, and fines were increased to 100 Euros per ton, among other modifications.[670]

Indeed, the most significant factor in the price collapse was the lack of sufficient data to set the initial carbon cap plausibly. In contrast to the U.S. Acid Rain Program, which relied heavily on historical data from coal-fired plants, EU policymakers utilized best-guess analyses of historical emissions and future projections. The EU policymakers estimated the emissions for each emission point and then set the targets and allocated allowances based on that estimation.[671] This led to an over-allocation of allowances and placed upward pressure on carbon prices until April 2006, when the first verified emissions reports arrived. The actual emissions were much lower than the cap, which caused the price to collapse soon thereafter.

Communication between the carbon emitters and the regulatory agencies was essential, and the EU policymakers failed in that aspect. In the absence of communication, either an under or overestimation of the cap and an erroneous allocation would inevitably result. Yet, with the experience garnered from the previous phases, carbon prices in the EU ETS are set to nearly double this decade to reach between 32 to 44 euros as the EU plans deeper emissions reductions.[672]

Even with the EU ETS Phase One missteps, it was considered to achieve at least a partial success in that it had quantifiably lowered carbon emissions by between 100-200 million tons in many quarters.[673] Perhaps more importantly, this represented the first time the

---

[670] Ibid.

[671] Janaki Ramakrishnan, *EU ETS-An Introduction* (2008). Available at http://www.internationalprofs.org/iesc/index.php?option=com_content&view=article&id=118:eu-ets&catid=908:eu-ets&Itemid=88

[672] However, when measured in 2030 prices, the higher end of the price band would be 59 euros by 2030. This would be an increase from the carbon price of 29 euros that held sway in third quarter 2020. This is using the assumption of an inflation rate of 2% per annum from 2015-2030. Kate Abnett, *EU Climate Plan Could See Bloc's Carbon Price Double This Decade*, Reuters (Sept. 17, 2020).

[673] Jonathan *Colmer, et al*, *Evaluating the EU Emissions Trading System: Take it or Leave It? An Assessment of the Data After Ten Years*, Grantham Initiative Briefing Paper No. 21 (Oct. 2016).

carbon price became an established factor in European market investment decisions. In short, the ability to reduce carbon emissions became an enterprise, and carbon savings became a commodity.[674]

While there were obstacles, those who view this scheme most optimistically argue that, even with imperfections, the EU ETS could (and should) be recognized as a success because it established a regulatory market that will create ever more ambitious future emissions targets. Yet, the EU achieved its carbon emissions reductions due to a multipronged approach, such as significant investment in renewable energy and energy efficiency directives, which resulted in steadily decreasing carbon emissions from 2007-2019 (See Figure 8.1). Again, it was not an unmitigated success, However, using the metric that it was actually implemented in the first instance and was able to operate transnationally, albeit with obstacles, led many to christen it a "success." At the very least, a success set the stage for later achievements and guided the implementation of carbon markets in other jurisdictions.

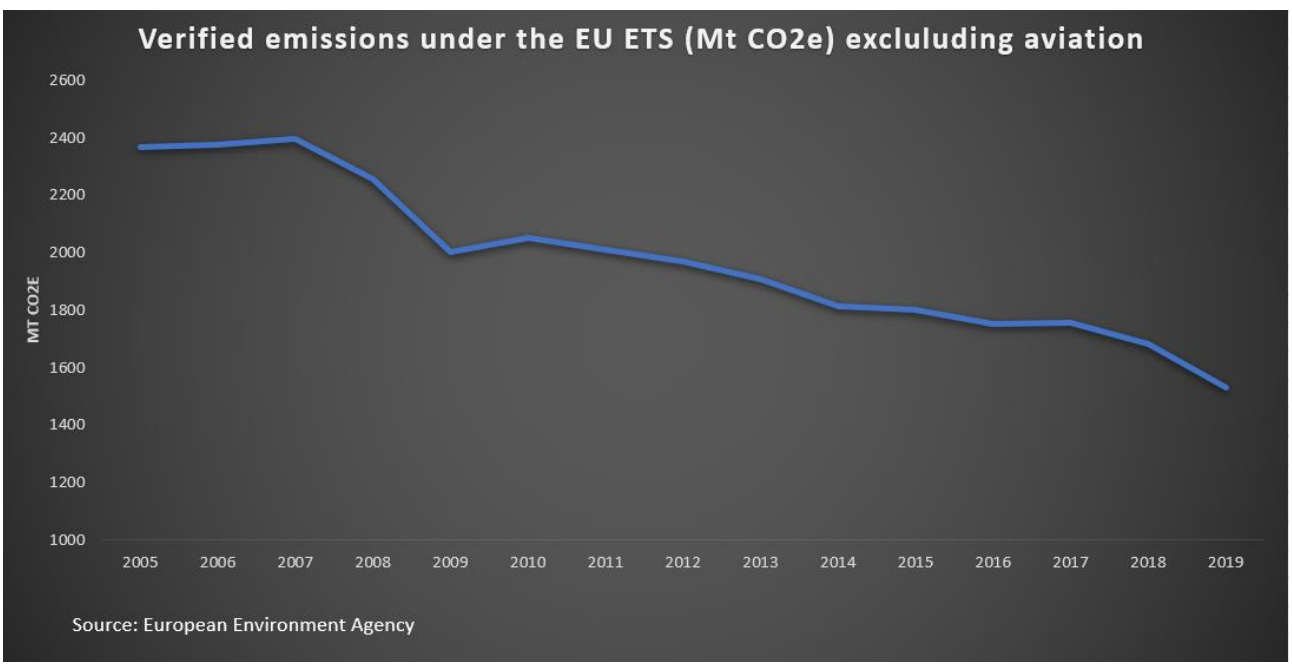


Figure 8.1 Verified Emissions Under the EU ETS, Excluding Aviation: Source: European Environment Agency

[674] Denny Ellerman, *Review of Pilot Phase of European Union Emissions Trading Scheme Finds it to be Successful*, (Oxford University Press: 2007).

The downside of the EU ETS Phase One presents a more familiar picture. Because Phase One lasted a mere two years, it had a minimal impact on technological development and implementation. And, the scheme did not have sufficient time to impact corporate decision-making substantively or drive investments into clean technology. Finally, the price collapse seemingly overshadowed much that was positive while amplifying everything that was not. Experience indicates that if emissions allowances were granted sparingly, not so much to push the market to become illiquid, but enough that emitters feel the necessity to either actively mitigate carbon emissions or purchase credits in the lack thereof, there is a greater likelihood of success.

Scarcity is the operative concept that drives any carbon emissions trading platform. It appeared that the European carbon market was beginning to experience upward pricing pressure in 2020/2021 as carbon prices began a steady upward climb (see Figure 8.2)-since the momentary dip due to the pandemic-to reach nearly €50+ level by late 2021, which when combined with a significant tightening of the cap, will finally have the desired effect of forming a more effective carbon price to drive investment and technological change.

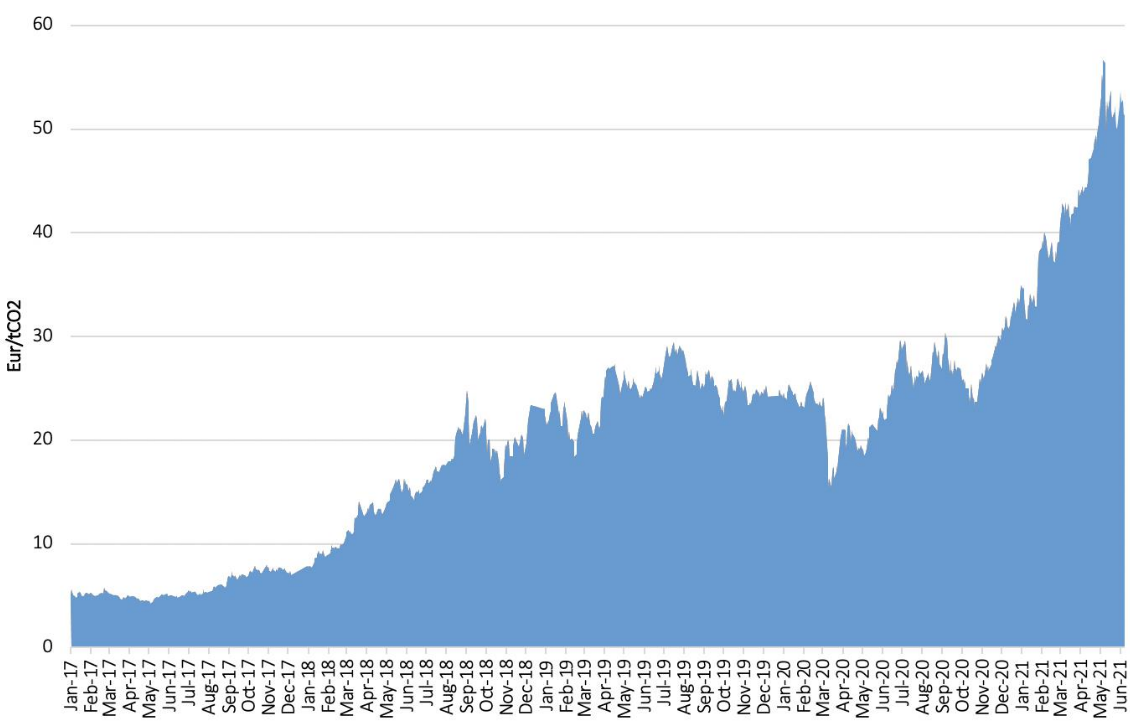


Figure 8.2: European Carbon Prices 2017-2021 Source: GECF Secretariat

8.3 Carbon Trading with Chinese Characteristics

Prior to developing its carbon market, China has participated in the global carbon market since 2005 through the Clean Development Mechanism (CDM) under the UNFCCC.[675] However, the decision by the Chinese government to proceed with the development of a domestic carbon market was driven by the progress of global climate change negotiations since the 2011 COP 17 in Durban, South Africa. In Durban, it was agreed upon that there should be a structural shift away from "top-down" limited participation, especially by developing countries, towards more "bottom-up" climate policies that emphasized local solutions to this global problem.[676]

As discussed extensively in Chapter Seven, COP 17 led to the agreement to create a global climate agreement with legal force to mitigate climate change. China's National Development and Reform Committee (NDRC) announced in October 2011 the *Notice of Starting the Work of Carbon Emission Trading Pilot Schemes* that it would begin the development of a national carbon market through the launch of seven ETS pilot schemes. The NDRC chose two provinces and five cities to initiate the program (i.e., Beijing, Shanghai, Tianjin, Shenzhen, Chongqing, Guangdong province, and Hubei province, See Figure 8.3). [677] The first trading period operated in conjunction with the Twelfth Five-Year Plan (2011- 2015).[678] China announced that the national carbon market would launch in 2017; however, no trading occurred, and the government did not promulgate the relevant regulations.

As a result, the Chinese government delayed the formal unveiling to the period of 2021-2025. Since its proposed inception, technical problems and various concerns about the

[675] Jeff Swartz, *China's National Emissions Trading System: Implications for Carbon Markets and Trade*, Global Economic Policy, and Institutions (March 2016). p.1
[676] Ibid. p.2
[677] From among these locations, Hubei, Guangdong, and Shenzhen are industrial zones, of which many different industries are clustered together. For more information about China's industrial clusters, see, *China's Industrial Clusters*, China Briefing (Feb. 23, 2012).
[678] *Thirteenth Five-Year Plan*, Grantham Research Institute on Climate Change, and the Environment (2016).

transparency and accuracy of emissions data have plagued the scheme.[679] However, the Chinese national ETS, officially launched in July 2021, is expected to overtake the EU ETS to become the world's largest carbon trading scheme once it is fully implemented.[680]

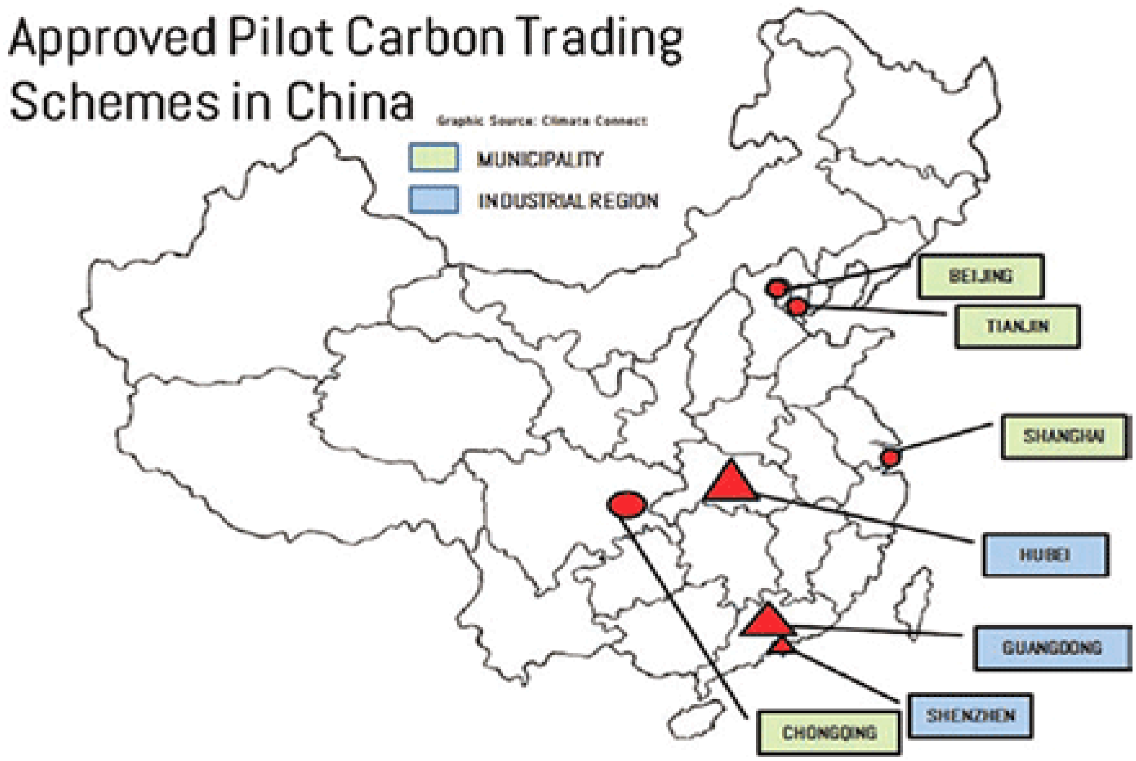


Figure 8.3: Pilot Trading Schemes in China: Source: Climate Policy Observer, SEI 2012

China based its pilot schemes, and subsequently, its national ETS, on the American Acid Rain program, the EU ETS, and the California cap-and-trade market. As a result, it forged multiple policy dialogues with the EU and California to understand their best practices. China sent officials to both California and the EU to learn about the most efficacious methods to construct an ETS. Additionally, China spent nearly fifteen years dispatching its

[679] The Chinese government, by first quarter 2021, was still revising its draft plans of emissions allowance allocations in order to determine the impact of the Covid-19 pandemic after incorporating feedback from the local governments and power generators. *China's Plan to Launch the World's Largest Carbon Trading Scheme By 2025*, Reuters (Nov. 12, 2020).
[680] Ibid.

functionaries to various countries for training to grasp the obstacles that other emission trading schemes encountered.

As a result of the earlier dialogue and training collaboration, the European Commission supports the Chinese government in implementing and developing its national ETS.[681] And, in that vein, to further cooperation, on April 24, 2018, the European Commission, and China's then newly minted Ministry of Ecology and Environment, held their first policy dialogue on emissions trading in Beijing.[682] The project has a budget of over $10 million. It will assist in the capacity and training of Chinese carbon regulators and the establishment of regular bilateral policy dialogues during the 2020s.[683]

Much of the bilateral cooperation arose in the wake of the uncertainty about the American commitment to the Paris Agreement in the wake of the election of former President Trump in 2016 and the desire to continue global progress towards fostering decarbonization.[684] And, as discussed in Section 8.3.2, of particular importance to Chinese regulators, was gaining insight into the EU's initial struggle to develop a viable cap to support a stable carbon price that would meet carbon emissions reduction targets. The collaboration between China and the EU remains crucial. As discussed in Chapter Nine, that cooperation provides a method of how the three selected Gulf countries would begin the initial steps of promulgating their domestic carbon markets.

While China is utilizing a multitiered approach to reach its carbon reduction goals, as discussed below, carbon trading is an integral pillar of that policy. Market-based incentives were not a new concept for the Chinese government. It has already spent six years in active participation with the global CDM market and understood the relative advantages that a more incentive-based model would have for carbon emissions reductions.[685]

[681] Ibid.
[682] *Emissions Trading: European Commission and China Hold First Policy Dialogue*, Climate Action (April 26, 2018).
[683] Ibid.
[684] Marian Willuhn, *EU, and China to Cooperate on Clean Energy Technology and Emissions Trading*, PV Magazine (July 17, 2018)
[685] Ibid. p.12; As of 2016, China held forty-6% of registered CDM projects. Many of the state-owned enterprises had participated regularly in the CDM market and acquired advantages from the Certified Emission Reduction trading agreements with Western countries.

8.3.1 Structure of the Pilot Schemes

As stated above, the NDRC approved the carbon market pilot scheme in late October 2011. The Special Economic Zone of Shenzhen was the first to deploy the carbon market in June 2013, with Shanghai, Beijing, Guangdong, and Tianjin following in the same year. In Hubei and Chongqing, the last two schemes inaugurated their respective markets in April and June 2014.[686] Local authorities, comprised of provincial/municipal Development and Reform Commissions (DRCs) and local emissions trading exchanges and research centers in each jurisdiction, designed and deployed the pilot schemes under the general direction of NDRC officials.[687] Even though the seven pilot schemes only represented a relatively minor share of China's carbon emissions, they provided an invaluable opportunity for Chinese policymakers to test the utilization of market incentives for carbon emissions reductions.

The government desired to concretely implement the experience gleaned from these important economic and political zones to provide a template of lessons and experience to other subnational units upon adopting a national ETS.[688]

Due to the locally-based design metrics, the pilot schemes were a heterogeneous mix. They covered disparate industries and included different inclusion thresholds.[689] One of the main concerns for the local regulators was addressing potential leakage concerns. As a result, the seven ETS pilots utilized some manner of free allocation.[690] In terms of the defining feature of a carbon market, i.e., the emissions cap, the Chinese government decided to implement a carbon intensity target that indexed emissions with economic

---

[686] Ibid. p. 5

[687] The NDRC established the parameters for allowance management, transaction process, emission reports, monitoring, and supervision. And, the regional authorities created the detailed market design, including scope and coverage, allowance allocation, and market stabilization. Ibid. *Lessons Learned from China's Regional Carbon Market Pilots*. p. 5; *China's National Emissions Trading System: Implications for Carbon Markets and Trade. p. 12*

[688] Zhe Deng, *et al*, "Effectiveness of pilot carbon emissions trading systems in China," *Climate Policy*, 18:8, (2018) pp. 992-1011

[689] Ibid.

[690] Guangdong auctioned a small number of allowances. For a detailed review of the allowance process during the pilot scheme, please see, Ling Xiong, *et al*, "Assessment of Allowance Mechanism in China's Carbon Trading Pilots," *Energy Procedia* 75 (2015) pp.2510 – 2515

activities.[691] The Chinese government chose this method because it wanted to reduce emissions without having a deleterious impact on economic growth.[692] Within China, this was known as the "Two Mountain" theory, as enunciated by President Xi, which maintained that economic and environmental progress are not mutually exclusive and can operate in tandem.[693]

The seven pilot schemes covered a multitude of different emission levels for the covered industries. Most carbon-intensive sectors were covered in the chemical, iron, steel, cement, and power and heating sectors. Nonetheless, as the local regulators were responsible for the ETS's characteristics in their respective jurisdictions, they created each pilot scheme based upon that locality's particular economic structure and emissions level. Additionally, each regulatory authority in its respective jurisdiction implemented a framework for MERV to ascertain that the emissions reductions were credible. The MERV stipulations for all seven schemes generally resembled each other with only minor technical variations.[694] Overarching guidelines were developed at the national level, but the monitoring and reporting were self-reported by the regulated industries, with the reports sent for third-party verification.[695]

All the pilot carbon market schemes had deployed various penalties for non-compliance, which incorporated financial penalties and other enforcement mechanisms. But, in contrast with the EU ETS, which imposed a penalty of 40 euros per ton in Phase One and increased it to 100 euros per ton in Phase Two and Three, China's pilot ETS only levied a fine when entities failed to commit. Therefore, the carbon management department would request that these entities complete the necessary action within a specified period with a financial penalty for non-compliance. Because of the aforementioned, enforcement structure, compliance was high across all seven pilots, with only Chongqing reporting a comparatively low compliance rate of 70% compliance rates.[696]

---

[691] Ibid. *Lessons Learned from China's Regional Carbon Market Pilots*. p. 6

[692] China pledged a 40 to 45 % reduction target in carbon intensity, defined as carbon emissions per unit of GDP, by 2020 relative to its 2005 level in the 2009 Copenhagen Accord.

[693] *Xi's Huzhou Trip: The Birth of "Two Mountains" Theory*, The State Council Information Office: People's Republic of China (May 8, 2018).

[694] Ibid. 8

[695] Ibid.

[696] Ibid. 10

Research conducted by Zhang, Harris, and Li, illustrated that the seven pilot projects had a positive impact on carbon emissions reductions when compared to previous command-and-control methods based on central government regulation.[697] Many enterprises incorporated carbon emissions reductions into self-governing behavior, realizing that carbon emissions management can be linked to increased business investment, operational efficiency, and overall profitability.[698] There has been a stark increase in R&D to control pollution by firms located in the pilot zones, with a virtuous cycle occurring of increased operational efficiency, more revenue generation, and further investment in modern equipment to reduce pollution.[699] Nonetheless, the pilot schemes indicated the importance of a credible enforcement regime, a firm and transparent regulatory code, and the singular importance of data collection.[700] The Chinese government was able to draw forth lessons from the pilot schemes that it is currently applying in the operations of the national ETS.

8.3.2 The Creation of a National ETS

The Chinese government viewed the pilot schemes as a success and announced in 2015 that it would initiate a trial national cap-and-trade market in 2017. However, as discussed above, there were technical difficulties, and the nationwide launch was delayed after its target date of June 2021, finally coming online a month later. Initially, Chinese policymakers sought to incorporate eight sectors that would gradually expand over time. But, the NDRC subsequently determined that it did not have reliable data for many of the companies involved and narrowed the number of industries to three sectors, i.e., the power sector (including combined heat and power and captive power plants of other sectors), cement and electrolytic aluminum.[701] However, the authorities subsequently

[697] Ibid.
[698] Ibid.
[699] Dong Sun, *et al* (2016) "Carbon Markets in China: Development and Challenges," *Emerging Markets Finance and Trade*, 52:6, 1361-1371
[700] Yeifei Zhang, *et al*, *China's Carbon Market: Accelerating a Green Economy in China and Reducing Global Emissions*, Global Development and Environment Institute Working Paper No. 18-01 (April 2018). p.11
[701] *China ETS in Force*, International Carbon Action Partnership, (Sept. 21, 2018). p 1.

narrowed it to the power sector, with the scope to be subsequently expanded to cover seven additional sectors, petroleum refining, chemicals, non-ferrous metal processing, building materials, iron and steel, pulp and paper, and aviation.[702] The power sector was chosen as the initial covered sector as it is a more mature industry with better quality data and records.

Despite the scaled-back market, the national scheme will still cover nearly half of China's 10.4 billion metric tons of emissions from approximately 2,200-plus large firms. As of yet, there is no official timeline of when the additional sectors will be included, although it is speculated that relatively homogenous sectors, such as steel, iron, and cement, are considered to be the most probable candidates for early inclusion.[703]

In December 2017, the Chinese government announced the official commencement of the national carbon market. The national carbon market is based on a 1+3+4 framework, with one management decree as the legal foundation, three core management measures, and four supporting infrastructure systems.[704] The legal foundation was entitled, *The Carbon Emissions Trading Management Decree*; the three core measures delineated carbon emissions MERV measures, carbon allowance management measures, and market transaction measures.[705] And, the four supporting systems covered carbon emissions data reporting system, carbon registry, carbon trading system, and a carbon emissions transaction clearing system.[706]

The NDRC's official document guiding the creation of the national ETS, *Guidelines of National Carbon Emissions Trading System Construction*, set forth the parameters for constructing China's ETS which involves three phases. The first phase (infrastructure construction) would last approximately a year and develop a national MERV system, a

---

[702] Ibid.

[703] Jane Nakano and Scott Kennedy, *China's New National Carbon Trading: Between Promise and Pessimism*, Center for Strategic and International Studies (July 23, 2021).

[704] *The Progress of China's Carbon Market*, Environmental Defense Fund (2017). p.6

[705] Lawrence Goulder, *et al*, *China's National Carbon Dioxide Emission Trading System*, Economics of Energy & Environmental Policy, Vol. 6, No. 2 (2017). p. 3

[706] Ibid.

national registry to track allowance ownership, and a national platform for emission trading.[707] The second phase ("system test") will last another year and implement a test phase of only one sector. The second phase will incorporate a test of the power generation sector to assess the design of the national ETS, including the system's allocation, trading, registry, and compliance protocols without the entire regulatory/legal framework in place.[708] The third phase ("development and improvement") will initiate the complete ETS regime with the power generation sector and extend it to other sectors incrementally from 2020 onward.[709] And, as with the previous pilot scheme, the national ETS will only cover carbon dioxide for the interim. The singular focus on carbon emissions raised some concerns as China is the largest coal-producing country globally and responsible for over 50% of global methane emissions from that sector.[710] If the national carbon market operates as envisioned, it could likely incorporate other greenhouse gases in the future.

China has already experienced some success with carbon emissions reductions as their carbon emissions have essentially leveled off from 2014 (See Figure 8.5). The decline in emissions was not just due to the carbon market; slowing economic growth and a transition away from coal in certain regions also played essential roles in the reductions.[711]

---

[707] William Pizer and Xiliang Zhang, *China's New Carbon Market*, Georgetown University U.S. China Initiative (Dec. 31, 2017). p. 5
[708] Ibid.
[709] Ibid.
[710] *See, generally, Tao Zhu, et al,* "An Improved Approach to Estimate Methane Emissions from Coal Mining in China," *Environmental Science & Technology,* 51 (21) (2017) pp. 12072-12080
[711] Dabo Guan, *et al*, "Structural Decline in China's CO2 Emissions through Transitions in Industry and Energy Systems," *Nature Geoscience* volume 11 (2018) pp. 551–555.

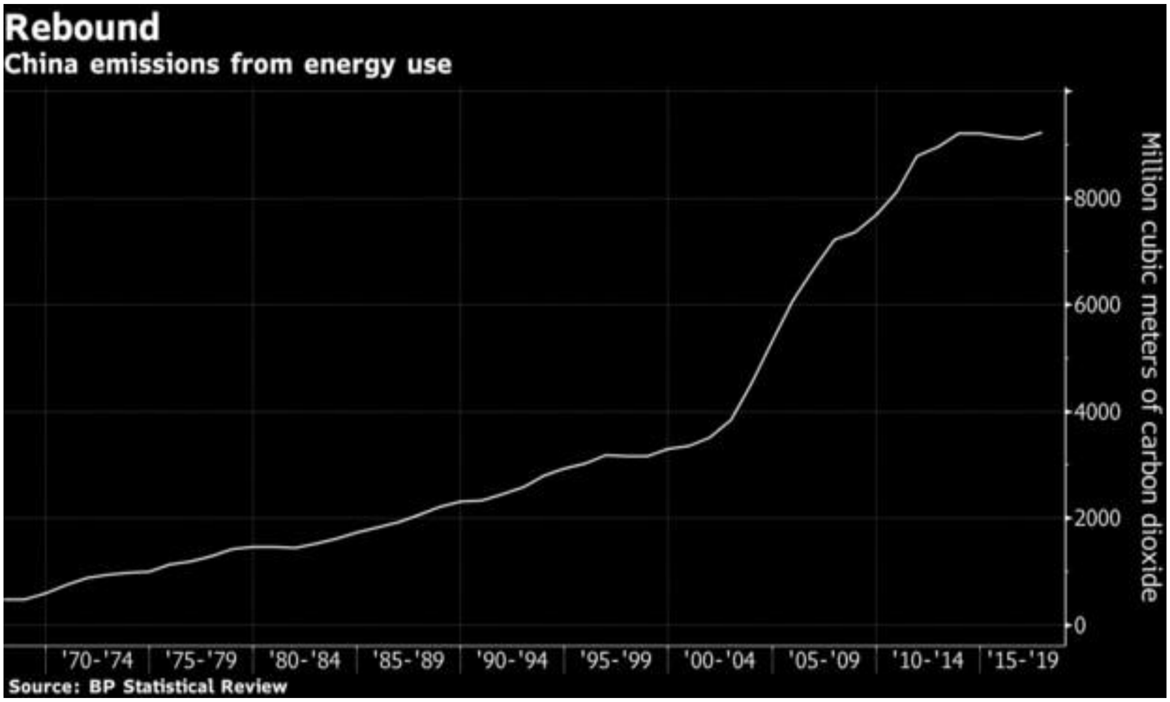


Figure 8.4 Chinese Energy Use Emissions: Source: Matthew Carr, *China's Carbon Emissions May Have Peaked*, Bloomberg (July 2, 2018).

During the first phase of China's national ETS, the emissions allowances will be allocated freely, as determined by the NDRC. But the provinces are required to formulate a list of companies in their jurisdictions that will be incorporated into the national ETS. The revenue generated by the ETS will be invested in a national innovation fund to stimulate further investment in alternative energy technologies and energy-efficient industrial equipment.[712] The reasons are manifold why the NDRC chose the gratis allocation method. Firstly, there was difficulty creating a "reasonable and fair" grandfathering option as NDRC officials did not have the required data for the covered sectors.[713] Secondly, power and heat tariffs are regulated by the governmental authorities. And, as a result, power and heating companies cannot pass along the increased marginal costs to end-users. There is increasing power demand throughout China, which differs from developed countries with declining per capita power demand.[714]

Thirdly, as the Chinese manufacturing sector is still expanding, and new capacity additions

[712] *China's National Emissions Trading System: Implications for Carbon Markets and Trade.* p. 18
[713] Ibid. p.7
[714] Ibid. These companies requested that the government grant them additional allowances to meet the projected increased demand.

tend to incorporate lower carbon intensity machinery, the grandfathering method would "punish" those with low carbon emissions but high output growth.[715] Lastly, certain sectors, such as steel and cement, have overcapacity and are reducing production capacity. A grandfathering approach in that instance would lead to windfall profits, such as the EU ETS experienced.[716]

The NDRC also collaborates with other ministries to implement an adjustment mechanism to mitigate large pricing fluctuations and a regulatory framework to prevent price manipulation. Even though the national ETS is currently operational, it is still essentially a trial run as regulators, officials, and covered companies become acclimated to operating an ETS of this scope.

One of the principal reasons the Chinese government chose a national ETS over a carbon tax was that there was already public resentment over the current tax regime, which is broadly viewed a burdensome.[717] And, as stated above, due to the perceived success of the SO_2 market and the carbon market pilot schemes, Chinese policymakers considered a market incentive approach as much more viable.[718] Amongst Chinese policymakers, indeed, in most countries, a carbon tax is viewed as much more politically difficult to deploy than a carbon market.[719]

[715] Ibid.

[716] Ibid.

[717] For a broad overview of the Chinese taxation regime and the popular perception, see, Yuhua Qiao, *An Evaluation of China's Tax System: Insights for Future Reform*, Missouri State University (2016).

[718] For instance, in 2016, the Chinese legislature authorized the promulgation of a new environmental tax in 2018, but policymakers resisted even the explicit authority to implement a carbon tax. *China to Introduce Environmental Tax for Enhanced Pollution Control*, Xinhua (Dec. 25, 2016); Mehran Khan and Yen-Chiang Chang, "Environmental Challenges and Current Practices in China-A Thorough Analysis," *Sustainability Journal* 2018, 10, 2547 p. 18

[719] China has collected a pollutant discharge tax since 1979. But, overall, industry is resistant to additional taxes. Ibid.

8.3.3 Challenges to the National ETS

China has made immense strides in regulating its carbon emissions. Even so, implementing an ETS on this scale will undoubtedly bring forth challenges. The quality of data is a significant challenge with which Chinese regulators will have to contend. For instance, the difference in the quality of statistics between various departments could lead to data corruption.[720] Many different government departments collate energy data under different metrics and standards, such as the Bureau of Energy, the Development and Reform Commission, and the Commission of Economy and Information Technology. Therefore, some data inconsistencies increase the uncertainty of an accurate assessment of national carbon emissions. Additionally, the utilization of multi-sector tradeable performance standards can create perverse outcomes. Some sectors that have relatively lower standards could be subsidized by other industries that have more rigorous standards. As a result, there are some concerns that cross-region subsidization could occur with the output-based allocation method.[721]

Asymmetry of information is also an issue that the Chinese regulators will attempt to manage. This involves two issues. Firstly, the data asymmetry between the local/central authorities and large enterprises. The Chinese methodology incorporates the company as a whole, instead of as discrete facilities or installations, as emissions sources.[722] Therefore, these firms are in a position to manipulate data as they have higher quality information regarding their respective technological levels, fuel quality, and production capacities; all the preceding would influence allowance allocation.[723]

Additionally, there is the issue of information asymmetry between the local and central governments. The local governments may seek to protect local "champions" by the allocation of excessive allowances.[724] Due to this information asymmetry, national

---

720 Shaozhou Qi and Si Cheng (2018) "China's National Emissions Trading Scheme: Integrating Cap, Coverage and Allocation," *Climate Policy*. p.5

721 Ibid. *China's New Carbon Market p. 14*

722 Ibid. *China's National Emissions Trading Scheme: Integrating Cap, Coverage and Allocation*. pp.5,7

723 Ibid.

724 Ibid.

regulators may not be able to reliably verify the cap and allocation as reported by the local authorities.[725] Therefore, overallocation may arise due to the firms' inaccurate data and the local authorities' protection of certain firms by granting more allowances than required.[726]

The Chinese national carbon market finally became fully operational in July 2021, with much fanfare that heralded it as the world's largest. But, for it to become anything more than a vast exercise in bureaucracy, it will have to evolve significantly in terms of its methodology (the current intensity-based targets) and coverage. And, as discussed above, it has been beset by delays. It may not be ambitious enough in scope to allow China to achieve its emissions-reductions targets, including a 2030 deadline for peak emissions and a 2060 target for net-zero emissions. Nonetheless, the Chinese experiment does announce that China is taking carbon emissions reductions seriously, a significant departure from its positions during multilateral climate negotiations in the 2000s.

[725] Ibid.
[726] Ibid.

8.4 Conclusion

As discussed in the Introduction, the theoretical understanding of externalities was developed in the late nineteenth and early twentieth centuries. Since then, economists have created- and policymakers deployed-various instruments to contain and manage environmental pollution. Even though governments promulgated laws protecting the environment as early as 1272 when King Edward I of England banned the burning of sea-coal, the prominence of environmental legal regimes began to spread in the mid-twentieth century with the broadening of ecological awareness amongst various citizenries.[727] Governments, typically those in the developed world, such as Europe and North America, sought to utilize the levers of governmental authority to induce compliance, such as through command-and-control regimes and pollution taxes.

However, during the 1970s, the deregulatory movement emerged, initially concerned with regulatory capture, but then expanded based on the perception that regulation stifled innovation, placed an overwhelming burden on the industry, and inhibited economic growth.[728] Deregulation posited that market incentives were a much more beneficial method to stimulate market competition and achieve environmental goals. As a result, when global warming became a worldwide cause for concern, market instruments were tabled as an efficacious means to reduce greenhouse gas emissions.

Therefore, the Coasian bargaining approach is now nearly inextricably embedded in most climate change discourse as one of the most efficient ways to combat climate change and the most amenable to the business community. Likewise, as many broad-based protest movements that arose throughout history (some eventually toppling governments) were animated by the perception of onerous taxation, carbon trading has not met fierce opposition of this sort. Carbon trading, amongst the general populace, is generally considered slightly esoteric.

---

[727] Peter Brimblecombe, *Attitudes and Responses Towards Air Pollution in Medieval England*, "Journal of the Air Pollution Control Association," 26:10, (1976) pp. 941-945,

[728] Interestingly, one of the first advocates of deregulation was Ralph Nader, a prominent American environmentalist and consumer protection advocate. Ralph K. Winter, Jr, "Economic Regulation vs Competition: Ralph Nader and Creeping Capitalism," *The Yale Law Journal* Vol. 82, No. 5 (April 1973), pp. 890-902

Due to the Coasian approach's success in the U.S. Acid Rain Program in the 1990s and the EU ETS subsequently reducing sulfur dioxide and carbon dioxide, respectively, the market-based system of combatting negative externalities tends to be the preferred approach to mitigate global warming. As European policymakers discovered, the learning curve was quite steep, and many complex issues required resolution. In particular, they established a robust MERV system and empowered regulators to ascertain whether a fraudulent activity was occurring.

Europe's carbon market plunged more than 90 % due to the global financial crisis in 2008/2009. But, despite these issues, the EU ETS successfully reduced carbon emissions by nearly a quarter since 1990 with prices stabilized (See. Figure 8.2) and expected to increase substantially over the early 2020s. Also, quite notably, the European business/industrial sector ceased its active resistance and factored carbon pricing into its daily operations while not precisely in full support of the EU ETS.

The Chinese example is critical as it relates to the Gulf countries. China experimented with a mix of policies to reduce pollution, such as command-and-control frameworks, environmental taxation, and a Coasian market-based incentive approach. Overall, China instead chose to utilize carbon trading as being the most efficacious means to reduce emissions. And, as the Chinese experience illustrated, it is entirely possible to learn from the history of other emissions reduction frameworks to avoid their pitfalls. As discussed in Chapter Nine, the initial allocation of tradeable emission allowances is one of the most critical features in constructing an emission trading scheme. And, especially as China encounters, the framework's complexity, lack of coordination amongst various governmental agencies, and incomplete and insufficient information can operate as significant hurdles.

While the EU ETS had many missteps during its initial implementation and struggled to set an effective price, it must also not be forgotten that certain implementation errors were bound to occur as it was the first carbon trading market established. That said, as the EU ETS is concluding with its third phase, it seems to have developed a more successful model as it flexibly refines the system to meet its policy goals. Judging from the EU ETS and China's experience with carbon abatement, it is abundantly clear that quality data is essential and an adequate regulatory regime that can implement a credible MERV. And, it does appear, although it is too early to tell from China's national ETS, that China has learned from the EU ETS experience and will likely bypass the most glaring deficiencies of the EU ETS.

Broadly speaking, what becomes clear from a review of the EU ETS and Chinese experiences is that a phased implementation process is beneficial. A phased process allows a country to progressively establish a national carbon abatement scheme while learning from implementation errors and having the flexibility to modify the scheme as required. Therefore, Chapter Nine will discuss in depth how the various carbon abatement frameworks could apply to the three selected Gulf countries while assessing the institutional robustness of their respective environmental agencies. Chapter Nine will also discuss how realistic it would be for the selected countries to implement a carbon abatement process in adherence with their Paris Agreement obligations in the 2020s.

Chapter Nine: Carbon Abatement Strategies in Saudi Arabia, the UAE, and Qatar

9.1 Introduction

This chapter details in depth what past and current actions Qatar, Saudi Arabia, and the UAE are undertaking to reduce greenhouse gas emissions. In addition, it analyzes what a potential carbon abatement mechanism could resemble for the three selected countries in the post-2020 period when the countries submit their updated or new greenhouse gas abatement programs, as per the stipulations of the Paris Agreement.[729] A carbon abatement program could take many forms, including a cap-and-trade scheme (CaT), a carbon tax, a hybrid model, or command-and-control (direct) regulation (See Chapter 2, Section 2.2, for an in-depth discussion of the various carbon abatement frameworks). Of importance, this chapter reviews potential institutional weaknesses that could inhibit the three selected countries from creating a viable carbon abatement mechanism. Creating a robust structure in the initial stages is fundamental as it would be a significant factor in the scheme's future success and the level of acceptance by the local business community and populace.

Furthermore, understanding the legal frameworks of the three selected countries is vital as they are still in the process of increasing their administrative capacities. The development of financial markets and downstream industries in the region over the past several decades gave the impetus to establish feasible regulatory structures to support foreign investment and create a robust environmental framework. This had a spillover effect in other sectors as Gulf countries modernized their legal/regulatory capabilities.[730] For instance, as the Saudi economy grew apace, its regulatory apparatus expanded to

[729] The UAE submitted its updated NDC in December 2020, thereby meeting the deadline. However, Saudi Arabia and Qatar missed the deadline, along with numerous other signatories. It is expected that they will submit theirs in early 2022.

[730] Olivier Holmey, *Gulf Regulators Push for Modernization*, Euromoney (Apr. 4, 2018)

match its economic needs.[731] But, while the EU is a focal point of inspiration for the GCC member states for regulatory harmonization, there is still significant work required before the Gulf states can reach that level of coordination and sophistication.[732]

Most MENA countries designate the Islamic Sharia as a principal source of law, and the Gulf countries are no exception.[733] In Saudi Arabia, for example, the Islamic Sharia is the foundational legal base of the law in the Kingdom. There is also enacted legislation as the second source of legal decrees in Saudi Arabia. Yet, these enacted decrees are subject to, and cannot come into conflict with, Sharia law. In slight contrast, the Emirati legal system was founded upon civil law principles but is heavily influenced by the Egyptian legal code and Islamic Sharia law, which, as in Saudi Arabia, the Islamic Sharia provides the guiding principles of the legal code.[734] Legislation in the UAE is formulated into myriad legal codes that constitute the general legal principles and many subsidiary legislations. The UAE, especially Dubai, has the most advanced regulatory apparatus in the region, when compared to the other Gulf countries. The UAE could therefore be considered a modern administrative state in comparison to its Gulf neighbors.

Qatar's legal/regulatory code is based upon its national constitution and Islamic Sharia, with the Islamic Sharia as the primary source of legislation in the country. Although behind the UAE in terms of regulatory modernization, Qatar is currently modernizing its legal and regulatory structure to adhere to international norms, especially as it relates to corporate governance and the financial sector.[735] Furthermore, as discussed in Sections 9.4-9.6, the three selected countries have varying levels of compliance with the codes that their

---

[731] *Saudi Arabia's Legal Framework Evolves Alongside Economic Needs*, The Report Saudi Arabia (2015)

[732] Tomas Lamanauskas, *Regional Harmonization of Telecommunications Regulatory Frameworks Outside the European Union: A Case of the Gulf Cooperation Council States*, Telecommunications Regulatory Authority, Kingdom of Bahrain (no date).

[733] The Sharia is a collection of prohibitions and regulations from a variety of sources, including the Qur'an, the sayings of the Prophet Muhammed (the Sunna) and the myriad interpretations and opinions of the respected theologians. A notable exception in the MENA region is Lebanon as it is an Arab country does that not designate the Sharia as its primary legal inspiration. This is because Lebanon that has a multihued sectarian and confessional political and legal framework.

[734] Andrew Tarbuck and Chris Lester, *Dubai's Legal System: Creating a Legal and Regulatory Framework for a Modern Society* (Motivate Publishing, 2009) p. 6.

[735] See, generally, *Strategic Plan for Financial Sector Regulation*, Qatar Central Bank (No Date). Available at http://www.qfcra.com/en-us/publications/CorporateDocuments/flipbook%20pdfs/English%20Strategic%20Plan%20Book.pdf

environmental agencies and energy ministries promulgated to manage pollution and hydrocarbon production throughout their respective jurisdictions.

While the Islamic Sharia would not directly affect the principal sinews of a carbon abatement scheme in the Gulf, merely creating caps on emissions would have a particular impact on the deployment of Sharia-compliant carbon finance issues and securitization. And, while this chapter does not comprehensively review the interrelationship between the Islamic Sharia and carbon abatement programs, it is helpful to understand that Sharia compliance for carbon finance is one of the issues that has inhibited carbon finance from being able to obtain a fatwa that verifies that it conforms to Islamic norms. However, as Nathan Brown has written, recent scholarship has identified that Sharia law should not simply be considered a set of rules and regulations, but also institutions and practices. But, as Brown argued, while these institutions and practices were able to withstand and survive after colonialism and the incorporation of European legal frameworks, in practice, they began to decay and were incrementally abandoned as the commanding heights of the legal codes.[736]

Amongst Islamic scholars, there are differing views on a carbon market's acceptability in Islam. For instance, some studies, such as a 2012 study by Naila Nazir, judged that carbon trading was fundamentally non-Sharia compliant because it was based on an artificial commodity, i.e., the right to emit carbon, and therefore could not be considered an asset class.[737] Nevertheless, the consensus view of many notable Islamic scholars in the Gulf is that carbon credits are Sharia-compliant as they are a commodity based on adding value to existing projects and not simply a standalone intangible asset class. [738] Moreover, as they are backed by an economic value given to specific commodities, carbon credits are often compared to currencies that have no inherent value but are guaranteed by a central bank or government. A theological obstacle, though, is that there is no fundamental right to pollute under Islamic law. Yet, many Islamic scholars have maintained that rather than being a right

[736] Nathan Brown, "Sharia and State in the Modern Muslim Middle East." *International Journal of Middle East Studies* 29, no. 3 (1997): 359-76.
[737] See, generally, Naila Nazir, *Carbon Trading Market: Viability for Islamic Financial Industry*, Center for Islamic Economics and Finance: Qatar Faculty of Islamic Studies (2012).
[738] *Islamic Carbon Trading: Goldmine or Minefield?* Islamic Finance (May 15, 2013). p.5

to pollute, carbon credits would indeed be proof positive of carbon emissions reduction, which therefore would be permissible as environmental preservation.[739]

Several variables, some unique to the Gulf, would have to be adequately addressed to formulate an optimal carbon abatement platform. For instance, if the selected countries decided to implement a carbon market, one of the most essential variables would be constructing an effective allowance disbursement scheme and enforcing the requisite regulatory framework and data coherence. The initial disbursement can significantly impact industrial competitiveness (e.g., carbon leakage) and issues concerning potential windfall profits accruing to certain companies.[740] Additionally, as will be discussed below, if policymakers decide on a gratis initial disbursement, potential WTO conflicts could arise under the WTO's Agreement on Subsidies and Countervailing Measures Agreement (SCM Agreement).[741]

In terms of the methodology employed in this chapter, the normative approach of Coasian bargaining will be utilized as detailed in the Introduction. Concerning this chapter's general outline and preview, Section 9.2 outlines certain issues that would likely be necessary to create a viable carbon abatement regime in the selected countries. It employs the NIE approach of distributing property rights to carbon emitters in a bid to build the foundations of a viable carbon market, an analysis of the minimization of transaction costs, and the establishment of the institutional exoskeleton that would have to be implemented. Additionally, this section utilizes the analysis of the EU's difficulties in Chapter Eight, such as over-allocation of permits. It delineates the requirements that a Gulf-based carbon abatement scheme must have to succeed. Section 9.3 discusses why the three selected Gulf countries would implement a carbon abatement mechanism and certain steps they are undertaking in that direction. Section 9.4-9.6 includes an in-depth analysis of the three

[739] Ibid.

[740] As will be discussed subsequently in more depth, carbon leakage occurs when there is a relocation of energy or carbon intensive industries from countries that have a carbon price to countries with less stringent rules. The fear of potential relocation of critical industries, and the resultant negative economic impact, acts as a barrier to acceptance of the implementation of creating a carbon pricing regime.

[741] While WTO rules grants some legal flexibility for carbon pricing related measures, there still is the potential for certain measures to be interpreted as constraining the import of carbon intensive goods from countries without such regulations. This could potentially run afoul of WTO non-discrimination and market access rules.

selected countries' current and past carbon reduction efforts while assessing their announced policies against the relative strength of their environmental agencies. It also creates a framework of how the three selected countries could potentially move forward with creating a carbon abatement mechanism in their respective jurisdictions.

9.2 Requirements for Designing an Effective Carbon Trading Platform

This section will assess what requirements are necessary to construct a viable carbon market. It also analyzes the various methods to utilize a Coasian approach to grant property rights to carbon emitters to reduce greenhouse gas emissions. Using the European and Chinese experiences as a guide, as discussed in Chapter Eight, CaT schemes generally tend to be preferred by the business community for deployment instead of the hybrid model, carbon taxation, or command-and-control regulations.[742] Overall, corporations prefer climate-oriented policies that would allow them to meet their greenhouse gas emissions reductions at the lowest cost possible, utilizing a market approach.[743]

The EU succeeded in achieving economic and environmental benchmarks by applying a CaT model to various ecological problems. And, the U.S. has had exceptionally positive results with its emissions trading through the auspices of a CaT scheme under the American Acid Deposition Control of Title IV of the 1990 Clean Air Act (Acid Rain Program). Under this approach, the U.S. not only met environmental goals but achieved significant program-wide cost declines. Furthermore, China successfully implemented a pilot carbon scheme in 2013/14 and its fully operational national carbon market in 2021.

Of particular importance is that while the EU ETS had significant hurdles in its operation due to overcoming country member resistance and data problems, China sent its emissaries around the world, particularly to the EU and California, to learn best practices. And this ensured that China would design a system that would at the very least be mindful of what

[742] For instance, in 2007, the U.S. Climate Action Partnership, consisting of ten large corporations with an overall capitalization of approximately $750 billion, issued a blueprint for a mandatory economy-wide, market driven approach to climate protection." *A Call to Action*, U.S. Climate Action Partnership (2007).
[743] *How Do Companies Do Business in a Carbon-Constrained World*, Ernst &Young (No Date). p.3

problems it could experience. For example, China was able to implement a trial national carbon market only seven to eight years after the initial launch of the pilot schemes.

However, implementing a CaT system requires careful adherence to several factors to ensure a successful deployment, as the EU and Chinese experience discussed in Chapter Eight illustrated. Generally, a phased introduction of a carbon trading platform tends to be most successful as it would potentially allow adequate time for the various industrial sectors to acclimate their human and technological resources to the new carbon-constrained reality. And a phased approach also allows the regulatory agencies time to test and assess compliance and design the optimum procedures to ensure efficient operation of the scheme

2.1 An Initial Allowance Disbursement in a Cap-and-Trade System

To establish a viable CaT system, it is necessary to first promulgate the required cap on overall emissions levels and then allocate the emission allowances so that the market can begin to operate. Under the Coasian method, it is necessary to assign property rights to carbon emissions. The allocation of emissions allowances is one of the most contentious aspects of a carbon emissions platform because it portends enormous consequences for future financial viability, firm competitiveness and whether the carbon market will work as envisioned. As discussed in Chapter Eight, in the initial phases of the EU ETS, overallocation in allowances led to low allowance prices and insufficient investments in low-carbon technology. The lack of adequate data and experience in emissions trading by the market participants exacerbated the initial overallocation of allowances in Phase One of the EU ETS that caused the price volatility. But the low prices that occurred in Phase Two were due in no small part to the market's success in stimulating emissions reductions as allowance trading will decline if regulated entities meet their reduction targets.[744] Yet, at the same time, during the initial construction of a CaT framework, setting a cap that is not too stringent allows the market participants to acclimate themselves to the process without unduly disrupting business competitiveness.

[744] The 2008/2009 economic downturn also played a role. Lucas Merrill Brown, *et al*, *The EU Emissions Trading System: Results and Lessons Learned*, Environmental Defense Fund (2012). p. 12.

Broadly, there are two main methods for allocating emission allowances to market participants. Either the regulator may convene an auction to enable emitters to bid for the initial tranche of allowances, or the regulatory body may disburse them at no charge to an initial cohort of market participants. The latter technique was the primary method utilized to disburse sulfur dioxide emissions under the Acid Rain Program and the EU ETS. Some combination of the two previous methods may also be used. If the regulatory body decides to grandfather existing emitters into the scheme, it could determine the metrics for the initial disbursement. Each method presents advantages and disadvantages for the covered firms involved, even though the allocation method makes a negligible impact—if there is a credible baseline—on the ultimate analysis of whether the market functions or environmental benchmarks are achieved.

The international business community generally considers the gratis allocation of emission allowances the most acceptable method of initiating a carbon emissions scheme. Furthermore, its implementation tends to be relatively simple from a regulatory standpoint. One major criticism is that it may create high entry barriers for later entrants in the sector. In this scenario, the new entrants would be obliged to purchase a set of allowances, even though earlier competitors were grandfathered into the system. One possible way to overcome this challenge is to create an allowance set aside for later entrants. This would provide a set of no-cost allowances for new competitors and mitigate favoritism concerns.

Nonetheless, as discussed earlier, there remains the risk that a free initial disbursement could contravene WTO rules under the Subsidies and Countervailing Measures (SCM) Agreement. If a free allowance scheme is adopted to assist a few targeted industries under the auspices of an all-encompassing CaT scheme, a danger exists that the free grant of allowances could be considered an actionable subsidy[745] under the SCM Agreement; as it

[745] See, generally, Justin Dargin, *The Gulf Natural Gas Dual Pricing Regime: WTO Rules and Economic Growth in the*

could be construed as a “benefit.”[746] To reduce this possibility, the WTO could perhaps renew its five-year experiment with the so-called “green light” subsidies which considered certain types of subsidies as “non-actionable,” even if they were specific and would otherwise be prohibited. When green light subsidies were in effect, subsidies for certain environmental compliance costs were thus deemed by the WTO as non-actionable. A potential renewal of this designation as per gratis disbursement of carbon allowances would assist in helping encourage countries to develop binding carbon caps.[747]

With an initial auction allowance, whereby all entrants (new and old) are charged, new entrants would not confront a competitive disadvantage vis-à-vis older firms in the absence of an allowance set aside because all participants would be on equal footing. Of course, few businesses find this procedure an acceptable allocation method, as some consider it a hidden tax. However, the system's proponents argue that an initial auction allowance reduces tax distortions, provides more significant incentives for technological innovation, and avoids quarrels over the distribution of rents.[748]

As the EU ETS Phase One was created to provide a learning-by-doing process, allowances were allocated generously in the view that it would take some time for companies to become acclimated to incorporating carbon into business decisions. The EU regulators patterned their CaT framework on the successful U.S. Acid Rain Program, which reduced U.S. acid rain pollution since 1995 at a low cost.[749] The difference between the EU ETS and the Acid Rain Program was that the U.S. system was based upon actual historical emissions. In contrast, the EU ETS incorporated overly optimistic growth scenarios and allowed each member state to allocate carbon allowances on the facilities’ estimated future emissions.[750] Therefore, as discussed in Section 9.2.2, reliable historical data is a prerequisite for

---

Gulf Cooperation Council (Nova Science Publishers, Inc, 2011).

[746] Ibid. *Climate Change, Emissions Caps and Carbon Leakage: Cracking a Tough Policy Nut*.
[747] Alan O. Sykes, *The Economics of WTO Rules on Subsidies and Countervailing Measures*, The University of Chicago Law School (May 2003) p. 16.
[748] See, generally, Peter Cramton and Suzi Kerr, “Tradeable Carbon Permit Auctions: How and Why to Auction Not Grandfather.” *Energy Policy* 30 (2005) pp. 333-345
[749] Ibid. *The EU Emissions Trading System: Results and Lessons Learned*. p. 12.
[750] Ibid.

designing an effective system.

Corruption is also an issue that must be addressed as well. Various scholars, such as Kossov and Guignon, detailed how corruption enabled and facilitated the resale and misreporting of used carbon allowances, value-added tax fraud, and hacking theft from the national carbon emission registries.[751] During the implementation phase, proactive reform and adjustments would allow the mainstreaming of anti-corruption tools to bolster carbon markets' overall efficacy and functioning. This is primarily a function of strengthening capacity for data collection and analysis in the carbon market jurisdictions. Allowing the market regulators to have the power to address potential corruption of nepotism-or in the case of the Gulf region, *wasta*, would go a long way in eradicating these issues and improving the carbon market's performance.[752]

[751] A. Kossoy and P. Guignon, *State and Trends of the Carbon Market 2012*. Washington D.C.: World Bank Carbon Finance Unit (2012).

[752] *Wasta* is an Arabic word that is loosely translated as "nepotism" or "favoritism." It is the ability for someone to leverage his or her connections to influence affairs or get things done as expeditiously in his or her favor. To understand this concept in more depth, and the role it plays in Middle Eastern countries, see, generally, Andy Barnett, *et al*, "Regulation, Trust, and Cronyism in Middle Eastern Societies: The Simple Economics of "Wasta"" *The Journal of Socio-Economics*, Vol. 44, June 2013 pp. 41-46

9.2.2 Developing the Base: Development of MERV, Certification, and the Construction of a Baseline

To establish a Gulf-based carbon emissions trading platform, a country considering its deployment must not make haste in the initial developmental stages but, instead, use the time effectively to design a viable system that will meet long-term environmental benchmarks.

If the three selected Gulf countries develop any form of carbon abatement mechanism, comprehensive monitoring, evaluation, reporting, and verification (MERV) framework would be necessary for regulators to review. Not only will a MERV potentially assist policymakers in avoiding the unnecessary problems that entangled the EU ETS Phrase One (See Chapter Eight), but it could credibly illustrate carbon emissions averages from different projects and industries. Gulf policymakers must consider that a robust MERV system allowed the U.S. Acid Rain Program to succeed, and its absence caused the price collapse of the EU ETS Phase One.

Only greenhouse gases that can be feasibly certified could be part of the cap, and energy-intensity standards may be utilized to regulate difficult-to-monitor greenhouse gases. Lack of historical data could plausibly cripple a drive to establish a trading platform, as well as the lack of a consistent methodology. The models used for the baseline calculation could potentially cover the average emissions of a several-year period to avoid the risk of a single year's emissions being an aberration. Furthermore, as the rapid onset of the global financial crisis in 2008/2009 demonstrated, as well as the Covid 19 pandemic, basing emissions reduction targets on overly optimistic economic growth rates is perilous, and unbridled optimism should be restrained as black swan events may arise at any moment.[753]

Setting forth the proper groundwork allows policymakers to receive input and make

[753] The Black Swan theory constitutes a type of metaphor describing a major event that came unexpectedly, and thereafter, rationalized by observers. Some notable examples are the collapse of the USSR, the global financial crisis (2007-2008), and the Covid 19 pandemic.

informed decisions in developing a national baseline. The three selected countries have already produced carbon inventories, as discussed in Sections 9.4-9.6. Still, it would be essential that their regulatory agencies develop detailed certification procedures to prove that the verified emission reductions constitute tradable emissions credits. In brief, before a carbon trading platform comes into existence, the sinews of the system— MERV, certification, and the establishment of a project-industry- or nation-specific baselines— would have to be in place to ensure successful implementation. The Gulf region currently does not have significant MERV capacity related to carbon emissions; however, the region has substantial monitoring capacity pertaining to energy production and consumption and is making a concerted effort to reduce its energy inefficiency.[754] Furthermore, the three selected countries have already established carbon-centric agencies in some capacity and would have to develop adequate methodologies to standardize their respective carbon inventories across the various agencies.

9.2.3 National Carbon Scheme Integrity

With the expert assistance of a governmental regulatory authority, an interested country would ideally develop a comprehensive law on data submission and impose strict sanctions for non-compliance. The objective would be to set forth a nationwide schema of carbon emissions, which will function as an effective baseline. The law could establish or authorize the relevant regulatory agency ample time to collect and analyze data in an effective manner, even before the commencement of a Phase One emissions trading platform.

The absence of a credible certification procedure increases the potential for an EU ETS

[754] For example, the Saudi Energy Efficiency Center (SEEC) has developed comprehensive energy efficiency standards and labels to reduce energy consumption over the next two decades. *Saudi Arabia: Government Join Forces to Implement Energy Efficiency Labels*, United Nations Development Programme (UNDP) (April 2017) Available at http://www.sa.undp.org/content/saudi_arabia/en/home/ourwork/environmentandenergy/successstories/ee_implementation.html; A. Al kanani, *et al*. "Energy Efficiency in Residential Buildings in the Kingdom of Saudi Arabia" In (ed) M. Dastbaz *et al*., *Building Information Modelling, Building Performance, Design and Smart Construction* (Springer, Cham, 2017); Meanwhile, the Dubai Supreme Energy Council has partnered with United National Building Efficiency Accelerator to double the Emirate's energy efficiency by 2030. *Dubai to Double Energy Efficiency by 2030*, Khaleej Times (Aug. 6, 2016). Qatar has also invested significant sums to foster energy efficiency as well. Joshua Meltzer, *et al*, *Low Carbon Energy Transitions in Qatar and the Gulf Cooperation Council Region*, Brookings Institution (Mar. 7, 2014).

Phase One type of scenario of permit overallocation. The selected Gulf countries would ideally also follow the regulatory steps outlined in Chapter Eight that the EU and China undertook to cut down on potential fraud or "gaming" of the carbon market. Gulf policymakers would have to create the necessary audit powers to enter the premises of businesses and request documentation to prosecute a wide array of climate-related offenses, including fraudulent carbon offset schemes and inaccurate-either deliberate or negligent-reporting of carbon emissions. These regulatory powers already exist in the three selected countries as their environmental agencies have the mandate to withdraw licenses and penalize non-compliance.

It could assist in the creation of a carbon abatement scheme if Gulf policymakers were attentive to signs of market-related speculation or carbon fraud. In one of the most prominent allegations of carbon fraud, German prosecutors conducted an April 2010 search of Deutsche Bank AG in Frankfurt, a sweeping investigation covering over 50 companies and 150 suspects.[755] And, in a theft that even shut down the EU ETS for one week at the beginning of January 2011, approximately 475,000 carbon credits worth around $9 million were stolen through a hacking attack directed at a Czech carbon register.[756] Financial fraud is a grave issue that could impact the structural integrity and the public trust of a carbon market.

Because carbon trading fabricates "wealth" out of a previously valueless commodity, individuals and companies may illegally profit by piggybacking on carbon regulations. Carbon credits can be particularly attractive to criminals as they can be valuable, intangible, and easily moved between countries. Because it is a relatively recent phenomenon, many nascent carbon markets often have a weak accounting and regulatory regime.[757] A comprehensive carbon trading platform would have to arm policymakers with credible subpoena power to gather evidence from those suspected of carbon-related fraud in a bid to build confidence in the system and stem carbon-related fraud.

[755] Gina Roos, *Carbon Market Poised for Growth, More Cases of Carbon Credit Fraud*, Environmental Leader (April 29, 2010).
[756] Rowena Mason, *European Carbon Market Suspended Over Fraud Fears*, The Telegraph (Jan. 19, 2011).
[757] Ibid.

9.3 Could a Cap-and-Trade Regime be Realistically Implemented in the Three Selected Gulf Countries?

Section 9.3.1 below will discuss the rationale for the selected Gulf countries to create a carbon abatement scheme. This section will only focus on carbon-related issues, and will not consider other initiatives that would reduce carbon emissions, such as renewable energy development and hydrocarbon price reformation/subsidy removal (discussed in depth in Chapter Six). It will also discuss the steps they have taken to reduce greenhouse gas emissions and create carbon abatement mechanisms in line with their Paris Agreement pledges. Emphasis will be given in assessing the development of institutions that could administer a carbon reduction policy, such as environmental agencies and the legal/regulatory frameworks in their environmental sectors. Furthermore, Sections 9.4-9.6 will review what should be implemented for the three selected Gulf countries to construct viable carbon abatement mechanisms.

Implementing a carbon abatement mechanism is not a simple process. It does require time to orient industrial and energy policies towards a decarbonization path, especially given that the Gulf economies are focused on producing hydrocarbons. Nonetheless, as discussed below, the selected Gulf countries have already invested billions of dollars in renewable energy projects, have established carbon-centric agencies, and developed energy efficiency programs to reduce their carbon emissions (See Appendix B for a detailed accounting of Gulf GHG emissions). In fact, there has been a relative amount of success in reducing their carbon footprint, both per capita and in the aggregate. [758]

[758] All three of the selected countries experienced sharp drops in carbon emissions by 2020. For instance, Dubai has reduced its aggregate carbon emissions by 33% in 2020, which exceeded its planned reduction target by more than double. These reductions were due to a mix of factors, such as the increase of renewables in Dubai's energy mix, power pricing reformation, energy efficiency programs, and an expansion of district cooling which saved nearly 650 gigawatt-hours of power in 2020, and various incentive programs that expanded the deployment and utilization of electric vehicles. Additionally, the UAE as a whole has experienced carbon emissions reductions, declining from 280.3 million tons in 2017 to 245.9 million tons in 2020. Saudi Arabia witnessed a decline from 605.3 million tons to 570.8 million tons in 2020. Lastly, Qatar's carbon emissions reductions went from 106 million tons in 2017, to 87.7 million tons by the end of 2020. Varun Godinho, *Dubai Reduces 33% of its Carbon Emissions in 2020*, Gulf Business (Dec. 13, 2021); *BP Statistical Review of World Energy* (2021) p. 15

Perhaps, more importantly, as Chapter Seven illustrated, there has been a psychological shift whereby Gulf policymakers transitioned from a resistance posture during global climate negotiations to a complete acceptance of the fundamental premise that cooperation during international negotiations is necessary to reduce global carbon emissions. And, there is a measure of self-interest involved as the Gulf countries need to diversify their economies and reduce their domestic hydrocarbon consumption. The Gulf policymakers realized that carbon emissions reduction policies are a viable way to achieve that goal to reduce their ever-rising energy demand.

9.3.1 The Rationale for the Implementation of a Domestic Carbon Abatement Schemes in the UAE, Saudi Arabia, and Qatar

In the late 2010s, a wave of administrative energy price reconfiguration spread across the MENA region. Nearly every country engaged in the process of reconfiguring their energy or power pricing (or seriously exploring the possibility of doing so), primarily to reduce budgetary burdens and to reduce hydrocarbon demand. However, as the Gulf countries have some of the highest carbon/energy intensity rates per capita globally, the governments are keenly interested in reducing those on their own accord- not just to reduce the opportunity cost of domestic energy consumption for environmental reasons. The situation in the Gulf region during the 2020s is in marked contrast to the 2000s and early 2010s, where regional governments refused even to discuss the possibility of power/energy pricing reform. However, as mentioned in Chapter Six, even though there have been significant modifications of the energy pricing regime across the MENA region, some industrial sectors and consumers have still resisted. Yet, after the initial hydrocarbon pricing reformation in the mid-2010s, progress has appeared to stall. At the same time, there has been an extensive reconfiguration of power prices throughout the region, and given the amount of natural gas and oil utilized for power generation, it can be considered somewhat of a proxy for direct natural gas subsidy removal.

As the Qatari blockade of 2017-2021 illustrated, and the various border disputes between the GCC member states in the past, political acrimony is liable to arise from time to time. However, it is exceedingly unlikely that geopolitical imbroglios between Qatar, Saudi Arabia, and the UAE would impact the potential implementation of a domestic carbon abatement mechanism in their respective jurisdictions. As discussed in Chapter Three, the embargo levied on Qatar did not impact the energy trade (such as gas exports through the Dolphin gas pipeline) between these countries to date,[759] nor has it impacted the functioning of the Gulf Cooperation Council Interconnection Project (GCCIP).[760] Additionally, the embargo has not influenced the decision of QP and ADNOC to renew the Al-Bunduq field oil field joint concession in March 2018. [761] Regardless of those islands of cooperation mentioned earlier, currently, it is not expected that there would be significant collaboration between the three selected Gulf countries in carbon emissions reduction coordination. Therefore, it is much more probable that the Gulf countries would initially implement their plans separately, aligning them with their national climate action plans, i.e., NDCs.

While the three selected Gulf countries do not currently have an institutional carbon emissions regulatory apparatus, existing environmental regulatory agencies would be able to monitor and manage the deployment of a carbon abatement scheme through their current mandates. But certain institutional weaknesses would have to be resolved first, as discussed below. Nonetheless, as of the early 2020s,the three selected countries do have some manner of climate-related agencies. The three selected countries may avoid many potential pitfalls by studying how the EU ETS and China dealt with numerous structural obstacles. It cannot be overstated that the most important lesson from the EU ETS Phase One and China's pilot carbon market schemes was that accurate emissions data is essential to establish a credible baseline.

---

[759] *Qatar Petroleum Renews Shared Oilfield Concession Pact with UAE*, Reuters (March 13, 2018); Anthony McAuley, *Gas Supplies Keep Flowing as Qatar Diplomatic Spat Flares*, The National (June 5, 2017).

[760] The GCC Interconnection Authority inaugurated in 2012 to connect the power grids of the GCC member states. By 2017, the GCCIA has already registered more than 1,320,000 MWh and concluded upwards of fifteen contracts. Justin Dargin, *Energy as the Driver for Gulf Integration: The Gulf Power Grid*, Middle East Economic Survey (Dec. 7, 2012); *Energy Trading*, Gulf Cooperation Council Interconnection Authority. Available at http://www.gccia.com.sa/p/energy_trading/79

[761] *Qatar Petroleum Signs Deal with Abu Dhabi for Al-Bunduq Oil Field Operation*, The Peninsula (Mar. 13, 2018).

Therefore, the development of a robust MERV framework is of paramount importance. One of the principal reasons the EU ETS Phase One carbon price collapsed in 2013 was the lack of reliable industry data on which to base carbon targets.[762] Whatever carbon abatement platform is eventually incorporated in the three selected countries, robust MERV procedures, as were developed in the EU ETS and China, that harmonize both the corporate and national levels would have to be developed. Gulf officials could analyze and weigh the costs of instituting the system, i.e., the basic infrastructure costs that cover the MERV.

As discussed in Chapter Eight, China is a case in point of a developing country without previous carbon reduction experience, becoming able to scale up rapidly and transition from a pilot to a national carbon scheme within seven to eight years (2013/4-2021). Yet even China had a measure of preparation beforehand when it sent its officials to (principally) the EU and the U.S. to learn how they constructed their various pollution CaT frameworks. After that, and with significant guidance from officials from the jurisdictions mentioned earlier, it set up its pilot schemes. And even though China inaugurated the national market launch in 2017, it was still effectively a trial period until 2021.

Gulf policymakers would consider including carbon dioxide, nitrous oxide, and methane into their greenhouse gas reduction policies to establish a workable carbon market. However, given their significant hydrocarbon production, they need to include methane reduction from the initial implementation. As discussed in the sections below, current policies reduce, i.e., monetizing methane leakage in the three selected countries. The costs of reducing the emissions of different gases can vary immensely. Nonetheless, as discussed in Sections 9.4-9.6, any issues with potential carbon abatement frameworks in the Gulf, such as minimal oversight, oversupply, and potential fraud, could be resolved through robust regulation and expansion of existing environmental regulatory agencies to monitor the market.

To date, there are indications that the three selected Gulf countries are considering implementing domestic carbon abatement schemes. In 2007, the UAE state-run Dubai Multi Commodities Centre (DMCC) and London-based Ecosecurities launched to make

[762] Damian Carrington, *EU Carbon Price Crashes to Record Low*, The Guardian (Jan. 24, 2013).

Dubai a regional center for carbon trading. However, due to the global financial crisis in 2008/2009, the plans for a mandatory market were delayed as the UAE dealt with the economic consequences of the resulting financial turmoil. Then, in 2013, Capital Alternatives Group (CAG) and the Dubai Carbon Centre of Excellence (Dubai Carbon) created a partnership to supply Certified Emissions Reduction (CER's) credits to businesses within the UAE.[763] And, building upon the initial steps, in 2018, the UAE revisited those plans when the Securities and Commodities Authority announced that it would create an initiative to launch a country-wide carbon trading market.[764]

And, the UAE, in a grand gesture prior to the 2021 COP 26 climate talks, was the first Gulf country to announce that it would implement a net-zero strategy to achieve zero emissions by 2050.765 The Emirati leadership indicated that they wanted to become a regional leader in climate issues as the impetus behind its announcement.

Additionally, while not as far along in its carbon reduction plans as the UAE, in May 2015, Saudi Arabia signed up for Japan's Joint Crediting Mechanism (JCM).766 The JCM is a bilateral carbon offset mechanism that allows Japan to acquire carbon credits to export or fund clean technology. In addition, on October 30, 2019, Prince Abdulaziz bin Salman announced that Saudi Arabia would soon launch a carbon trading scheme, stating that, "We will come soon with a suggestion on carbon trading that would be a fair carbon trading system ... And I think it will work." [767] And, to further bolster its carbon credentials, Saudi Arabia followed the UAE and announced as well prior to COP 26 that it would achieve net-zero by 2060. While many detractors noted that not only was the announcement void of substantive details, but the Kingdom was unlikely to reach its goal. Even if that is the case, the official statement is still a meaningful step in the right direction and is impactful.

Meanwhile, Qatar had initially planned to develop a carbon trading mechanism in 2009, but it placed its plans on hold due to the global financial crisis, much as Dubai. In the meantime, it has developed an organization to assist with knowledge sharing of carbon

[763] *CAG, Dubai Carbon Centre Sign Deal for UAE Carbon Market*, Emirates 24/7 (April 3, 2013)
[764] *UAE's SCA Proposes First of its Kind Carbon Emissions Trading*, AlBawaba (Jan. 28, 2018)
[765] *UAE Launches Plan to Achieve Net-Zero by 2050*, Reuters (Oct. 7, 2021)
[766] *Saudi Arabia Signs Up for Japan's JCM*, Carbon Pulse (May 19, 2015)
[767] Rania Gamal, *Saudi Arabia Plans to Launch a Carbon Trading Scheme*, Reuters (Oct. 30, 2019).

reduction techniques to other MENA countries.[768] Qatar has also been playing a significant role in global climate negotiations. However, after the net-zero pledges from Saudi Arabia and the UAE, Qatar criticized their plans as being overly "vague." Qatar's energy minister, Saad Al-Kaabi, stated that, "For me to just come out and say net-zero 2050 would be very sexy…[B]ut it's not the right thing."[769] He felt that many politicians "are just throwing it out there without a plan." What is of interest is that Al-Kaabi followed up these statements maintaining that natural gas investment is critical as the global economy will depend heavily on natural gas as a bridge fuel.[770]

CaT schemes in Saudi Arabia and the UAE could potentially meld well with the current focus on transitioning from command-and-control instruments towards market-based mechanisms.[771] This is due to the broad cross-sectoral macro-economic reform in Saudi Arabia, and the UAE primarily focused on the energy sector. Additional forms of taxation, such as the Pigouvian method, tend not to fit well with the general focus on the Gulf countries of avoiding tax on their citizens and companies in their welfare states.[772]

[768] Karin Kloosterman, *Qataris Get Seminar on Carbon Market Trading from UK Specialists*, Green Prophet (March 6, 2009).
[769] Simone Foxman, *Qatar Criticizes Nations for Making Vague Net-Zero Pledges*, Bloomberg (Oct. 11, 2021).
[770] Ibid.
[771] *UAE's SCA Proposes First-of-its-Kind Carbon Emissions Trading*, Albawaba (Jan. 28, 2018).

[772] This is not to say that taxation does not exist in the GCC. For instance, the UAE and Saudi Arabia in 2018 implemented a value added tax of 5%. And Saudi Arabia and the UAE also imposed a "sin" tax on tobacco products and soft drinks in 2017. There are also various other indirect taxes. However, overall, taxation in the Gulf states is related to hydrocarbon production and export, rather than revenue derived from residents and citizens. Suparna Dutt D'Cunha, *UAE and Saudi Arabia End Tax Free Living, Roll Out 5% Vat as Oil Revenue Slump*, Forbes (Jan. 1, 2018); *Value Added Tax (VAT) and Excise Tax Developments in the Gulf Cooperation Council*, KPMG (July 2, 2017).

9.4 Current and Potential Progress of the Development of Carbon Abatement Mechanisms in the Three Selected Gulf Countries[773]

9.4.1 The Potential Development of a Carbon Abatement Mechanism in the United Arab Emirates

The UAE has several enabling factors that would potentially ease the introduction of a carbon abatement mechanism. There are several reasons for this. Firstly, the UAE already developed a nascent voluntary carbon trading mechanism in Dubai, initially launched in 2012. Secondly, as discussed earlier, the Emirati Securities and Commodities Authority launched an initiative in 2018 to posit a feasibility study to lay out the rationale of why Emirati policymakers should implement a national carbon market in the UAE in the near future.[774] Furthermore, as discussed below, the UAE created several agencies to deal with climate change and manage Emirati carbon emissions.

However, due to its breakneck industrial development, the UAE is currently the fifth largest carbon emitter per capita globally, emitting 19.31 tons of carbon dioxide per person.[775] In the aggregate, the UAE emitted approximately 276 million metric tons of carbon dioxide (as of 2018/2019) equivalent and stood at the thirty-third place by global ranking (See Figure 9.1).[776] It is estimated that the UAE's greenhouse gas emissions will reach between 280 to 300 (excluding LULUF) MtCO2e in 2030, which would be nearly a 46 to 58 % increase compared to 2010 levels.[777]

---

[773] See Appendix B for a detailed GHG accounting of the UAE, Qatar, Saudi Arabia and other global benchmarks.

[774] *UAE's SCA Proposes First-of-Its-Kind Carbon Emissions Trading*, Al Bawaba (Jan. 28, 2018).

[775] *The UAE's Response to Climate Change*, The Official Portal of the UAE Government. Available at https://government.ae/en/information-and-services/environment-and-energy/climate-change/theuaesresponsetoclimatechange

[776] In 2020, Emirati carbon emissions declined to 249.5 MtCO2e, principally due to the impact of the Covid-19 pandemic. *UAE Carbon Dioxide Emissions*, BP Statistical Review of World Energy (2020) p.15; Joshua Meltzer, Nathan Hultman, *et al*, *Low Carbon Energy Transitions in Qatar and the Gulf Cooperation Council*, Global Energy and Development: Brookings Institution (February 2014) p.8.

[777] This is excluding land use, land-use change, and forestry (LULUF). These are also updated figures considering the effects of the Covid-19 pandemic. While it will still take some time to determine the long-

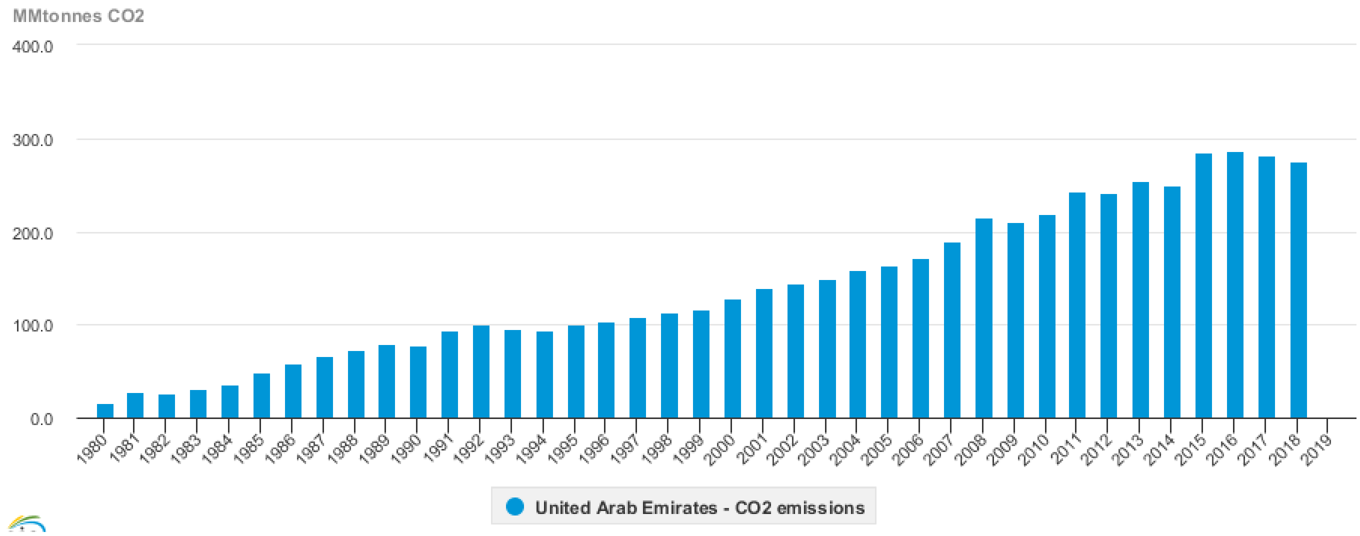


FIGURE 9.1 UAE Annual Carbon Dioxide Emissions (MMtonnes) Source: Energy Information Administration

The Emirati economy is highly energy and carbon-intensive, even when compared to the relatively elevated levels in the overall MENA region. Its energy intensity is approximately three times higher than European economies with a comparable GDP per capita.[778] Energy consumption in the UAE is principally hydrocarbon-based with a carbon intensity that is second only to Bahrain and Qatar in the region, while more than double the global average (See Appendix B for a detailed listing of scopes 1,2, and 3 emissions from Adnoc).[779]

term economic effects of the Covid-19 pandemic, it is likely that the UAE could experience a 10-20% decrease below this projection. See, *UAE Current Policy Projections*, Climate Action Tracker Available at https://climateactiontracker.org/countries/uae/current-policy-projections/>

[778] *Promoting Low Carbon Development in Dubai*, United Nations Development Programme (Jan. 22, 2014). p.8

[779] Ibid.

9.4.2 Carbon Reduction Initiatives

The Emirati government undertook several initiatives that prioritize energy diversification and climate change to reduce its carbon emissions. The UAE became a party to the UNFCC in 1996 and ratified the Kyoto Protocol in 2005.[780] The UAE also implemented several CDM projects across the country to reduce national carbon emissions. The UAE's registered CDM projects and projects pending validation generated approximately 6.4 million Certified Emissions Reductions (CERs) by 2020.[781] Moreover, the Emirati government announced $163 billion in renewable energy projects to come online by 2050 to generate nearly half of its power requirements.[782] Abu Dhabi also decided in 2008 to build the world's first carbon-neutral city christened, Masdar City.[783] And, lastly, the UAE was the first country in the region to deploy a comprehensive carbon reduction plan, christened the Dubai Carbon Abatement Strategy 2021. This strategy integrates alternative and renewable energy to diversify Dubai's energy mix and reduce carbon emissions.[784]

Altogether, Dubai Carbon Abatement Strategy 2021 defined the principal sectors contributing to carbon emissions, designated as "high-impact sectors."[785] These sectors are power and water, manufacturing, waste, and road transportation. Furthermore, in 2015, the Dubai Carbon Abatement Strategy reduced 5.7 million tons of carbon (10.6 %) from a business-as-usual metric for the same year. [786] Additionally, Dubai reduced 23.08 tons of carbon emissions per capita in 2016, compared to 18.37 tons per capita in 2011.[787] Taking

---

[780] Ibid. *Promoting Low Carbon Development in Dubai*. p. 10

[781] Ibid. p.57

[782] The goal is to have an energy mix composed of 44 % from renewables, 38 % from gas, 12 % from clean fossil-fuels (utilizing carbon capture storage) and 6% from nuclear energy. For a broad analysis of renewable energy development trends in the UAE, see, generally, *Renewable Energy Prospects: United Arab Emirates*, International Renewable Energy Agency (April 2015).

[783] Masdar City was meant to showcase how the UAE could remake its embedded urban infrastructure to become a "city of the future" to a degree. However, since its initial construction, its expectations and ecological ambitions have been lowered somewhat. See, Molly McArdle, *Is Masdar City A Ghost Town or a Green Lab?* Popular Science (April 24, 2018).

[784] See, *Dubai's Carbon Abatement Strategy*, Supreme Council of Energy (no date). Available at http://dcce.ae/wp-content/uploads/2015/08/Dubais-Carbon-Abatement-Strategy.pdf

[785] Taher Diab, *Dubai: Pioneering a Sustainable Energy Model for Sustainable Development and Security of Supply*, Cornerstone, Vol. 4, Issue 4 (May 10, 2017).

[786] Ibid.

[787] *Dubai Gets Certified by C40 Cities Climate Leadership Group in Reducing Climate Change*, Dubai Electricity and Water Authority (Dec. 9, 2017).

the UAE as a whole, it reduced its carbon emissions per capita from 80.65 tons in 1973 to 33.3 tons in 1996 and declined further to 23.6 tons in 2016.[788]

As part of Dubai's carbon reduction initiatives, the C40 Climate Leadership Group certified Dubai in 2017 as a "global city" committed to reducing its carbon footprint.[789] As part of its obligations as a member, Dubai must present an annual report on greenhouse gas data and reduction targets through the Greenhouse Gas protocol.[790] The greenhouse gas data is collected annually and compared with its reduction targets.[791] The Emirati government considers that it is on track to exceed its "conservative" goal of generating 24 % of its power from renewable energy sources by 2021.[792] And, because of its posture to promote renewable energy policies, the International Renewable Energy Agency chose the UAE to be the site of its permanent headquarters in 2011.[793]

The UAE is currently engaging in reconfiguring its energy prices to remove subsidization and reduce national demand. Suhail Mohammad Faraj Al Mazroui, the Minister of Energy and Industry, stated that: "We are trying to remove all forms of subsidy from the gas and to all forms of electricity."[794] Al Mazroui indicated that energy subsidization does not reflect the "real" price of generation and implied that it was detrimental to the environment and the economy in the long term (this is discussed in depth in Chapter Six)[795]
The preceding capitalizes on trends in the UAE of various projects garnering carbon credits under the Kyoto Protocol's CDM. The first phase of the Mohammed bin Rashid Al Maktoum Solar Park was awarded 10,635 carbon credits from the CDM Executive Board of the UNFCCC.[796] In addition to Dubai's carbon market, the Dubai Municipality's Al

---

[788] *United Arab Emirates-CO2 Emissions Per Capita*, Knoema. Available at https://knoema.com/atlas/United-Arab-Emirates/CO2-emissions-per-capita
[789] Ibid. This group was founded in 2005 and is composed of 75 major cities that are reducing carbon emissions through knowledge and best practices sharing amongst themselves.
[790] Ibid.
[791] Ibid. The targets are set by Dubai Electricity and Water Authority (DEWA), Roads and Transport Authority (RTA), Dubai Municipality, Emirates Global Aluminum (EGA).
[792] Nada Al Taher, *UAE Plans on Exceeding Target of 24% of Renewable Energy by 2021*, Gulf News (Jan. 18, 2016).
[793] See the Website of the International Renewable Energy Agency, available at http://www.irena.org/
[794] Anwar Ahmad, *UAE Mulls Cancelling Energy Subsidies*, Gulf News (Jan. 15, 2018).
[795] Ibid.
[796] These carbon credits were for electricity generated by the park in 2014 that exceeded expectations. *DEWA and Dubai Carbon Win Carbon Credits for Renewable Energy Production*, Zawya (June 10, 2015).

Ghusais landfill became the first facility in the Gulf region in 2016 to trade carbon credits it earned after generating electricity by flaring methane gas produced by waste combustion. [797]

Additionally, Dubai Carbon, in 2017, joint-ventured with Innogy International Middle East to launch the region's first blockchain-based crowdfunding investment platform to leverage solar power deployment across the UAE. [798] ADNOC, which aims to expand oil production capacity over the next several years aggressively, has been attempting to forge partnerships in developing CCS technology. ADNOC has claimed that it can capture nearly 800,000 tons of carbon per year from its Al Reyadah facility in Abu Dhabi.[799] And, in tandem with its oil production expansion, ADNOC set a target of capturing nearly five million tons yearly by 2030.

And, the UAE, true to its mission to become an innovative first mover in the Gulf, announced in early October 2021, prior to COP 26, that it intended to reach net-zero by 2050. Connected to its net-zero pledge, the UAE simultaneously announced that it would concurrently invest $163 billion in renewable energy development, a notable increase over the $40 billion spent on renewable energy over the past 15 years.[800] While the net-zero announcement was heralded as an immense step for some of the world's hydrocarbon producers to telegraph their sincerity in the fight against climate change, few details were given. The UAE did state, though, that combatting climate change was also a way for it to increase industrial competitiveness and stimulate foreign direct investment. And, lastly, the UAE is bidding to become the host of COP 28 to be held in 2023. As discussed in Chapter Seven, the aforementioned benefits from decarbonization show that the UAE and other Gulf countries, view climate change as an opportunity to foster economic growth.

---

[797] *Carbon Credits for Dubai Landfill Earn Money from Norway*, Gulf News (Dec. 19, 2016).

[798] Diarmaid Williams, *Dubai Carbon Links Up with Innogy on Crowdfunded Blockchain Energy Initiative*, Power Engineering International (Oct. 30, 2017)

[799] Dan Murphy and Natasha Turak, *Abu Dhabi Eyes New Partnerships for Carbon Capture and Emissions Cutting as Oil Price Climbs*, CNBC (Mar. 9, 2021).

[800] *UAE Launches Plan to Achieve Net-Zero by 2050*, Reuters (Oct. 7, 2021)

9.4.3 Gas Flaring and Methane Leakage

The Emirati government has also actively reduced gas flaring and methane leakage throughout its natural gas value chain. The UAE has succeeded in reducing gas flaring by nearly 98 % since 1990, flaring approximately one BCM per annum in 2020.[801] And, the UAE is also one of the large oil and gas producing countries not in the top twenty for gas flaring due to its gas flaring minimization/zero-tolerance policy.[802] And, since 2012, the Emirati government modified its policy from minimal gas flaring to zero tolerance by the 2020s. The Petroleum Resource Conservation Law sets the parameters for the utilization of natural gas during petroleum operations. Articles 44-46 of the Petroleum Conservation Law stipulate that excess natural gas must either be utilized during reservoir pressure maintenance, i.e., enhanced oil recovery, or if not, written permission must be obtained from the government for flaring. [803] Additionally, Federal Law No. 24 of 1999 for the Protection and Development of the Environment requires that specific regulations be followed to keep the level of gas flaring to a minimum.[804]

Regarding methane leakage, The UAE emitted 7107 kilotons in 2020, equaling 9.3 % of global emissions (See Figure 9.2 and Appendix B). [805]

---

[801] The UAE became a partner of the World Bank's Global Gas Flaring Reduction Partnership in 2009. And, for the data on Emirati gas flaring per annum, see World Bank Global Gas Flaring Reduction Partnership, Available at https://www.ggfrdata.org/#indicators-by-country

[802] Ibid.

[803] *Article 44 to 46, Petroleum Resource Conservation Law, See, Oil and Gas Regulation in the UAE,* Sherman & Sterling LLP. Available at https://www.lexology.com/library/detail.aspx?g=ab9744bb-2cb5-4378-8022-5fb7870a5af7

[804] *Federal Law No. 24 of 1999 for the Protection and Development of the Environment*

[805] *Methane Tracker Database: United Arab Emirates*, International Energy Agency (2020) Available at https://www.iea.org/articles/methane-tracker-database

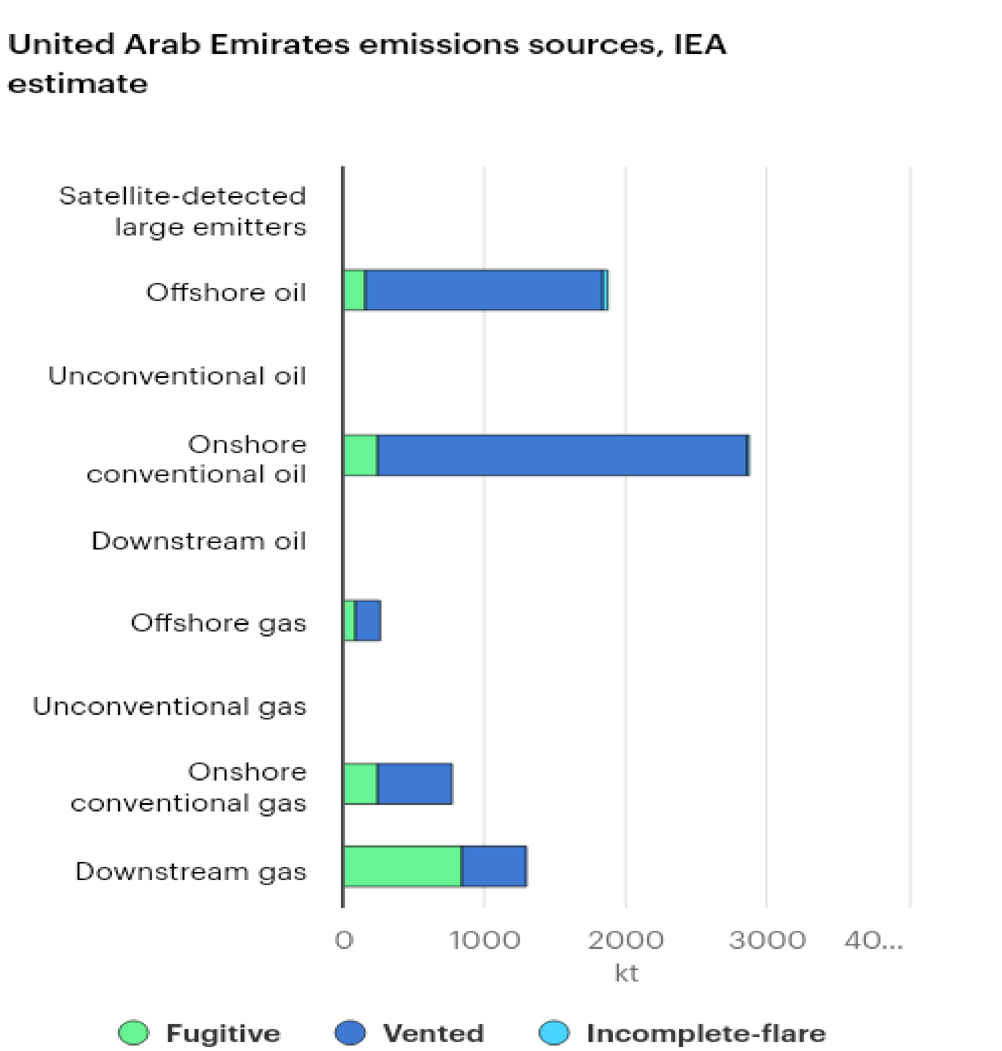


Figure 9.2: UAE Methane Emissions (2020); Source International Energy Agency

However, carbon dioxide constitutes the lion's share of energy sector emissions at 94 % (see Figure 9.1 and Appendix B), with methane and nitrous oxide making up the balance. [806] Yet, some steps are being taken by the Emirati government to address methane emissions. For instance, in 2013, the government of Dubai launched its first project to produce electricity from methane generated from Dubai's Al Qusais waste dump.[807] The goal of the federal government is for similar projects to be created throughout the country.

[806] For a detailed assessment of greenhouse gas emissions in Abu Dhabi per sector, see, *Greenhouse Gas Inventory for Abu Dhabi Emirate*, Environmental Agency-Abu Dhabi (Dec. 2012); *Abu Dhabi Technical Report-Greenhouse Gas Emissions Factors*, Abu Dhabi Quality and Conformity Council (June 2015). p.9
[807] Salman Zafar, *A Primer on Landfill Gas Recovery*, EcoMENA (July 8, 2016).

Abu Dhabi also developed various schemes to monitor and reduce fugitive emissions from natural gas reservoirs, such as the Upper Zakum field.[808] In 2016, the Abu Dhabi government announced strict periodic industrial inspections to control fugitive emissions.[809] And, as ADNOC often partners with international energy companies, the largest oil and gas companies pledged to reduce their fugitive methane emissions across the value chain in their global operations through various agreements such as the Oil and Gas Methane Partnership and the Methane Guiding Principles Initiative.[810] As part of their pledges, these companies have begun to publish reports in 2016 on their methane leaks throughout their global operations.[811]

9.4.4 Current Status of Emirati Environmental and Carbon Regulatory Agencies

The UAE currently has a robust regulatory apparatus to evaluate and monitor compliance with a future carbon abatement scheme. The powers of the federal and emirate governments are delineated in the national constitution of 1971. While the Emirati government is built upon a federal structure, each emirate enjoys considerable autonomy in the political and economic realms.

Article 120 of the Emirati constitution grants the federal government exclusive jurisdiction over the power sector in the country. However, in practice, the larger emirates of Dubai and Abu Dhabi, and to a lesser extent, Sharjah, and Ras Al Khaymah, promulgate and implement their own policies in the power and energy sectors.[812] At the emirate level, the Supreme Council of Energy of Dubai created Dubai Carbon in 2011, tasked with facilitating

[808] *Fugitive Emissions Monitoring at Upper Zakum Field*, Abu Dhabi National Oil Company website. Available at https://www.protenders.com/companies/abu-dhabi-national-oil-company/projects/fugitive-emission-monitoring- at-upper-zakum-field

[809] Haseeb Halder, *Abu Dhabi Soon to Have Low Emission Vehicles*, Khaleej Times (May 9, 2016).

[810] *The Oil and Gas Methane Partnership*, Climate and Clean Air Coalition (2015), *Reducing Methane Emissions Across the Natural Gas Value Chain-Guiding Principles*, Climate and Clean Air Coalition (2017).

[811] For the Oil and Gas Methane Partnership methane leaks reports for 2016 and 2017, see *Oil and Gas Methane Partnership Reporting*, Climate and Clean Air Coalition. Available at http://ccacoalition.org/en/content/oil-and-gas-methane-partnership-reporting

[812] Ibid.

Dubai's transition to a low carbon economy.[813] Its role is to stimulate carbon finance in Dubai and improve sustainable development by integrating climate change considerations into development planning and implementation processes to contribute to Dubai's overall strategy to become the lowest-carbon economy in MENA.[814]

While Dubai Carbon is not a political agency, its mission is to implement the Dubai government's carbon policies through an advisory role and knowledge sharing, in line with the Emirati national policies.[815] Dubai Carbon also registers CDM projects for CER units across Dubai. Dubai Carbon facilitated its first carbon credit transaction in 2017 with the sale of CERs from the DEWA Chiller Station L Project to Farnek Total Facility Management.[816] This inaugural sale of locally generated CERs will likely drive forward further investment and expansion of CDM projects across the UAE.

However, Dubai and Abu Dhabi lead the rest of the emirates in various initiatives as they tend to be wealthier and have more international companies located in their jurisdictions. They are also responsible for the majority of GHG emissions in the UAE. Therefore, the other five emirates of Sharjah, Ajman, Umm Al Quwain, Ras Al Khaimah, and Fujairah, would not have as large of a greenhouse gas imprint as Dubai and Abu Dhabi, and concordantly, must develop their respective capacities. That being said, the other five emirates have environmental agencies with authority to regulate pollution. [817] The oil and gas center of the UAE, Abu Dhabi, instructed its Environment Agency in 2014 to prepare a Climate Change Strategy for the Emirate of Abu Dhabi to "[accelerate] progress towards protecting the climate through the mitigation of anthropogenic pressures, as well as adapting to the environmental, social and economic impacts of climate change."[818]

In order to support the project, Abu Dhabi undertook two comprehensive GHG emissions

[813] See the *Dubai Carbon* website, available at http://dcce.ae/
[814] *Promoting Low Carbon Development in Dubai*, United Nations Development Programme (Jan. 22, 2014). p.8
[815] See the mission statement of the Dubai Carbon Centre of Excellence website, available at http://dcce.ae/
[816] *Carbon Credits Drive Green Funding in Dubai*, Emirates 24/7 (Nov. 21, 2017).
[817] For a listing of all the environmental agencies in the UAE, please see, *Environmental Authorities in UAE*, Beeatna. Available at https://beeatna.ae/en/environmental-authorities-in-uae
[818] *Abu Dhabi Technical Report-Greenhouse Gas Emissions Factors*, Abu Dhabi Quality and Conformity Council (June 2015). p.3

inventories in 2010 and 2012, based upon critical governmental and private sector stakeholder operations.[819] The inventory studies' principal goal was to accurately measure Abu Dhabi's GHG emissions, which would then support the UAE's climate change and greenhouse gas mitigation agenda by providing policymakers with a detailed understanding of the contributing factors among the various industries. The Abu Dhabi inventory also estimated emissions projections until 2030 based on a business-as-usual scenario and an emissions control scenario.[820]

Nationally, the UAE Ministry of Energy is responsible for greenhouse gas inventory and producing national inventory data. The Ministry of Energy estimated its GHG emissions for 1994, 2000, 2005, 2012, 2013, and 2014. The Emirati National Communications utilized the first three data sets to the UNFCCC. In comparison, the Ministry of Energy collected the last three sets to develop a national GHG inventory on an annual cycle. [821] While there is a basic level of information sharing and coordination between Abu Dhabi and the national inventories, there is, as of yet, no commonly agreed methodology, data collection, estimation, and verification between the two processes[822]

At the national level, the Ministry of Climate Change and the Environment undertakes environmental regulation and governance in conjunction with the Ministry of Energy. In 2016, the Emirati government enlarged the role of the Ministry of Environment and Water to manage all domestic and international issues related to climate change and the environment. The newly broadened ministry was designated the Ministry of Climate Change and the Environment. The Ministry of Climate Change and the Environment manages the implementation of comprehensive policies and initiatives to mitigate and adapt to climate change. [823] Under the relevant federal laws, such as the primary national

---

[819] The GHG emissions inventory for Abu Dhabi was created under the parameters of the 2006 IPCC Guidelines in collaboration with key stakeholders representing the main contributing sectors of GHG emissions, such as oil and gas, electricity production and water desalination, manufacturing industry, transport, agriculture, land use change and forestry, and waste. Ibid.

[820] *National Climate Change Plan of the United Arab Emirates 2017-2050*, United Arab Emirates Ministry of Climate Change and the Environment, p. 35. Available at https://www.moccae.gov.ae/assets/30e58e2e/national-climate-change-plan-for-the-united-arab-emirates-2017-2050.aspx

[821] Ibid.

[822] Ibid.

[823] See the mission statement of the Ministry of Climate Change and the Environment, available at https://www.moccae.gov.ae/en/about-ministry/about-the-ministry.aspx

environmental law, Federal Law No. 24 promulgated in 1999, the Ministry of Climate Change and the Environment would implement regulations concerning MERV and oversee the functioning of an integrated national carbon market in the future.[824] Federal environmental law in the UAE sets the benchmark for noncompliance with Emirati environmental law/regulations, and high fines and potential imprisonment can result in non-compliance with environmental regulations.[825]

Through Ministerial Decision No. 795 of 2016, the Emirati government formed the UAE Council for Climate Change and Environment. This council has the authority to develop plans to achieve Emirati climate and greenhouse gas objectives and represent the UAE in international and regional climate negotiations.[826] The council also has the mandate of creating public-private partnerships and leading scientific research in fields in the scope of the Ministry of Climate Change and Environment's work.

The Emirati federal government promulgated the *National Climate Change Plan* in 2017.[827] This national strategy is in conjunction with UAE Vision 2021 and the UAE Green Agenda 2015-2030. Its principal focus is to manage greenhouse gas emissions while sustaining economic growth from 2017-2050. Furthermore, the plan is designed to cover any gaps in long-term Emirati policymaking. The implementation of the Climate Change Plan will be overseen by the UAE Council on Climate Change and the Environment as an inter-ministerial, inter-emirate governance body. The Ministry of Climate Change and the Environment will undertake the role of the secretariat while also having the primary responsibility for monitoring the progress of the National Climate Change Plan.

The Ministry of Climate Change and the Environment coordinates the ongoing efforts at

---

[824] For a detailed listing of Emirati environmental laws, please see, *Environmental Law and Practice in the United Arab Emirates*: *Overview* Environmental Global Guide 2017-2018 (June 2017). Available at https://www.stalawfirm.com/en/blogs/view/environmental-global-guide-2017-2018.html

[825] Alexis Waller and Andrew Thomson, *A Guide for Environmental Regulation in Dubai, and the Wider UAE*, Cylde and Company (May 27, 2013)

[826] *UAE Forms Council for Climate Change and the Environment*, United Arab Emirates: The Cabinet. Available at https://www.uaecabinet.ae/en/details/news/uae-forms-council-for-climate-change-and-environment

[827] *The National Climate Change Plan* is available at https://www.moccae.gov.ae/assets/30e58e2e/national-climate-change-plan-for-the-united-arab-emirates-2017-2050.aspx

the sectoral and emirate level to monitor and manage greenhouse gas emissions utilizing international best practices.[828] The ministry is attempting to develop a comprehensive and uniform system for stringent GHG measurement, reporting, and verification across all sectors to implement a national GHG management system. Moreover, the Emirati government seeks to develop a common domestic platform that would serve as a national climate change management system (NCCMS) that would integrate the GHG data across the country into other data and findings from climate-related research at the latest by 2050.[829]

The UAE is also building up its capacity for a new generation of future environmental administrators and regulators to understand the intricacies of greenhouse gas emissions and incorporate that knowledge in future policymaking.

In conjunction with that, the Dubai Electricity and Water Authority established the Carbon Ambassadors Program to train university students to understand various topical issues related to developing a low carbon economy and sustainable development.[830]

The Carbon Ambassadors Program aligns with various other programs implemented in universities to teach students working in the Emirati government the complexities of managing the UAE's transition to a low-carbon economy. And, as the UAE already has developed a mature educational apparatus in the hydrocarbon sector, it would not entail a significant cost nor substantial difficulty to include decarbonization training to multidisciplinary programs dealing with overall energy issues. Additionally, in a bid to expand its collaborative efforts in the climate sphere, the UAE agreed with the US in April 2021 to engage in joint investment for decarbonization efforts in the MENA region.[831]

Domestically, the UAE has been aggressive in implementing anti-corruption regulations in the 2010s to bolster its image as a financial powerhouse. Essential in these efforts has been

---

[828] Ibid. *National Climate Change Plan of the United Arab Emirates 2017-2050*, United Arab Emirates Ministry of Climate Change, and the Environment. p. 25
[829] Ibid.
[830] See *Carbon Ambassadors Program*, Available at http://dcce.ae/wp-content/uploads/2015/04/CAP.pdf
[831] Rachel Frazin, *US, UAE Say They'll Invest in Middle East Decarbonization* (April 5, 2021).

the creation of a new economic security "super-regulator" tasked to monitor and combat corruption in the Dubai financial services and promulgating enhanced criminal and financial penalties for bribery and corruption offenses.[832] These policies and regulations will assist the UAE in stemming potential fraud that could arise in implementing a carbon abatement mechanism, as discussed in Section 9.2.3.

9.4.5 How the UAE Could Implement a Carbon Market

In order to viably create a carbon market, the Emirati government would have to promulgate a general roadmap for creating a national CaT that each emirate would follow. Principally, there would be a trial period that would launch in various stages with the creation of the market fundamentals in the beginning stages.

Phase One: For the UAE, each subnational entity, i.e., at the emirate level, would initially implement legislation for localized GHG monitoring, evaluation, reporting, and verification (MERV) for entities in the power sector that emit more than a specified amount of carbon per year.[833] Besides Abu Dhabi and Dubai, the other emirates have not published detailed greenhouse gas inventories. Therefore, each emirate must establish a benchmark and create an updated inventory for carbon emissions. As not all the emirates have the potential to form a deep and liquid localized carbon market, preliminarily, each emirate would have to develop its inventory for the formation of a national market in Phase Two. Developing a national greenhouse gas inventory system would enhance coherence with the disparate greenhouse gas mitigation strategies across the UAE. At the same time, the Ministry of Climate Change and the Environment must standardize greenhouse gas assessment methodologies and regulate data sharing between the various emirates. Furthermore, the Ministry of Climate Change and the Environment would have to create more rigorous forms of greenhouse gas inventory reporting, such as Common Reporting Format tables that contain a standardized set of time series data and yearly national inventory reports that would have transparent and detailed information to indicate the

[832] Adam Vause, *The UAE's Fight Against Bribery and Corruption*, DLA Piper (July 16, 2019).
[833] This would include combined heat and power, as well as captive power plants in other industrial sectors.

institutional arrangement for inventory development and the methodologies utilized.[834]

This legislation would have to delineate the nationally standardized MERV protocols for the covered industries. Data would have to be collected over a two-year period, which would work in conjunction with training and capacity-building programs. A robust and comprehensive MERV system and uniform across the country would improve data and cross-sectoral coordination for future emissions reduction caps.
ghh
This initial period would be critical for each emirate as the collection of company-wide data would set the overarching legal foundation and market support mechanisms. After that, each emirate would likely construct a baseline of emissions data for the various industrial, manufacturing, and power companies across the country. Each emirate should have its regulatory authorities audit companies with penalties, such as fines, if they do not comply with timely submissions of emissions data. However, this would be based on standardization from the Council for Climate Change and the Environment at the federal level. Furthermore, each local regulatory authority would have to verify the emissions audits by third parties selected by the Ministry of Climate Change and the Environment. The UAE already has several stringent federal laws (i.e., Federal Law no. 3 of 1987 UAE Criminal Code) that govern corruption and bribery through the country, which would apply to any illicit activity in the carbon market. In addition, regulators must be given the power to manage "soft" corruption that could arise from such practices as *wasta* (nepotism).

Phase Two: This particular phase must create a required cap at the federal level from the Council for Climate Change and the Environment on overall emirate-based emissions levels and then allocate them to begin the initial market operation. As discussed above, this would involve allocating property rights to carbon emitters in the power sector. After the regulatory authorities create the carbon inventories and the legal/regulatory structure during Phase One, in Phase Two, they would have to articulate the foundation of a national scheme. To enhance the acceptance from the various large emitters in the power sector

[834] Ibid.

and mitigate resistance, the Ministry of Climate Change's regulatory authorities should disburse the first tranche of allowances at no charge. Initial gratis disbursements of allowances generally have fewer transaction costs. As discussed above in Section 9.2.1, the gratis distribution of allowances to earlier entrants does tend to cause relatively high entry barriers for later entrants to the sector as they would be required to purchase a set of allowances. Therefore, the Ministry of Climate Change and the Environment could create a set-aside of allowances for later entrants into the scheme. And this could assist in the mitigation of potential business resistance as well. It is expected that the financial sector and various financial institutions would play a critical role in facilitating carbon trading in the UAE. Most of the companies would likely trade allowances with the assistance of financial intermediaries, with the largest carbon emitters trading directly on the exchange.

Phase Three: After the conclusion of Phase Two, Phase Three would cover companies in all industrial sectors (this would include the power sector, the oil and gas industry, the manufacturing sector, and the downstream natural gas industries, the chemical sector, building materials, steel, nonferrous metals, and heavy industry) that emit over 10,000 tons of carbon annually. When Phase Three is launched, federal regulators under the auspices of the Ministry of Climate Change and the Environment will set more ambitious targets as the various economic sectors would understand the functioning of the carbon market at that point. Additionally, due to market signals, they will invest in less carbon-intensive technology to meet the future carbon price. Phase Three would also create Biennial Update Reports that would contain national inventory reports, information on mitigation efforts, and the requirements and support received, as part of the National Communications for the UNFCCC.[835]

---

[835] Ibid. *National Climate Change Plan of the United Arab Emirates 2017-2050*, United Arab Emirates Ministry of Climate Change, and the Environment. p. 36

9.5 The Potential Development of a Carbon Abatement Mechanism in Saudi Arabia

Saudi Arabia's greenhouse gas emissions rapidly increased over the past several decades and are expected to increase further over the coming decades due to demographic increases, urbanization, and industrial capacity expansion. Saudi Arabia ranks at number one for carbon emissions per capita globally amongst the G20 countries in 2020, an increase from 9 tCO_2/capita in 1990.[836] In terms of aggregate emissions, in 2020, Saudi Arabia emitted 570.8 million metric tons of carbon dioxide equivalent, residing at number eighteen by global ranking (See Figure 9.3).[837]

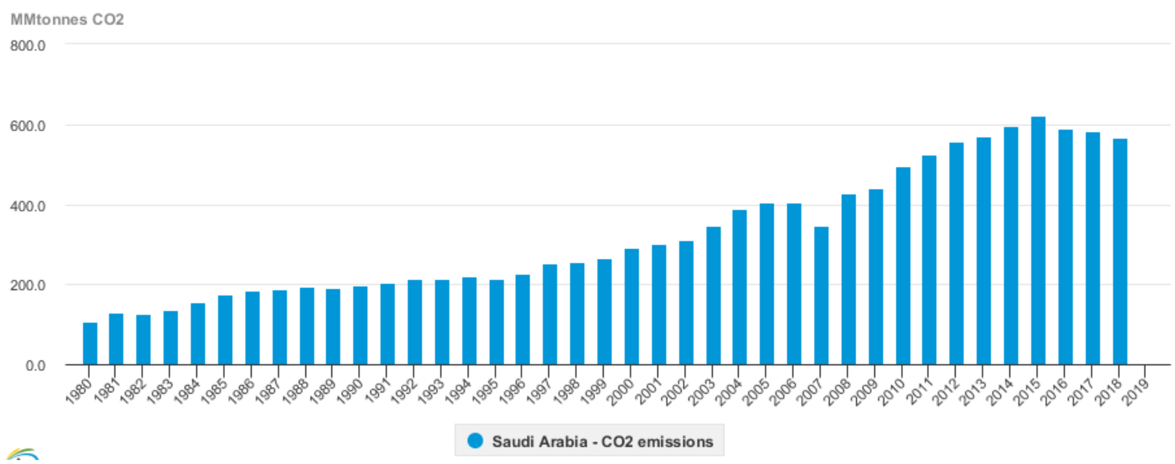


Figure 9.3 *Saudi Arabian Annual Carbon Dioxide Emissions: Source U.S Energy Information Administration*

Saudi Arabia still has a carbon-intensive economy (See Appendix B for a detailed listing of Aramco's scopes 1, 2, and 3 carbon emissions). For example, the Saudi oil sector is the country's most important economic sector. It contributes approximately 47% of GDP, 90% of revenues, and 90% of export earnings.[838] But, somewhat counterintuitively, the

[836] See, *Climate Transparency: Brown to Green: G20 Transition to a Low Carbon Economy*, Climate Action Tracker (2016). Available at https://www.climate-transparency.org/wp-content/uploads/2016/09/Saudi-Arabia_Country-Profile.pdf

[837] Joshua Meltzer, Nathan Hultman, *et al*, *Low Carbon Energy Transitions in Qatar and the Gulf Cooperation Council*, Global Energy and Development: Brookings Institution (February 2014) p. 8; *Saudi Arabia Carbon Dioxide Emissions*, BP Statistical Review of World Energy (2021) p.15

[838] M. El Hedi Arouri, AB. Youssef, H. M'henni and C. Rault, "Energy Consumption, Economic Growth and CO2

power sector emits the majority of carbon emissions, totaling nearly 50% of Saudi carbon emissions, followed by the transport and the industrial/construction sector.[839] Saudi Arabia's increasing demographic growth, rising living standards, extensive urbanization, and the expansion of government-directed downstream hydrocarbon industries led to a continuous rise in energy demand and carbon emissions. Population growth in the Kingdom expanded by approximately 1.71 % between 2010-2020 (currently at nearly 34 million), with more than 90% of the population living in cities.[840] And, unless firm action is undertaken to fulfill Saudi Arabia's climate pledges, business-as-usual development will cause an increase in carbon emissions, with some estimates projecting that it could double by 2030.[841]

9.5.1 Carbon Reduction Initiatives

As discussed in Chapter Seven, Section 7.3.1, Saudi Arabia submitted its Intended Nationally Determined Contribution (INDC) on November 10, 2015, and its updated NDC on October 23, 2021.[842] It indicated that the Kingdom desires to reduce its carbon emissions annually by approximately 130 MtCO2e in 2030 with measures that have co-benefits with its pursuit of economic diversification from petroleum. If Saudi Arabia successfully achieves the outcome in its first NDC, then its carbon emissions are projected to reach approximately 1,160 MtCO2e (excluding LULUCF) by 2030.[843]

Saudi Arabia has been engaging in reducing its carbon emissions since the early 2010s through a multi-pronged strategy of reducing domestic hydrocarbon and power consumption through pricing reconfiguration, implementing energy efficiency projects, investing in renewable energy deployment, and lowering methane leakage/gas flaring

Emissions in Middle East and North African Countries," Energy Policy, 45, 342-349. p. 343

839 N. Taher and B. Hajjar, *Energy and Environment in Saudi Arabia: Concerns and Opportunities*, (Springer International Publishing, 2014) p. 31

840 A.N. Khondaker, Syed Masiur Rahman*, et al*, *Dynamics of Energy Sector and GHG Emissions in Saudi Arabia*, Climate Policy, Vol. 15, Issue 4 (2015). P.3

841 This projection does not take into account the still uncertain macroeconomic environment due to the Covid-19 pandemic.

842 As discussed in Chapter Six, Section 4.1, Saudi Arabia's Intended Nationally Determined Contribution (INDC) transformed into a Nationally Determined Contribution (NDC) on December 3, 2016.

843 This is approximately a 132% increase above 2010 levels, or a 600% increase above 1990 levels.

levels.[844] There has been some success to date in reducing carbon emissions as the Saudi Electricity Company (SEC) programs on greenhouse gas reductions saved more than 24.8 million barrels of equivalent fuel and 13 million barrels of diesel in 2016.[845] Additionally, Saudi Arabia had entered into bilateral carbon reduction agreements, such as in 2017, when the Saudi Ministry of Energy and Industry signed a carbon emissions control agreement with the U.S. Department of Energy.[846] The two countries created the memorandum of understanding to stimulate a partnership to engage in joint research regarding Carbon Capture and Storage (CCS) technology and new carbon management strategies. The goal of the collaboration is to achieve near-zero carbon emissions for power plants and carbon-intensive industries. To further research into the design and testing of advanced CCS as part of the collaborative venture, the Department of Energy's Office of Fossil Fuel had provided nearly $36 million in federally funded financial assistance.[847]

Much of the knowledge sharing between Saudi Arabia and the U.S. is also based on the successful CCS testing and deployment of various successful CCS facilities in the US, such as ExxonMobil's Shute Creek Gas Processing Plant, which is the largest post-combustion CCS project globally.[848] Meanwhile, Aramco committed nearly a third of its research budget on research in CCS and energy efficiency.[849] Aramco is building upon its experience with its CCS plant in Hawiyah, the largest CCS project in the region.[850] The project will

---

[844] *Saudi Arabia Collaborates with the US on Managing its Carbon Emissions*, Asharq Al-Awsat (Dec. 3, 2017).

[845] SEC and Petroleum, Chemicals and Mining Company Sign a Partnership Agreement to Establish the Green for Carbon Services, Saudi Electricity Company Webpage. Available at https://www.se.com.sa/en-us/pages/newsdetails.aspx?NId=551

[846] *Saudi Arabia Collaborates with the US on Managing its Carbon Emissions*, Asharq Al-Awsat (Dec. 3, 2017).

[847] *Secretary of Energy Rick Perry Announced $36 Million for Projects to Advance Carbon Capture Technologies*, Department of Energy (Sept. 22, 2017).

[848] Shute Creek has a storage capacity of seven million metric tons per annum and grants carbon dioxide for enhanced oil recovery projects. See, *ExxonMobil Shute Creek Treating Facility Subpart RR Monitoring, Reporting and Verification Plan,* Environmental Protection Agency (2018) Available at https://www.epa.gov/sites/default/files/2018-06/documents/shutecreekmrvplan.pdf

[849] Collin Eaton, *Saudi Aramco Touts Carbon Capture as Policymakers Push Investments*, Houston Chronicle (March 15, 2018); Jessica Farrell, "Carbon Capture," *Journal of Science, Policy and Governance*, Vol. 12, Issue 1, February 2018. p. Collin Eaton, *Saudi Aramco Touts Carbon Capture as Policymakers Push Investments*, Houston Chronicle (March 15, 2018); Jessica Farrell, "Carbon Capture," *Journal of Science, Policy and Governance*, Vol. 12, Issue 1, February 2018. p. 3

[850] *Large Scale CCS in Saudi Arabia*, Global CCS Institute (August 5, 2015).

utilize 40 million standard cubic feet per day of carbon dioxide. This carbon dioxide will be extracted and treated at the natural gas extraction plant and transported through a pipeline. The carbon dioxide will then be injected into oil reservoirs to assist in enhanced oil recovery.

And, as discussed in Chapter Seven, Saudi Arabia indicated a significant change in its previous unstated policy of resisting global climate negotiations when Saudi Arabian oil minister Khalid Al-Falih announced in 2016 that, "The [oil] industry has a role in playing the part of the solution and meeting the commitments required by COP 21 [the 2015 UN climate summit]."[851] Saudi Arabia has also been progressing in the area of energy efficiency through broadening the usage of energy efficiency standards and labels. The Saudi Energy Efficiency Center (SEEC), the agency responsible for developing energy efficiency and conservation policies in all relevant sectors, formulated energy efficiency labels for air conditioners in 2014.[852] Due to the region's climatic conditions, air conditioning is a substantial portion of energy demand in the Kingdom.[853] Moreover, the Saudi government established the National Energy Services Company (National Esco) in October 2017 to further the country's economic diversification and environmental sustainability objectives. National Esco estimates that it will be able to implement energy savings totaling approximately 40 GW in 2018.[854]

As a critical portion of Saudi Arabia's commitments under the Paris Accord and its

Vision 2030 plans an investment of between $5-$7 billion of renewable energy projects in 2018 for eight projects equaling 4.125 gigawatts of capacity.[855] And, by 2023, the Saudi

---

[851] Ed King, *Saudi Arabia Says Oil Industry Must Meet Climate Goals* (Oct. 19, 2016).

[852] The Council of Ministers created the SEEC in October 2010. Due to Saudi governmental policies of promoting energy efficiency, the Saudi Ministry of Commerce and Industry confiscated more than 50,000 air conditioners that did not meet Saudi energy saving standards. *Saudi Arabia: Government Join Forces to Implement Energy Efficiency Labels*, United Nations Development Programme (2015). Available at http://www.sa.undp.org/content/saudi_arabia /en/home/ourwork/environmentandenergy/successstories/ee_implementation.html

[853] Saudi Arabia utilizes nearly 70 % of its power generation on air conditioning and cooling. Ayhan Demirbas, *et al*, *The Cost Analysis of Electric Power Generation in Saudi Arabia*, Energy Sources, Part B: Economics, Planning and Policy, Vol. 12, 2017, Issue 6. pp. 591-596

[854] National Esco has been granted the mandate to implement energy efficiency measures in the nation's mosques, schools and all public buildings occupying 30,000 square meters or more. *Saudi Arabia Aims to Increase Energy Efficiency Levels*, Middle East Utilities (Jan. 27, 2018).

[855] Mahmoud Habboush, *Saudi Arabia Plans Up to $7 Billion of Renewable Energy Projects This Year*, Bloomberg (Jan. 16,

government desires to have 9.5 gigawatts of solar and wind power installed. Saudi Arabia is also benefiting from record low-cost solar plant construction.[856] These investments represent a crucial pillar of the Vision 2030 strategy by the Saudi government, christened the National Renewable Energy Plan.[857] The National Renewable Energy Plan is designed to stimulate renewable energy development to deliver long-term economic diversification and economic stability to the Kingdom by reducing domestic fossil fuel consumption.

Saudi industry has also been engaged with the CDM sector. In 2018, SABIC received its second issuance of carbon credits at its Al-Bayroni manufacturing facility, where it acquired over 48,000 carbon credits for an efficiency improvement by boiler rehabilitation in 2016 and 2017. The same project received nearly 53,000 credits for 2014 and 2015. [858] On May 13, 2015, Saudi Arabia became the thirteenth country to sign on to Japan's joint Crediting Mechanism (JCM). This bilateral venture grants Japan the ability to earn carbon credits to fund and export renewable energy technology. [859] While the JCM started its operations as a non-tradeable credit type mechanism, both Saudi Arabia and Japan are continuing consultation with the ultimate goal of transitioning to a tradeable credit type mechanism. Saudi Arabia will likely register more CDM projects in the coming years as it successfully lobbied to have CCS projects included in the UNFCCC's CDM in 2011.[860]

The Saudi government has been paying increasing attention to issues related to climate change and, under the 10th Development Plan (2015-2019), is merging environmental issues with the government's macroeconomic restructuring.[861] This includes the

2018).

856 In 2017, Saudi Arabia received the lowest bids in the world at that time on solar plant construction at 1.7 cents/Kilowatt hour. Anthony Dipaola, *Saudi Arabia Gets Cheapest Bids on Solar Power in Auction*, Bloomberg (Oct. 3, 2017).

857 For a concise overview of the Saudi Vision 2030, please see, *Vision 2030 Kingdom of Saudi Arabia* website, available at http://vision2030.gov.sa/en

858 The Designated National Authority of Saudi Arabia is the sole agency that administers CDM projects in the Kingdom. By 2018, only SABIC has received carbon credits for verified emissions reductions. *United Nations Issue Second Carbon Credits to SABIC*, SABIC (May 23, 2018). Available at https://www.sabic.com/en/news/12753-united-nations-issue-second-carbon-credits-to-sabic

859 For more information about the Joint Crediting Mechanism, see *Carbon Markets Express* website, available at https://www.carbon-markets.go.jp/eng/

860 *CCS Under the Clean Development Mechanism*, Global CCS Institute. Available at https://hub.globalccsinstitute.com/publications/international-climate-change-legislation-kyoto-protocol-1997/ccs-under-clean-development-mechanism

861 *The State of the Environment: Responsibilities and Achievements*, The General Authority for Meteorology and

reduction of greenhouse gases and the promotion of renewable energy. As a result of these policy objectives, Saudi Aramco has been developing significant carbon management strategies with the support of various research centers in the Kingdom, such as the King Abdullah Petroleum Studies and Research Center (KAPSARC) and the King Abdulaziz City for Science and Technology (KACST)[862]. To accurately detail its greenhouse gas emissions, a team of experts from the PME, Saudi Aramco, and King Fahd University of Petroleum and Minerals jointly developed a national greenhouse gas inventory for the Kingdom and published their results in 2015.[863]

Likewise, in February 2017, Saudi Arabia established the Green Saudi Company for Carbon Services.[864] According to regional and international agreements, this organization's goals are developing and managing carbon emission reduction programs and sustainable development mechanism projects. The Green Saudi Company for Carbon Services is a partnership between Petroleum, Chemicals, Mining Company Limited, and the Saudi Electricity Company.[865] Overall, the organization attempts to assist the government in achieving its objectives consistent with the Kingdom Vision 2030 and the National Transformation Program 2020. The development of this organization is essential as it has the support of the senior management of the Ministry of Energy, Industry and Mineral Resources, and various other Saudi agencies concerned with alternative energy development.[866] The endorsement by the Saudi government for this organization telegraphs its commitment to the carbon reductions pledged under the Paris Agreement.

The Green Saudi Company for Carbon Services seeks to register renewable energy projects and carbon emissions reduction programs with the UNFCCC. It will also issue and market certificates of carbon emissions reduction from renewable energy projects, both regionally and globally. Generally, while Saudi Arabia was somewhat resistant to the

---

Environmental Protection: Kingdom of Saudi Arabia (2017).

[862] *Saudi Arabia and Political, Economic and Social Development*, Ministry of Foreign Affairs (May 2017). p.27

[863] A.N. Khondaker, Syed Masiur Rahman*, et al*, "Dynamics of Energy Sector and GHG Emissions in Saudi Arabia," *Climate Policy*, Vol. 15, Issue 4 (2015).

[864] *Green Saudi Company for Carbon Services to Focus on Emissions Reduction*, Gulf News (Mar. 2, 2017).

[865] Ibid.

[866] Ibid

Intergovernmental Panel on Climate Change's (IPCC) findings, previously, it decided to host the region outreach event in September 2017 that focused on the plans for the Sixth Assessment Report and the overall work of the IPCC.[867]

The organizers intended for the event to educate Saudi and Gulf policymakers about the research methods of the IPCC and how to apply certain climate methodologies in the respective climate-related work of their ministries and universities. Still, to develop effective carbon reduction policies in the future, the Saudi government has been attempting to educate a new generation of government officials through various joint research programs with foreign universities.

The King Fahd University of Petroleum and Minerals (KFUPM) and Berkeley Global Science Institute established the KACST Technology Innovation Center of Carbon Capture and Sequestration in 2011.[868] And, an outgrowth of this collaborative venture was formed with the Saudi Aramco Carbon Capture and Utilization Chair Program to broaden and extend research into carbon emissions mitigation methods. Saudi Arabia also joined Mission Innovation in 2015 during its launch at COP 21. Mission Innovation is a multilateral organization focused on building knowledge-sharing capacity in various countries to assist in reducing carbon intensity levels. Through Mission Innovation, Saudi university students, researchers, and private sector/governmental organizations seek to educate and research the best carbon reduction techniques.[869] The aforementioned joint research programs assist the Saudi government in creating a cohort of future policymakers with the necessary skillsets to facilitate the transition to a low carbon economy.

Saudi Arabia has, however, announced that it would take much more decisive steps to reduce carbon emissions in its macroeconomy. In 2021, Saudi Arabia announced two fairly significant decarbonization policies. One of them was the prospective implementation of a

---

[867] *Regional Outreach Event on the IPCC Activities and Findings.* Available at *https://events.kacst.edu.sa/en/IPCC17/Pages/home.aspx*

[868] For more information, please see, *Berkeley Global Science Institute*, Available at https://globalscience.berkeley.edu/centers/KFUPM-SA

[869] See the Mission Innovation website, Available at http://mission-innovation.net/participating-countries/saudi-arabia/

national carbon market. This market is to be oriented towards trading carbon offsets and credits generated in the MENA region. It is to be a joint venture between the country's sovereign wealth fund, the Public Investment Fund, and the Saudi Tawadul Group, which owns and operates the Saudi exchange.[870] And, the second announcement occurred prior to the COP 26 climate conference in Glasgow, where Saudi Crown Prince, Mohammed bin Salman, pledged that the country would reach a net-zero target in 2060. However, it must be noted that as with the Emirati net-zero pledge, few details were forthcoming.

Overall, Saudi Arabia's carbon reduction targets suffer from uncertainty as the government did not publish a baseline from which its abatement target is deducted in the NDC, as discussed in Chapter Seven. The Saudi NDC instead indicated that a "dynamic baseline will be developed based on a combination of two scenarios," i.e., whether more oil is consumed domestically or exported.[871]

9.5.2 Gas Flaring and Methane Leakage

In terms of gas flaring, Saudi Arabia has been successful in its reduction programs. In 1982, before the Master Gas System (MGS) development, Saudi Arabia flared the entirety of its natural gas. Nevertheless, after its construction, the MGS gathered nearly 50 BCM of associated natural gas that was previously flared. As of 2020, the MGS can collect nearly 100 BCM of gas, which is then utilized as petrochemical feedstock and power generation for energy-intensive industries, such as aluminum, water desalination, and steel. The captured gas is responsible for the bedrock of Saudi Arabia's vast petrochemical infrastructure. While Saudi Arabia still has much work to do, it still was able to reach the notable achievement of mitigating its gas flaring to less than 1% of its current gas production.[872] However, while Saudi Arabia substantially reduced its routine flaring, it still flares approximately 2,264 MCM/year in its upstream operations.[873]Saudi Arabia is also combating methane leakage across its energy sector. Saudi Aramco instituted a robust

[870] *Saudi Arabia to Launch a Regional Carbon Trading Platform*, HIS Markit (Sept. 3, 2021).
[871] *Saudi Arabia*, Climate Action Tracker. Available at https://climateactiontracker.org/countries/saudi-arabia/
[872] A. PourMirza, *Gas Flaring Status, Trends and Policy around the Persian Gulf*, Energy Sources, Part B: Economics, Planning, and Policy, 12:3, (2017) pp. 250-259,
[873] See, the *Global Gas Flaring Reduction Partnership* website for the relevant figures, available at http://www.worldbank.org/en/programs/gasflaringreduction#7

leak detection and repair (LDAR) program within the past decade in furtherance of that goal.[874] The LDAR program has been implemented across the Kingdom with continuous optimization.

The World Bank showed that Saudi Arabia released 2,618 kilotons of methane in 2020, 3.4 % of the global emissions total, while a country such as Iran has nearly twice the amount of Saudi emissions at 5257 kilotons (See Figure 9.4).[875]

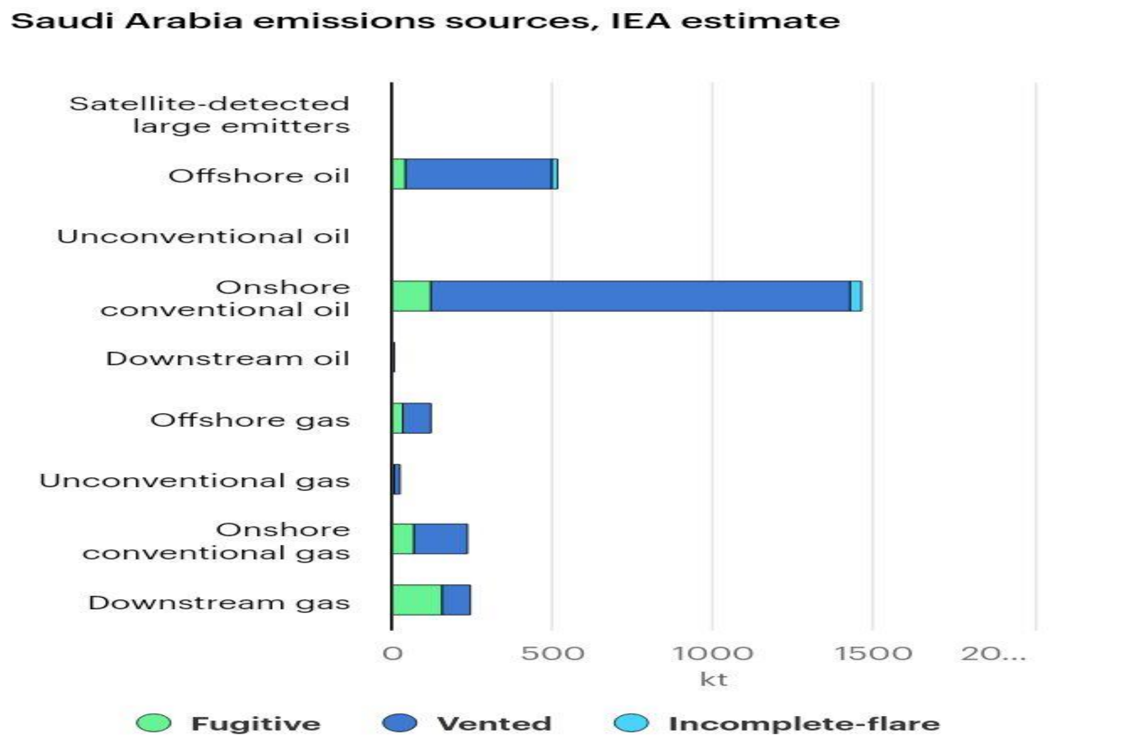


Figure 9.4: Saudi Arabian Methane Emissions (2020) Source: International Energy Agency

[874] Homood Al-Hilal, *Saudi Aramco Leak Detection and Repair Program*, Environmental Protection Department, Saudi Aramco (undated); *Saudi Arabia-Oil and Gas's Activities on Methane Mitigation* (undated). Available at https://www.globalmethane.org/documents/Saudi-Arabia-Methane-Initiative-Oil-Gas-2014.pdf

[875] It is not entirely clear if this differential is due to different protocols for hydrocarbon production or whether it relates to different methodological approaches. Ibid. p.6

Current assessments maintain that Saudi leakage rates reach .02 CH4/MMBTU of oil produced; however, a 2018 study published in the Science journal, *Global Carbon Intensity of Crude Production*, comprehensively analyzed the carbon intensity (CI) of oil production, i.e., the greenhouse gas emissions associated with crude production, across nearly 9,000 of the world's active oil fields across 90 countries, found that Saudi Arabia has the lowest CI of any major oil producer (See Figure 9.5).[876] Saudi Arabia's low CI rates are due to multiple factors, such as implementing reservoir best practices, flare minimization, greenhouse gas emissions management, and LDAR.[877]

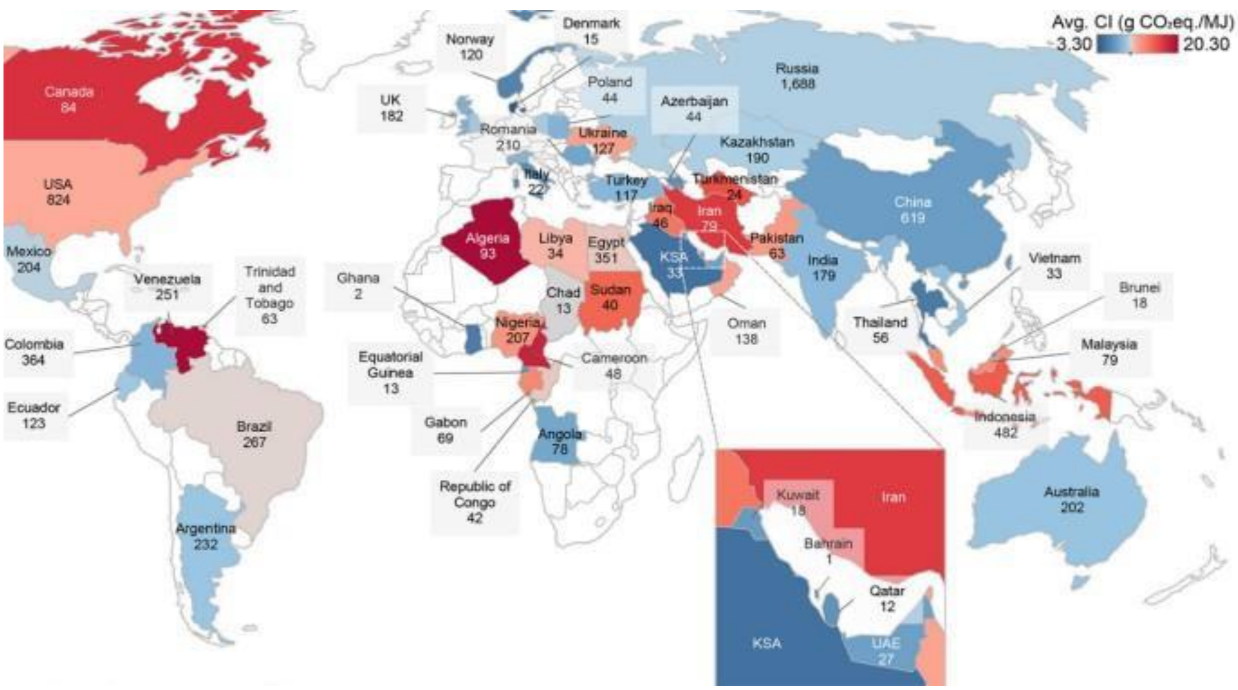


Figure 9.5: Carbon Intensity of Global Crude Oil Production Source: *Global Carbon Intensity of Crude Oil Production*

To further reduce methane leakages, the Saudi government implemented a jointly funded project with the British government for disclosing and assessing its methane gas

[876] The oil fields studied represent approximately 98 % of global crude oil and condensate production in 2015. Mohammad Masnadi, et *al*, "Global Carbon Intensity of Crude Oil Production," Science 31 Aug 2018: Vol. 361, Issue 6405, pp. 851-853
[877] *Study Shows Record Low Carbon Intensity of Saudi Crude Oil*, Saudi Aramco (Oct. 7, 2018).

emission sources and developing mitigation technology.[878] And Aramco also became a founding member of the Oil and as Climate Initiative (OGCI) and other significant hydrocarbon producing companies. The group aims to reduce its collective average methane intensity from upstream operations to below .25 % by 2025.[879] In a bid to telegraph its intent to reduce gas flaring, Aramco joined the World Bank Initiative: "Zero Routine Flaring by 2030."[880]

Additionally, Saudi actions to reduce methane and gas leakage also may be understood in the economic context for monetization. Aramco invests in advanced technology to grant greater efficiency and reduced carbon emissions in the transport sector, carbon capture, utilization, and storage (CCUS), and other aspects of carbon management to create a circular carbon economy while financially benefiting from its gas flaring mitigation efforts (See Section 7.3.1 for a detailed discussion for the Saudi circular carbon economy).

9.5.3 Current Status of Saudi Arabian Environmental and Carbon Regulatory Agencies

The Saudi government enacted its initial comprehensive environmental legislation on September 24, 2001, using the General Environmental Regulation: Council of Ministers Resolution No. 193.[881] This law entered into force in October 2002, and the implementing rules were published on September 30, 2003. Under this code, the Presidency of Meteorology and Environment (PME), an agency of the Ministry of Defense, was charged

[878] Thus far, the project successfully determined baseline data for the targeted methane sources based on the IPCC guidelines for 2006. It also established geographical mapping for methane emission sources, evaluated the economic potential of mitigating methane gas emission, and developed environmentally sound and cost-effective technologies to be deployed. Ibid. 27

[879] The organization represents nearly a third of total global oil and gas production. *Oil and Gas Climate Initiative Sets First Collective Methane Target for Member Companies*, Oil and Gas Climate Initiative (Sept. 24, 2018); Ron Bousso, *Big Oil Pledges to Slash Potent Greenhouse Gas Emission*, Reuters (Sept. 24, 2018)

[880] *Saudi Aramco Joins World Bank's Initiative: "Zero Routine Gas Flaring by 2030,"* Saudi Aramco Newsletter (Nov. 6, 2019).

[881] For a detailed explanation of the law, please see, *General Environmental Regulations and Rules for Implementation* (Translated from Official Arabic Version), Kingdom of Saudi Arabia Presidency of Meteorology and Environment (Oct. 15, 2001). Available at https://www.pme.gov.sa/Ar/DataLists//DocumentLibrary /General%20Environmental%20Regulations.pdf

with the overall supervision of environmental affairs in the Kingdom.[882] In 2016, the PME modified its name to the General Authority of Meteorology and Environmental Protection (GAMEP). This legislation mentioned above details broad prohibitions of pollution and contamination of land, air, and water by entities involved in the industry sector, services, and other economic activities. Owners of what is designated as "projects," i.e., utilities and facilities that may have an impact on the environment, are obligated to follow existing and future environmental specifications as set forth by the PME.[883]

The GAMEP has the full legal powers of coordination and cooperation with the relevant agencies/institutions and the mandate to monitor and implement environmental rules and standards.[884]

The GAMEP has two broad spheres of authority, focusing upon environmental protection services and sustainable development services. It has the mandate to review, develop, interpret, and issue environmental protection standards and ensure that public agencies and individuals abide by the environmental regulations set forth. According to GAMEP environmental regulations, companies and individuals found in non-compliance with applicable environmental regulations can face significant financial penalties. GAMEP regulations also require environmental impact assessments for residential and industrial development. The PME would likely regulate the development of a future carbon market in Saudi Arabia. This agency has the authority to craft environmental regulations supporting the government's objectives and various international agreements.

The GAMEP, and its predecessors, the PME and the Meteorology and Environmental Protection Administration, have had some achievements during its tenure. Most of these successes revolve around policy formulation rather than proactive approaches. Yet, as indicated above, Saudi Arabia has made significant strides in reducing methane leakage and improving ambient air quality in some of its larger cities due to environmental

[882] Ibid.

[883] Ibid, *Saudi Arabian Law Overview*: Environmental Laws, Saudi Legal (no date). Available at http://www.saudilegal.com/saudilaw/18_law.html

[884] Nahed Taher and Bandar Hajjar, *Energy and Environment in Saudi Arabia: Concerns & Opportunities* (Springer Science & Business Media, 2013) p. 12

regulations.[885] There are criticisms leveled at the agency. Most of them are concerned with the perception that environmental regulations are not implemented adequately in certain sectors. As a result, basic awareness of these regulations is limited, lacking enforcement and reduced compliance.[886] Overall, more work needs to be undertaken to facilitate environmental policy coordination amongst the various governmental agencies that have a role in environmental policy and implementation. And the GEMP requires a more robust and proactive approach in monitoring and enforcement of environmental regulations.[887]

9.5.4 How Saudi Arabia Could Implement a Carbon Market

As discussed below, the most efficacious method by which Saudi Arabia would create a future carbon market with political feasibility and economic efficiency in mind would be to implement a phased process.

Phase One: First and foremost, Saudi Arabia would need to improve essential coordination amongst the various governmental agencies that assist in environmental policy formation. Saudi Arabia is still weak in basic policy coordination. Additionally, while GAMEP has promulgated a multitude of environmental regulations over the past decade, compliance and enforcement still tend to lag behind other countries in the region. Therefore, for Saudi Arabia to successfully implement a carbon market, it would need to make its basic compliance/enforcement regime more proactive. Nonetheless, the Saudi government is currently telegraphing to companies in its jurisdiction to follow environmental regulations or face stiff sanctions.[888]

After Saudi Arabia strengthens its environmental enforcement regime, it would have to

[885] Badr Alharbi, *et al*, "Assessment of Ambient Air Quality in Riyadh City," *Saudi Arabia. Current World Environment*. 9 (2014) pp. 227-236.
[886] Waleed Abdullah Alsiary, *A Critical Investigation into the Barriers and Opportunities for Environmental Management Systems 'EMSs' Implementation for Delivery of Environmental Benefits to the Industrial City in Jeddah, KSA*, University of East Anglia (May 2015). p.1
[887] Ibid. *Energy and Environment in Saudi Arabia: Concerns & Opportunities.* p. 14
[888] DG McCullough, *Saudi Arabia's Green Decree Brings Hopes of Sustainability*, The Guardian (May 12, 2014).

launch several pilot schemes in its three key industrial and manufacturing areas, such as Riyadh, the Eastern Province, and Jeddah (See Figure 9.6).[889]

Initially, Phase One would focus on market development, and the pilot scheme would cover any industrial entity that emits more than 10,000 tons of carbon in any sector. The pilot schemes would likely construct the sinews of the forthcoming national carbon market and inculcate the various industries in the country on planning for carbon pricing. Through the authority of the GAMEP, the Saudi carbon regulators could begin to collect company-wide data that would create the framework for the complete legal basis for the carbon market.

Essentially, this would begin as a "learning by doing" phase that would educate both industry and governmental regulators on the intricacies of the functioning of the carbon market. Furthermore, this period would also assist in creating a baseline of emissions data in the various industrial and manufacturing sectors. The GAMEP must create an updated inventory for GHG emissions as Saudi Arabia's last official GHG inventory took place in 2000 (with an unofficial one in 2015).

A more recent national assessment would be required to create a baseline and a MERV framework. Overall, Phase One would complete the operational process through five steps: determination of the list of covered entities, method of allowance allocation, developing MERV, creating the foundation of the trading scheme, and determination of the compliance framework.

[889] *Key Business Areas in Saudi Arabia*, Doing Business in Saudi Arabia Guide. Available at: http://www.saudiarabia.doingbusinessguide.co.uk/the-guide/key-business-regions-in-saudi-arabia/

Figure 9.6 Map of Saudi Arabia: Source: Free World Maps

Firstly, the GAMEP must develop a list of the industries that would be covered, while the local GAMEP offices would create a list of specific enterprises. Secondly, the national authorities would determine the allowance allocation method, while the local regulators would create localized granting procedures. Thirdly, the national authorities would have to develop the MERV methodology and appoint third-party auditors and regulatory standards. The local authorities would have to organize data verification and reporting for submission to the GAMEP. Lastly, the national authorities under the GAMEP would construct and manage the registration framework and assess the enterprise compliance status.

In contrast, the local authorities would supervise the covered entities and account for fulfilling their carbon emissions reduction/trading obligations. During this phase, data collection will also be carried out among all thirteen provinces in the Kingdom for all carbon-emitting economic sectors by the GAMEP. This would also assist in capacity building at the local and regional levels, considering that the Saudi government must work on its fundamental environmental compliance/enforcement regime.

Phase Two: Phase One would provide the national policymakers with the assurance, hard data, enforcement authority, and the requisite evidence needed to apply the pilot schemes at the national level. The Saudi regulatory authorities will need to analyze mock trading of the allowances at the national level while setting up a national baseline at the same time. This will examine the durability and effectiveness of the critical market actors and allow the regulatory authorities to implement a robust early warning and prevention framework for any emergent market risks while assisting the supporting mechanisms of the carbon market's governance framework. Moreover, a stakeholder platform should be organized to support the development of the national market by engaging in stakeholder dialogues while also building up the capacity of financial intermediaries to offer advisory, risk management, and brokerage services to their clients.

Phase Three: This phase would launch the official national carbon market that would cover all industrial and economic sectors that emit more than a certain amount of carbon emissions. The Saudi regulatory authorities would also tighten or loosen the nationwide carbon cap based on national priorities and obligations under future global climate accords.

9.6 The Potential Development of a Carbon Abatement Mechanism in Qatar

According to the Intergovernmental Panel on Climate Change (IPCC), Qatar emits the most carbon dioxide globally on a per capita basis.[890] However, Qatar has reduced its per capita carbon emissions from a peak of 156 tons/per capita in 1973 to 38.52 tons/per capita in

[890] See, generally, Mona Abdulla AL-Asmakh and Nadya Abdulmonim AL-Awainati, *Counting the Carbon: Assessing Qatar's Carbon Dioxide Emissions*, Qatar Foundation Annual Research Conference Proceedings (2018).

2016/17. [891] At the same time, Qatar emits relatively low aggregate greenhouse gas emissions, standing at (pre-pandemic) 101.8 metric tons of carbon dioxide equivalent in 2019, but this dropped to 87.7 in 2020, due primarily to economic contraction due to the pandemic (See Figure 9.7). [892]

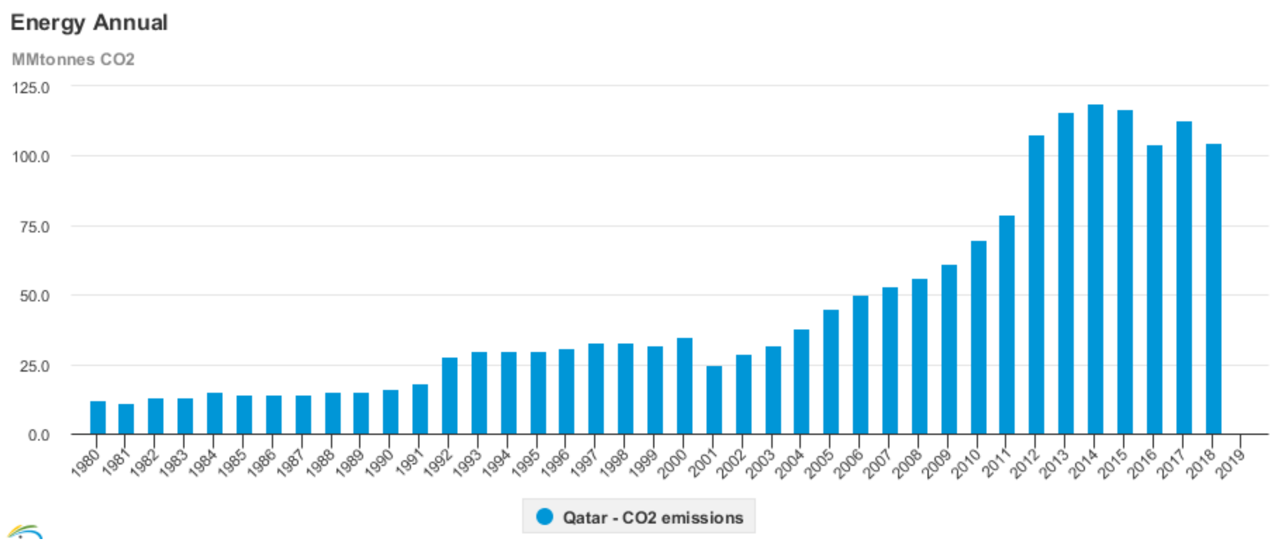


Figure 9.7 Qatar Annual Carbon Dioxide Emissions: Source: U.S. Energy Information Administration

It should be noted that the measurement of Qatar's carbon emissions depends upon which carbon emissions accounting method is utilized (See Appendix B for a detailed listing of QatarEnergy's (QP) scopes 1,2, and 3 carbon emissions). If a production-based accounting method is utilized, it would consider that Qatar is a large producer of fossil fuels and does not account that Qatar exports most of its hydrocarbons to the global market.[893] In comparison, a consumption-based method would merely assess the amount of carbon emitted due to domestic energy consumption. If the latter is utilized, Qatar would likely have lower per capita

[891] *Qatar CO2 Emissions Per Capita*, Knoema. Available at https://knoema.com/atlas/Qatar/CO2-emissions-per-capita
[892] *Qatar Emissions*, BP Statistical Review of World Energy (2021) p.15
[893] Ibid. *Counting the Carbon: Assessing Qatar's Carbon Dioxide Emissions*

emissions[894] The production-based accounting method is akin to the concept of "offshoring carbon emissions." This phenomenon occurs when developed countries outsource their manufacturing to developing countries, such as China, and then the developing countries export the manufactured goods to the developed world while retaining the increased emissions that result from the manufacturing process.[895] Some argue that the production-based accounting method should be utilized because Europe's natural gas fields are maturing, while the continent is also shuttering many of its fossil fuel production while importing more from Qatar. However, this is not the prevalent-nor most persuasive argument for emissions counting.

Besides burnishing its green credentials, and promoting natural gas as a bridge fuel, Qatar does have a vested interest in contributing to the global decarbonization efforts. Qatar stands to be adversely affected by climate change. It is predicted that by 2100, more than 22,000 residents in Qatar could be required to relocate due to a potential rise in sea levels by approximately one meter.

9.6.1 Gas Flaring and Methane Leakage Initiatives

Due to its extensive LNG production and export, Qatar is one of the world's leading LNG exporters. Since the 2010s, natural gas has been promoted as a bridge fuel to a low carbon economy because of its lower carbon intensity compared to other fossil fuels. It should be noted that environmentalists have concerns about the broad-based deployment of natural gas as a bridge fuel. It is unclear, but unlikely, at this juncture whether environmentalists will have the ability to stall a global transition to natural gas.

Broadly speaking, Qatar has implemented a multitiered approach to promote low carbon and a resilient climate base for its infrastructure. Its entire system is to integrate the various sectors of the economy, with a strategic vision at its core for development at the

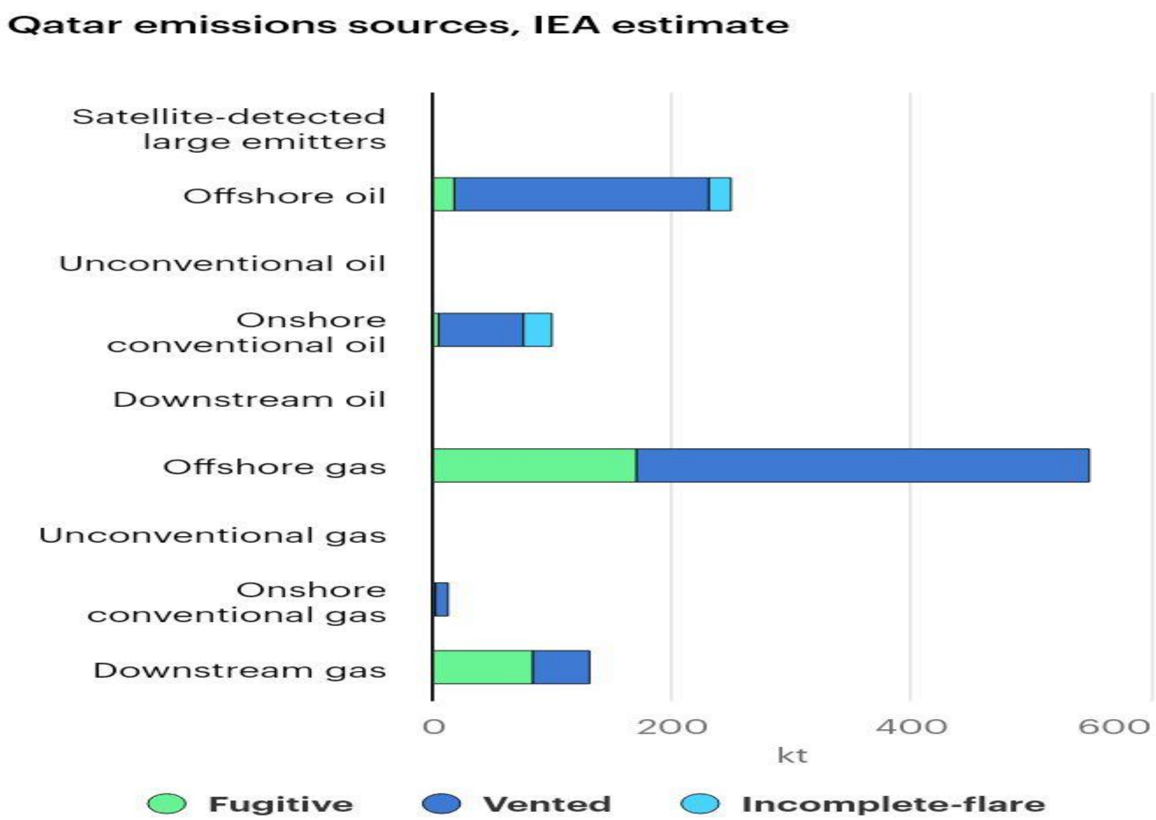
---

[894] Ibid. This research will utilize a production-based accounting method. But it is necessary to understand that various methods exist which are accepted by the World Bank for carbon emissions measurement.

[895] For a detailed review of this concept, please, see Steven J. Davis and Ken Caldeira, *Consumption-based Accounting of CO2 Emissions*, Proceedings of the National Academy of Sciences Mar 2010, 107 (12) 5687-5692

country-wide level that sets forth the broad human, social, economic, and environmental priorities that act as parameters for carbon intensity reduction.

The majority of Qatar's greenhouse gas emissions hail from its oil and gas sector. Fuel, which is combusted during energy production, accounts for nearly 70 % of Qatar's carbon emissions.[896] Gas flaring also accounts for almost 12 % of Qatari carbon emissions, wherein in 2020, Qatar flared 1.08 BCM of natural gas.[897] Additionally, in 2020, Qatar released about 1046 kilotons of methane, about 1.4 % of global emissions (See Figure 9.8)



[896] *Qatar National Development Strategy 2011-2016*, Qatar General Secretariat for Development Planning (March 2011). p.222
[897] Ibid. p.223; see *World Bank Global Gas Flaring Reduction Partnership*, Available at https://www.ggfrdata.org/#indicators-by-country

Figure 9.8 Qatar Methane Emissions (2020) Source International Energy Agency

Gas flaring reductions have been a particular focus of the Qatari government's efforts to reduce its carbon intensity. And, as Qatar recognized the negative environmental impact of gas flaring, it became the first Gulf country to join the World Bank's Global Gas Flaring Reduction Partnership (GGFR) in 2009.[898] Upon its joining, QP committed to the World Bank's Zero Routine Flaring by 2030 Initiative.

In 2021, Qatar entered as a member into the GGFR Multi-Donor Trust Fund to forge closer and stronger collaborations with other partners to reduce global gas flaring. QP views these partnerships as an alignment with its Sustainability Strategy, which is intended to reduce the emissions intensity of Qatar's LNG facilities by 25 % and a minimum of 15 % in its upstream facilities. QP also plans to reduce flaring intensity across its upstream infrastructure by more than 75 %.[899] QP's Sustainability Strategy also delineates a schedule to comprehensively eliminate routine flaring by 2030 and mitigate the release of fugitive emissions along the gas value chain by implementing a methane intensity target of .02 % across all facilities by 2025.[900]

There have also been several notable projects over the years to facilitate gas recovery. In 2007, Qatar introduced its first UNFCCC Clean Development Mechanism (CDM), the Al-Shaheen Oil Field and Gas Recovery and Utilization Project, significantly reducing gas flaring.[901] The Al-Shaheen oil field project was the first Kyoto Protocol-compliant carbon credit scheme launched in the Middle East, with the capacity to earn significant revenue from the sale of carbon credits potentially.[902]

[898] *Qatar Joins World Bank's Global Gas Flaring Reduction Partnership*, IISD (Jan. 27, 2009).
[899] *QP Joins WB in Global Fight Against Routine Flaring*, Gulf Times (March 17, 2021).
[900] Ibid.
[901] At the time, Al Shaheen was the world's largest CDM project. *Qatar's Commitment to Sustainable Development, Meeting the Challenges of Climate Change*, Qatar General Secretariat for Development Planning (2012).
[902] Mohamed Abdel Raouf Abdel Hamid, *Climate Change in the Arab World, Threats and Responses* in (ed) David Michel and Amit Pandya, *Troubled Waters: Climate Change, Hydropolitics and Transboundary Resources*, Stimson (2009) p.

Additionally, the Jetty Boil-off Gas Recovery Project, inaugurated in April 2014, captures gas that would otherwise escape into the atmosphere due to the loading of LNG cargo.[903] Another project that reduces Qatar's greenhouse gas emissions is the Qatar Fuels Additives project (QAFAC), which developed a carbon dioxide recovery unit at the Mesaieed Industrial City site. This facility can recover approximately 500 tons of carbon dioxide daily by turning the captured gas into methanol. [904] Additionally, from 2012-2017 the Qatar General Electricity and Water Corporation (Kahramaa) reduced carbon emissions by 8.5 million tons.[905] And, lastly, the National Rationalisation and Energy Efficiency Program (Tarsheed) is tasked with reducing approximately 6 million tons of carbon emissions by 2022. The Qatari government also established the National Flaring and Venting Reduction Project to significantly reduce gas flaring, targeting the most prominent companies responsible for flaring-related emissions.[906]

9.6.2 Other Carbon Reduction Initiatives

Qatar has several other initiatives to reduce carbon emissions. Domestically, it has set its sights on implementing 20 % of its total energy mix with renewable energy by 2024.[907] And Qatar's National Vision 2030 set forth the goal to reduce flaring to zero while also establishing the National Committee for Climate Change (a national body tasked with creating climate policy). Qatar is also broadening public transportation usage and deploying a national plan for energy efficiency, optimization, and resource allocation (QPEERU). The preceding is meant to be a driving force for greenhouse gas mitigation under Qatar's climate obligations.[908] And, as with Qatar hosting the 2022 FIFA World Cup, it pledged to deliver a carbon-neutral tournament by entirely reducing associated carbon emissions possible, allied with offsetting the remaining emissions. [909]

---

[903] The Jetty Boil-Off Gas Recovery Project will assist in reducing Qatar's greenhouse gas emissions by nearly 1.6 million tons per annum by capturing ninety % of the gas that would otherwise be lost by the loading of LNG into ships. *Qatar to Reduce Carbon Footprint with Major Projects*, Oxford Business Group (May 2015).

[904] Ibid.

[905] *Kahramaa Reduces 8.5 M Tonnes of Carbon Emissions*, The Peninsula (Nov. 1, 2017)

[906] *Qatar National Development Strategy 2011-2016. p. 224*

[907] Joshua Meltzer, Nathan Hultman, *et al*, *Low Carbon Energy Transitions in Qatar and the Gulf Cooperation Council*, Global Energy and Development: Brookings Institution (February 2014) p. 13.

[908] Ibid.

[909] Santhosh Chandran, *Qatar to Host a Carbon-Neutral WC in 2022*, Qatar Tribune (Nov. 27, 2017).

Qatar initially intended to develop a carbon market to be based in Doha by 2009. Yet, due to the global financial crisis, Qatar delayed those plans for a later date. In the interim, Qatar established the Global Carbon Trust, an initiative by the Gulf Organization for Research and Development.[910] The organization aims to encourage and assist MENA countries in developing a voluntary carbon market by providing access to global best practices and deploying teams of carbon market experts to various Arab countries.[911] Furthermore, in late 2017, Qatar Petroleum and several other large international energy companies signed a set of guiding principles that pledged to reduce methane emissions across its value chain.[912] Those mentioned above aligned with Qatar's hosting of several global carbon emissions reduction initiatives, including COP 18 in 2012 for Research and Development.[913] The organization aims to encourage and assist MENA countries in developing a voluntary carbon market by providing access to global best practices and deploying teams of carbon market experts to various Arab countries.[914] Furthermore, in late 2017, Qatar Petroleum and several other large international energy companies signed a set of guiding principles that pledged to reduce methane emissions across its value chain.[915] Those mentioned above aligned with Qatar's hosting of several global carbon emissions reduction initiatives, including COP 18 in 2012.

The Qatari government is actively working on rectifying knowledge and capacity deficits that constrain its ability to develop an ecologically sustainable framework to reduce carbon emissions. Qatar is funneling significant investment funds to local universities and research and development laboratories in its pursuance to become a knowledge-based economy. There are myriad postgraduate programs, and joint research focused on sustainability issues located throughout the country. For example, the Qatar Science and Technology Park, which the government launched in 2009, forges connections with

---

[910] See, Global Carbon Trust website, available at http://www.gct.qa/en/service

[911] See *Gulf Carbon Trust website*, available at http://www.gct.qa/en/gulf-carbon-trust

[912] *Reducing Methane Emissions Across the Natural Gas Value Chain*, Climate and Clean Air Coalition (2017). Website available at http://ccacoalition.org/en/resources/reducing-methane-emissions-across-natural-gas-value-chain-guiding-principles

[913] See, Global Carbon Trust website, available at http://www.gct.qa/en/service

[914] See *Gulf Carbon Trust website*, available at http://www.gct.qa/en/gulf-carbon-trust

[915] *Reducing Methane Emissions Across the Natural Gas Value Chain*, Climate and Clean Air Coalition (2017). Website available at http://ccacoalition.org/en/resources/reducing-methane-emissions-across-natural-gas-value-chain-guiding-principles

various multinational corporations and advanced research institutions to develop carbon emissions reduction techniques.[916]

Additionally, Hamid Bin Khalifa University established the Qatar Environment and Energy Research Institute to promote research related to the intersection of energy consumption/production and climate change mitigation to fill gaps in research on mitigation and adaptation. Yet, despite the lavish funds granted to climate change research in Qatar, the research tends to be narrowly tailored to focus on technological issues related to carbon emissions reduction (such as CCS), as opposed to a broad-based interdisciplinary approach combining economic, social, political and cultural issues that all play a significant role in the country's high per capita carbon emissions.[917] As a result, this limited focus can handicap the complex climate-related capacity building and policy advice the Qatari government requires.

9.6.3 Current Status of Qatari Environmental Legal Frameworks and Carbon Regulatory Agencies

Qatar, symptomatic of other recently developing countries, previously had the mentality of "grow first, clean up later." But this focus has been modified as Qatar has been playing a leading role in the MENA region for climate-related issues that began with hosting COP 18 in 2012. And the country is also a party to other major international environmental agreements.[918] While Qatar was criticized in some quarters for not submitting ambitious carbon reductions during COP 18, the Qatari leadership began to develop policies and the regulatory apparatuses that would later serve to reduce carbon emissions across the country.

The beginning of Qatar's growing awareness of environmental sustainability issues was marked by the government's establishment of the Environmental Protection Committee in 1984 that reports to the Supreme Council for the Environment and Natural Reserves.[919] And

[916] *Qatar Science and Technology Park* webpage, available at https://qstp.org.qa/

[917] *Qatar's National Emission Inventory Report: Emission Inventories 1995-2015*, Qatar Foundation (2016). p.21

[918] Ibid. p. 40

[919] Sayeed Mohammed, *Qatar's National Emission Inventory Report: Emission Inventories 1995-2015*, Qatar Foundation (2016). p.35

in September 2002, the Qatari government implemented a decree to protect and manage the Qatari ecosystem, entitled, Promulgating the Law of the Environment Protection (Law No. 30 of 2002.) [920] This decree is comprised of eighty articles that stipulate environmental protection issues. Environmental sustainability has been taking a more prominent role in Qatar's development programs. Qatar's National Development Strategy 2011-2016 was the first official Qatari strategic policy paper to embed sustainable development as a critical pillar for future economic growth.[921] Qatar promulgated the Environmental Sector Strategy and National Resource Management Strategy in 2010 that provided the basis of the National Development Strategy and contained the "strategic directions and key initiatives" for 2011-2016.[922]

The Environmental Sector Strategy noted that Qatar lacked a national carbon mitigation strategy or reduction targets at the time.[923] Still, in the Qatar National Vision 2030, the Qatari government first formulated in 2008 that it posited environmental sustainability as the lodestone for the country's future development and formed the sinews of nearly every major Qatari policy. Two significant greenhouse gas reduction policy goals embedded in Qatar's National Vision 2030 are reducing gas flaring to near zero and reducing domestic consumption of fossil fuels by promoting renewable energy utilization and energy efficiency measures.

Qatar currently has two main governmental environmentally-oriented organs, the Ministry of Municipality and Environment and the Ministry of Energy and Industry, managing environmental and energy-related activities. QP also tends to act as a regulator over certain energy sector activities. The Ministry of the Municipality and Environment has little influence over operations in Ras Laffan, Messaied, and Dukhan industrial cities.[924] All companies that operate within these industrial cities submit regular environmental reports to QP, with significantly less emphasis on the Ministry of the Municipality and

---

[920] Ibid.

[921] *Qatar National Development Strategy 2011-2016*, Qatar General Secretariat for Development Planning (March 2011).

[922] The Ministry of Environment, the Ministry of Municipality and Urban Planning and Qatar Petroleum worked in conjunction to create the Environmental Sector Strategy. *Qatar's National Emission Inventory Report: Emission Inventories 1995-2015. p.39*

[923] Ibid. 40

[924] Ibid.

Environment.[925] Most large-scale and medium/small scale industrial and hydrocarbon projects undergo a comprehensive environmental impact assessment.[926]

Qatar's energy sector is regulated overall by the Natural Resources Law (Law No.3) of 2007 to exploit natural resources. The Ministry of Energy and Industry regulates the Qatari policy on hydrocarbons, which is under the ultimate purview of the Emir. As stated earlier, QP has the authority to manage and develop all of Qatar's oil and gas resources and operates as a regulator in many hydrocarbon operations.

The Ministry of Municipality and the Environment governs all issues related to the environment, such as emissions and discharges during the processing of hydrocarbons. It is the national focal point for all climate change issues in Qatar. This ministry establishes the policies and the legal/administrative regulations for hydrocarbon and petrochemical projects throughout the country.

To support its mandate, the Qatari government created a national policy formulating body, the National Committee for Climate Change (NCCC), residing in the Ministry of Municipality and Environment.[927] The primary responsibilities of the NCCC are to establish a comprehensive national program for climate change that includes policies to manage national greenhouse gas emissions, adherence to international commitments required by multilateral climate treaties, and preparation and publication of the national communications under the UNFCCC.[928]

Each regulatory authority in Qatar has the authority to levy fines for non-compliance. However, the Supreme Council of the Environment and Natural Reserves coordinates all environmental affairs in the country. It has a specialized chamber to assess and resolve disputes and infractions against the relevant environmental regulations. This council

[925] Ibid.

[926] However, the rigor of these assessments is not clear, nor, typically, are there independent studies on how project evaluation occurs. *Qatar's National Emission Inventory Report: Emission Inventories 1995-2015*, Qatar Foundation (2016). p.36

[927] The National Committee for Climate Change consists of nine members representing Qatar University, Qatar Petroleum, the Office of HH Heir Apparent, the Civil Aviation General Authority, the Ministry of Agriculture and Municipal Affairs, as well as the Ministry of the Environment. *Initial National Communication to the United Nations Framework Convention on Climate Change*, Ministry of Environment: State of Qatar (2011). p. 18.

[928] Ibid.

undertakes all the responsibilities of protecting the environment and realizing general policies to promote sustainable development. Additionally, it prepares legislative drafts and establishes databases that ensure that the Qatari ecosystem is maintained. In cases of non-compliance with environmental protection regulations, the council may withdraw the consent to operate for that particular entity.

Nonetheless, there is preciously little available publicly published on whether companies adequately comply with regulatory limits, whether licenses have been suspended, and whether a revocation for their consent to operate was applied for non-compliance.[929] During some of its earlier phases, Qatar's greenhouse gas reduction policies were followed somewhat haphazardly.

In 2007, Qatar published its first official comprehensive national greenhouse gas emissions inventory, implemented by public consultation and data collection nationwide. This inventory was updated in 2011 (comprising carbon dioxide, methane, and nitrous oxide), with the data published within the Initial National Communication to the UNFCCC. [930] But, more recently, an independent researcher at the Qatar Environment and Energy Research Institute compiled a substantive inventory of Qatar's greenhouse gas emissions from 1995-2015. This study noted that despite significant progress in Qatar's ability to utilize greenhouse gas emissions data to promulgate sustainability programs, some institutional weaknesses still need to be addressed.[931]

For instance, the Qatari government promulgated the Resolution of Ministers No. 15 of 2011, *Establishing Climate Change and Clean Development Committee and Determining its Functions*.[932] This resolution directed the relevant agencies in Qatar to propose policies and action plans to reduce greenhouse gas emissions and set up a database under the requirements of the UNFCCC and the Kyoto Protocol. Many agencies failed to follow the directive, and no penalties were levied for non-compliance.

---

929 Ibid.

930 *Initial National Communication to the United Nations Framework Convention on Climate Change*, Ministry of Environment: State of Qatar (2011).

931 See, generally, *Qatar's National Emission Inventory Report: Emission Inventories 1995-2015*, Qatar Foundation (2016).

932 *The Resolution of the Council of Ministers No. 15 of 2011 Establishing Climate Change and Clean Development Committee and Determining its Functions*

Thus far, Qatar has only published one national communication. And, while QP and many other companies began to publish emission data in their annual sustainability reports, other companies continued to withhold data.

Ultimately, since it was a voluntary process, companies had no legal requirement to report their carbon emissions. This began to change when QP Health, Safety and Environment (QP HSE) created an initiative to publish greenhouse gas emission data. As a result, many companies began to publish their emissions data in their annual sustainability reports. But many companies still withhold data as the process is not mandatory.[933]

Furthermore, there is a lack of cooperation and dialogue between the various ministries, and even departments within the same ministry may not interact with each other.[934] This often results in poor planning and a lack of the development of robust policies. There also tends to be tension between various agencies that causes creative initiatives to be discarded. [935] And cooperation between think tanks and ministries tends to be tenuous at best, as there are trust concerns and trepidation about territorial encroachment.[936]

9.6.4 How Qatar Could Implement a Carbon Emissions Abatement Framework

Phase One: The NCCC would have to develop an internally consistent multitiered approach to carbon mitigation using the command-and-control framework. Initially, a legal platform must be created that would mandate and standardize information sharing amongst the various ministries and industrial/energy companies within Qatar to develop a greenhouse gas emissions baseline. The Ministry of Municipality and Environment would operate as the central clearinghouse for all data related to greenhouse gas emissions. It would also operate under its current mandate of monitoring and evaluating compliance

[933] *Qatar's National Emission Inventory Report: Emission Inventories 1995-2015*. p.21
[934] Ibid.
[935] Ibid.
[936] Ibid.

with greenhouse gas emissions submissions from the relevant entities. While the Ministry of Municipality and Environment currently has the authority to impose penalties for lack of compliance with environmental regulations, the enforcement framework must be strengthened to ensure proper adherence to regulatory standards. Additionally, the NCCC must create an emissions and technology standard to which companies must adhere. Furthermore, a government-sponsored greenhouse gas mitigation fund would be necessary to assist the industry in researching, developing, and deploying energy-efficient technology/carbon capture storage to reduce emissions and reach the mandated benchmarks.[937]

Phase Two: In this particular phase, Qatar would have to utilize the greenhouse gas emissions data collected during Phase One to assess which companies would be required to deploy more energy-efficient machinery and reduce methane leakage. The Ministry of Municipality and Environment would also ascertain that energy companies adhere to zero flaring policies. Qatar would likely build upon its efforts to develop a sophisticated financial sector with the global export of climate financial and low carbon technical services. The low carbon technical advisement services would contribute to economic growth by leveraging the expertise developed for decarbonization in the energy and petrochemical sectors. Additionally, through Qatar granting soft loans and promotion of renewable energy projects across the MENA region, climate finance would likely assist Qatar in acquiring significant global prestige through its project development, such as China currently undertakes with substantial infrastructure projects in the developing world.

[937] Qatar's National Vision 2030 policy states that "Wherever there is an environmental cost to be paid for economic progress, it must be compensated with investments in technologies that help improve the environment." *Qatar National Vision 2030*, General Secretariat for Development Planning (July 2008).

Chapter Ten: Conclusions and Implications: Carbon Abatement Strategies in Saudi Arabia, Qatar, and the UAE

10.1 Introduction: Key Findings

This thesis reviewed the past and current steps the three selected countries of the UAE, Saudi Arabia, and Qatar have undertaken to limit carbon emissions in accordance with their pledges under the Paris Agreement. The research scrutinized the most efficacious models for carbon mitigation frameworks that they could establish in their respective jurisdictions and the timeframe in which these could potentially be completed.[938] The research reviewed the two largest carbon markets globally, i.e., the EU and China, and analyzed their challenges during implementation and whether the three selected Gulf countries could learn from their experiences.

Across the MENA region, the awareness of environmental issues and the need to reduce domestic energy consumption have risen to the top of the political agenda.[939] This is evidenced by the significant investments in renewable energy, proactive negotiations in multilateral climate change conferences, the announcement of a carbon market in Saudi Arabia in 2021, net-zero goals in Saudi Arabia and the UAE, and the establishment of various environmental regulations and agencies across the region. Since the beginning of the 2010s, the Gulf countries have engaged in an incremental process of energy pricing reconfiguration, the promulgation of energy efficiency policies, and national strategies to reduce their hydrocarbon consumption and carbon emissions.[940]

The three selected Gulf countries have ratified the Paris Agreement and indicated their fidelity to their pledges to reduce greenhouse gas emissions. They were to update their

[938] The carbon mitigation models that will be considered are a cap-and-trade framework, a hybrid model, carbon taxation and a command-and-control scheme.

[939] Most Arab populations are now concerned about the myriad ramifications of environmental degradation and climate change. Najib Saab, *Environmental Awareness in Arab Countries: A Survey* (Feb. 20, 2021).

[940] For a comprehensive review of energy subsidy reform in the MENA region, please, see Jim Krane and Francisco Monaldi, *Oil Prices, Political Instability, and Energy Subsidy Reform in MENA Oil Exporters*, Center for Energy Studies (May 2017).

respective NDCs in 2020, but the Covid-19 pandemic delayed progress on that front, except for the UAE, which submitted its second NDC in December of 2020 (As discussed in Section 7.3.2). Overall, it is highly likely that the 2020s will witness Saudi Arabia, Qatar, and the UAE undertaking serious and consistent action to reduce carbon intensity by developing various carbon abatement frameworks.

Research Questions and Answers

The thesis sought to answer two key questions: The reduction of natural gas consumption is the centerpiece of the Gulf countries' efforts to achieve macroeconomic diversification. In order to reduce domestic natural gas consumption to foster macroeconomic diversification and growth, what role could carbon pricing (taxation or trading) or command-and-control frameworks play in the policy mix of Saudi Arabia, Qatar, and the UAE? What alternatives are there, and why would these be more or less desirable?

Answer: I found that carbon emissions abatement policies would be beneficial for the three selected Gulf countries to comprehensively reduce their hydrocarbon demand/carbon emissions and foster macroeconomic diversification to transition them from being solely hydrocarbon export-based economies. My research indicated that a phased implementation of a carbon market would be more viable for the UAE and Saudi Arabia due to their large industrial base and growing financial sectors, thereby making a carbon market more liquid and flexible in those jurisdictions. In contrast, a command-and-control framework would fit better for Qatar as the country is much smaller and does not have the financial depth and liquidity to support a fully functioning carbon market.

Carbon taxation is less preferable for the three countries because the Gulf countries would like to implement a more business-friendly and flexible method of promoting decarbonization. Additionally, while the carbon trading and command-and-control frameworks would be the principal means of inducing reduced hydrocarbon consumption, other methods, such as renewable energy investment, technology/energy standards, subsidy removal, smart grids, and so on, do not stand in opposition to either a carbon trading framework or command-and-control regulations and can be utilized in a complementary fashion.

The three countries have not yet implemented a dedicated national carbon reduction framework; however, Saudi announced in 2021 that it would establish a national carbon market, and Dubai currently has a carbon market as well. Both countries also announced in 2021 that they would set net-zero targets to reduce their carbon emissions over the next several decades. However, preciously few details were granted as to how they intend to meet their pledges; therefore, they have not been able to reduce carbon emissions by that process yet.

Yet, there has been a steady decrease in per capita natural gas consumption since the late 2010s, plateauing since 2017, primarily due to power pricing reformation, various energy efficiency policies, and non-oil and gas energy production (mainly in the UAE).

The second question was if Saudi Arabia, Qatar, and the UAE implement carbon pricing or command-and-control frameworks, how would they be best designed for political feasibility and economic efficiency to meet their COP 21 climate pledges? What lessons are available and relevant from experience with carbon and energy pricing from other parts of the world?

Answer: I found that a staged implementation through carbon market pilot schemes would be more successful for the UAE and Saudi Arabia to deploy as it would allow time for the regulatory authorities to assess progress and for the preliminary covered sectors to adapt. As a general rule, if carbon markets are established in the UAE and Saudi Arabia, the timelines of the trading program should be set for a long enough period to influence technology investment decisions. And, in order to mitigate resistance from the industrial and power sectors, a gratis disbursement should be set up initially. Qatar, in contrast, would be able to establish its carbon reduction regulations through a command-and-control framework- a bit more expeditiously within a two-step process. And, in all countries, robust data collection and regulatory regimes should be established.

The U.S. (Acid Rain Program), the EU, and China provided a viable template for Saudi Arabia and the UAE to effectively fashion an emissions management regime using the flexible mechanisms embedded in an emissions trading framework. The Chinese experience is valuable as it struggles with many of the same challenges that beset the three selected Gulf countries. These common primary challenges that China and the three selected Gulf countries face are how to progress with macroeconomic growth and industrial diversification while stimulating domestic natural gas production and simultaneously reducing domestic oil and gas demand and carbon emissions.

Conclusions of the Research which Support These Answers

Chapters Three, Four, and Five examined the current structure of the respective natural gas sectors of Qatar, UAE, and Saudi Arabia and the challenges they face with their production/demand. It also discussed how these dynamics transpired in relation to domestic policies (such as energy pricing/ industrialization, etc.) and demographics. In each case study, hydrocarbon production and consumption fundamentals were analyzed against their respective macroeconomic reformation policies. It was found that while the three selected countries experienced stark increases in energy (and therefore power) demand since the early 2000s, the incremental and somewhat haphazard steps they undertook in the early 2010s proved to be insufficient to successfully tame the gas allocation shortages that Saudi Arabia and the UAE began to experience in 2008/2009. The gas shortages of 2008/2009, exacerbated by the global financial crisis, served as a harbinger of the severe economic difficulties that they would face if they did not engage in substantive energy demand reduction efforts.

As a result, most economic planning has been on how best to increase gas production, reduce domestic energy consumption via economic diversification, and spur job creation and industrialization. Meanwhile, while having significant gas reserves to meet its requirements, Qatar has also been experiencing increasing gas/power demand requirements. Qatar's goals differ from Saudi Arabia and the UAE as it seeks to reduce its domestic energy demand and explore more natural gas to maintain its status as one of the world's preeminent LNG exporters.

The UAE, due to its rapid economic growth in the 2000s, had a corresponding increase in gas demand. It has been successful in stimulating its non-associated natural gas production since the allocation shortages of 2008. And it has been able to achieve some of its goals in renewable energy production. For instance, the federal government and local emirates implemented energy efficiency policies and focused on non-natural gas power generation such as renewable energy, coal, and nuclear.

The UAE also has succeeded in reconfiguring its gas/power and water prices. This, combined with the oil price decline of 2014 and the 2020/21 Covid-19 pandemic and diversification into coal, nuclear, and renewables, has reduced the gas demand growth outlook. Moreover, the UAE focused on the expansion of its petrochemical sector by deploying ADNOC (which has been restructured) to develop aggressive petrochemical expansion as part of its convergence strategy to facilitate new technology development, skill-set transfer, and growth of local businesses in industries that mutually reinforce each other, such as engineering and plastics related manufacturing to enable profit maximization of the value chain of its hydrocarbon output.

As discussed and illustrated in Chapter Four, Section 4.3, Emirati gas demand seems to have already begun to plateau since the late 2010s (see Figure 4.2) and will likely decline beginning in the mid-2020s, especially in the power generation sector, as the remaining nuclear power and renewable energy plants come online, deeper and more extensive energy efficiency policies and additional power tariff reconfigurations are implemented.[941] For example, based on committed plans, the UAE expects that at least 20% of its installed capacity to come from clean energy production by 2024.[942] By 2024, the UAE will have approximately 50 GW of electricity generation with nearly 11 GW composed on renewable and nuclear energy.[943]

---

[941] In 2021, the UAE launched the National Water and Energy Demand Management Programme which is positioned to improve the energy efficiency of the three most energy-intensive sectors in the country, industry, construction and transport by 40% by 2050. It will also implement several parallel initiatives to reduce energy demand by 40%, expand the share of renewables in the energy mix by 50% and increase water reuse by 95%. *The UAE Launches its National Water and Energy Demand Management Programme*, Enerdata (Aug 10, 2021).
[942] *The UAE Expects that 20% of Power Generation to Come from Clean Energy in Three Years: Official*, S&P Global Platts (May 17, 2021).
[943] Ibid.

Future demand growth will probably hail from the industrial sector, not the retail sector, but increasing domestic gas/power prices and carbon emissions reduction policies would impact this growth. In furtherance of its national demand-side management policy, the Emirati government is working to reduce electricity consumption in various sectors, including the industrial sector, of which it accounts for approximately 50% of the country's power demand. Even then, the UAE expects to rein in and reduce industrial demand from historical growth rates as in the industrial sector energy usage is more efficient, and the power tariffs are much higher than that for the retail sector.[944]

I discovered that Qatari gas demand seems likely to increase substantially over this decade due to the assumption that plans for more petrochemical and industrial development and additional power generation and desalination expansion. Therefore, the post-2013 decline in gas demand would likely be reversed in the coming years (as per Figure 3.3). The development of the country's natural gas reserves fueled double-digit GDP growth during the 2000s. This economic growth also propelled Qatar's diversification into the downstream value-added industrial sectors. Due to the low cost of Qatari gas production and the lack of interest to reduce the wastage of power and water demand, these factors will add additional upward pressure on domestic gas demand until 2025.

The research found that Saudi Arabia needs to rapidly develop its incremental natural gas reserves to expand its downstream sector, provide inputs for water desalination and power generation, and reform its macroeconomy in line with its diversification strategy. The importance of natural gas for Saudi Arabia cannot be overstated as it is the veritable backbone for all facets of its industrialization policy. However, the most significant challenge that Saudi Arabia faces is in ascertaining the balance between natural gas/power pricing reform, maintaining competitive energy and industrial sector, and stimulating incremental gas production. For Saudi Arabia to achieve its macroeconomic goals as outlined in its Vision 2030, pricing reform and demand-side policies will have to go much further and faster in the future. And, as noted in Chapter Five, Saudi Arabia is still contending with institutional, technical, and technological barriers that impede its ability to fully develop its incremental

[944] Ibid.

gas production.

The Gulf countries eventually abandoned their stringent opposition to climate change issues in 2012 and embraced decarbonization as a future developmental model by initially utilizing energy/power price reformation and alternative energy investment. The alternative energy drive is finally bearing fruit in the region, although some countries, such as Bahrain and Kuwait, remain significantly far behind their neighbors. All three selected countries have implemented energy and power pricing reform to moderate their domestic hydrocarbon demand and have been able to reduce their per capita hydrocarbon demand while attracting investment for non-associated natural gas production and renewable energy deployment.

Energy pricing reformation has been somewhat uneven throughout the three selected countries. Despite progress in the reform of power sector pricing, natural gas pricing reconfiguration has mostly stalled since the mid-2010s. However, electricity sector pricing reconfiguration may be somewhat a proxy for direct natural gas pricing reform. This is because of the significant amount of natural gas utilized in regional power generation. I found that while the three selected countries have telegraphed the political will to reform their energy pricing comprehensively, there are still institutional barriers and special interests serving as obstacles. The forward momentum of natural gas pricing reformation stalled since the mid-2010s, however the ongoing power pricing reconfiguration is able to act as an indirect proxy for straightforward natural gas price increases.

Furthermore, while the nominal natural gas prices have stayed the same since their initial reconfiguration in the mid-2010s, but due to inflation, the prices have decreased in real terms over the past decade. This issue does mitigate the pricing reform efforts and energy efficiency incentives efforts that have taken place. As a result, establishing a carbon abatement regime would adequately compensate for the pricing fluctuation due to inflationary pressure.

But the funneling of billions of dollars into alternative energy development and the reform of domestic energy pricing frameworks in the three selected countries do herald a fundamental psychological shift, or perhaps, a transformation, in the future regional economic development contours. And my research points to the fact that while the appetite for future natural gas price increases may have waned, decarbonization policies will likely provide the future methods to reduce hydrocarbon demand. This may be witnessed by when a ranking Emirati Ministry of Energy and Infrastructure official declared that, "If you want to really reduce carbon you have to really work on efficiency, you have to reduce your own consumption…this is really low hanging fruit."[945] Since the mid-2010s, solar power generation costs in the Gulf has been on a steady decline due to technological improvements in the hardware itself, enhancements in the manufacturing process, economies of scale and financial incentives. Currently, in the Gulf, new solar power is less expensive than new complex natural gas generation, allowing the countries the opportunity to recoup the significant opportunity costs they incur from the domestic consumption of hydrocarbons. This price declines in the Gulf track global trends which witnessed solar module price reductions by nearly 100% from 1976 and the price of electricity from new solar plants fell by 89% from 2009-2019.[946]

As my research has shown, the primary motive for the three selected countries to agree to reduce their carbon emissions as per their Paris Agreement pledges is because of their gas shortages caused by increasing demand in the early 2010s. They viewed it in their best interests as not only would they portray themselves as global environmental stewards but also reduce their respective economies' carbon/energy intensities. As a result, they would be able to increase their industrial efficiency and help develop a multifaceted macroeconomy able to meet the requirements of creating employment opportunities for their citizenry as they promote the private sector to increase its share of the national economy. However, as my research indicated, the Gulf countries view their commitment to climate change through a national security prism as well.

There are clear stability concerns related to an abrupt disruption of international hydrocarbon consumption, which would cause economic dislocation in the Gulf region. Additionally, climate change itself poses unique challenges as it can exacerbate underlying socio-political tensions that exist both domestically and regionally. Lastly, a rapid evolution of the traditional social contract and subsidization framework could also engender legitimacy debates surrounding popular enfranchisement which would also prove to be

---

[945] *The UAE Expects that 20% of Power Generation to Come from Clean Energy in Three Years: Official*, S&P Global Platts (May 17, 2021).

[946] Max Roser, *Why Did Renewables Become So Cheap So Fast*, Our World in Data (Dec. 1, 2020).

somewhat destabilizing. Therefore, as my research indicated, the Gulf states recognized that a delicate balance exists, such as if they fail to effectively combat climate change, they risk instability, but the very means to adequately manage GHG emissions-reducing subsidies-also can give birth to widespread discord and dissent.

Geopolitically, my research illustrated that while there have been tensions between the various Gulf countries that took the form of border disputes, conflicts concerning maritime borders, foreign policy rivalries and squabbles concerning ownership of hydrocarbon resources, it is exceedingly unlikely that these issues could alter the development of nation specific decarbonization policies. At most, any disagreements between Qatar, Saudi Arabia and the UAE would lead to a lack of cooperation in international climate forums or any potential progress on a future regional carbon abatement framework, e.g., a pan-Gulf carbon market.[947] For example, the most notable flare up of intra-Gulf tension, which was the three-year Saudi led embargo on Qatar, energy trade between the three countries was not affected. Qatar did not halt Dolphin pipeline gas exports and joint field exploitation with the UAE, even at the height of the blockade. Additionally, the operation of the Gulf Cooperation Council Interconnection Project was not obstructed in any way. This tends to show that energy-and perhaps climate-related issues would likely not be affected by intra-Gulf competition.

The U.S. Acid Rain program and the EU ETS should prove valuable templates for establishing viable carbon emissions reductions frameworks regarding the undeniable hurdles upon their implementation and successes. Numerous studies detailed that the U.S. Acid Rain program demonstrably reduced particulate matter in American skies. At the same time, the EU ETS illustrated that a transnational carbon trading platform could be implemented and effectively reduce carbon emissions. As with China, Gulf policymakers would learn and collaborate with the U.S. and the EU to develop their carbon abatement frameworks. Additionally, the EU ETS provides a wealth of empirical evidence on what is required to construct a well-designed carbon mitigation framework to acquire quality data and implement an adequate regulatory regime that could deploy a credible MERV system.

[947] The way that regional tension could cause a lack of cooperation in regional organizations may be evidenced by Qatar deciding to end its nearly 60 year membership in OPEC in 2018.

By studying the EU ETS, as well as China's foray into carbon mitigation, the Gulf countries would be able to anticipate and avoid their most glaring deficiencies such as lack of policy coordination, lax enforcement of environmental regulations, incoherent methodologies, and weak/inconsistent data by cooperating with officials from other jurisdictions before creating a carbon abatement system to learn best practices to prepare the ground for an effective carbon abatement scheme. And, while the EU ETS took many years of tinkering to arrive at a viable carbon market, China was able to learn from the EU ETS and construct a national trial framework in four years. That relatively short time frame, considering the sheer size of the Chinese economy, indicates that with proper foresight, a developing country could potentially forge a national carbon abatement scheme within a period of a few years. Yet, at the same time, it remains crucial to be cognizant that while the pilot schemes were successful, it will still take some time to understand whether China's national carbon market will successfully reduce carbon emissions over its operational lifetime.

Broadly speaking, what becomes clear from a review of the EU ETS and Chinese experiences is that a phased implementation process is beneficial. A phased process allows a country to progressively establish a national carbon abatement scheme while learning from implementation errors and having the flexibility to modify the scheme as required.

My research indicated that the Gulf states are now under internal and external pressure to decarbonize, the former because of their growing power demand, the need to diversify economically, and the potential difficulty securing adequate feedstock for their downstream domestic industries. And various reputable surveys and opinion polls have illustrated that the populations are concerned about climate change and other related issues.[948] It is exceedingly likely that their citizenries will become more environmentally aware and

[948] In 2021, more than half of Arab Youth (56%) in a 2021 poll indicated that they were concerned by climate change. Furthermore, the Arab Forum for Environment and Development found that 95% of Arabs in the MENA region believe that their governments have not done enough to manage environmental pollution. Overall, a regional average of 75% held that their governments were not taking enough action to combat climate change. For a detailed discussion of climate-change efforts, impacts and attitudes in the MENA region, see (ed) Najib Saab and Rima Habib*, Arab Forum for Environment and Development* (2020) pp.174-197; Joerg Hildebrandt, *et al*, *Are Consumers in the Gulf States Ready to Go Green?*, Boston Consulting Group (Jan. 31, 2021); *Health and the Environment in Arab Countries: Hope for the Future*, Arab Youth Survey (2021) Available at http://arabyouthsurvey.com/en/findings/

provide cautious domestic pressure as occurred in the developed world.[949]

In terms of external pressure, the international climate accords are legally binding, and the Gulf countries find themselves increasingly obligated to cooperate globally to reduce the threat of climate change.

In short, I claim that the pivot to renewable energy merely showcases the confluence of numerous factors but mainly deals with how they consume and produce their energy. My findings indicate that the three selected countries in my study view decarbonization as a means to more comprehensively reduce energy-based subsidies, maintain foreign revenue generation through the increase in exports, foster interlinkages between different sectors of the economy, such as finance, petrochemicals, technical training, knowledge hubs, industry, and develop a renewable energy and carbon mitigation technology research and development and manufacturing sector.

However, it must be noted that my research only analyzed carbon abatement issues *within* the three selected countries. I did not assess in depth the impact of Saudi Arabia and the UAE, and to a lesser extent Qatar, attempting to increase foreign revenue inflows by exporting their oil demand savings to the international market, thereby increasing global emissions. Additionally, in COP 26, the country delegates decided to focus much more on reducing hydrocarbon consumption (principally oil and coal) rather than just aggregate carbon emissions. As a result, the Gulf countries are working to promote CCS technology as a means to continue to make hydrocarbons an attractive option to meet future global energy demand. Because this process is a recent development during the time of my thesis research, I was not able to analyze the potential permutations of this phenomenon.

Overall, despite the stated intentions of the three selected countries, there are still

[949] There have already been youth climate protests cropping up and spreading across the Gulf region and broader Middle East and North Africa. On December 1, 2012, the Gulf witnessed some of its first youth protests when 800 people marched through Doha demanding immediate climate-change action. However, these movements are proceeding cautiously because in general, and especially in the post-Arab Spring era, regional authorities carefully monitor all public mobilization activities for signs of anti-state agitation. Nasheed Shafi, *Young People Are Leading Climate Activism in the Middle East*, The Cairo Review of Global Affairs (Fall 2021); Najib Saab, *Environmental Awareness in Arab Countries: A Survey* (Feb. 20, 2021); Saltanat Berdikeeva, *Cautious Activism: Arab Youth's Cautious Rise Against Climate Change*, Inside Arabia (August 21, 2019).

institutional obstacles they are managing as their alternative energy investments proceed apace. The lack of indigenous technical know-how is a substantial detriment for the successful implementation of alternative energy projects. While the three selected countries were active participants in the COP 21 negotiations, my analysis found they still attempted to "water down" some language and commitments. However, they did ultimately accede to the treaty and submitted their INDCs (See Tables 7.4-7.10 Appendix).

My research assessed the strength of their NDCs according to the three-part WRI matrix of whether they were ambitious, transparent, and equitable. And I found that, for the most part, they are vague to a certain degree and did not state the planned or implemented carbon reduction and alternative energy deployment strategies. Furthermore, after careful review of these documents, it became apparent that even though the three countries had already announced or implemented their carbon mitigation strategies while at the same time investing significantly in renewable energy production, they did not note these in their NDCs. And while their NDCs do lack a certain comprehensiveness, I found that that should not be taken to mean that they were not implementing policies to reduce hydrocarbon consumption and carbon emissions.

Further announcements were made in 2021 where Saudi Arabia indicated its goal of establishing a national carbon market, and Abu Dhabi initiated a clean energy certificate scheme. The Saudi carbon market project, christened, The Riyadh Voluntary Exchange Platform, would be jointly constructed by the Saudi Arabia sovereign wealth fund, PIF, and the Saudi stock exchange, Tadawul. The primary goal of the market is to help Saudi Arabia achieve its Paris Agreement pledges while also positioning Saudi Arabia as the preeminent carbon market in the Middle East and North Africa to facilitate the trading of carbon offsets and credits produced anywhere in the region.[950]

Abu Dhabi implemented its clean energy certificate program in August 2021 as part of its commitment to drive the energy sector decarbonization strategy where voluntary tradeable financial instruments certify that a specific amount of electricity had been generated from a

[950] Saeed Azhar, *Saudi Arabia to Launch Voluntary Middle East Carbon Trading Platform*, S&P Global Platts (Sept. 3, 2021).

clean energy source (solar or nuclear). Once the clean energy generated electricity is fed into the grid, the certificates can be traded as credits to buttress the ESG goals of companies.[951]

The UAE and Saudi Arabia also announced in 2021, before COP 26, that they intended to set net-zero goals. There were few details granted alongside these announcements; however, my research indicates that it does indicate a profound shift in thinking across the region and that these countries are taking climate change seriously.

Furthermore, in April 2021, Saudi Arabia, Qatar, the U.S., Canada, and Norway-collectively responsible for nearly 40 % of global oil and gas production-formed a "Net Zero Producers Forum" that "will develop pragmatic net-zero emissions strategies." [952] And, while there has been considerable skepticism thus far about how far the members intend to go win curbing GHG emissions, it does seem that they could be poised to reduce substantial amounts of methane emissions through relatively inexpensive methods. The UAE is also taking more of a globally proactive role with the joint establishment of the $1 billion Energy Transition Accelerator Financing Platform with IRENA to fund 1.5 GW of new renewable energy power in developing countries by 2030.

My findings show that by 2024, at the latest, Saudi Arabia and the UAE will likely develop the preliminary sinews of a carbon trading platform to assist in meeting their Paris Agreement pledges. Qatar, for its part, will probably move ahead with a command-and-control structure to reduce its carbon emissions.

10.2 Contributions to Research

The study of carbon abatement mechanisms in the Gulf region makes several significant contributions to the literature, both theoretical and empirical. First, this study illustrates that the steps Gulf governments are taking to reduce carbon emissions can be viewed through the lens of the New Institutional Economics (NIE) theory. This theory emphasizes

---

[951] *Abu Dhabi Launches Clean Energy Certificate Scheme*, World Nuclear News (Sept. 22, 2021).
[952] Joe Lo, *Saudi, U.S. Net-Zero Oil Producer Initiative Meets Skeptical Response*, Climate Home News (April 26, 2021).

that market transactions do not occur in a vacuum and contends that governmental agencies are essential in forming and continuing carbon market operations. The theory assesses the role of transaction costs in creating any institution. These institutions emerge when the benefits they grant are more significant than the transaction costs generated with their creation and continued operation. In addition, NIE extends the focus on economics much beyond neoclassical economics to examine the social norms and legal/regulatory frameworks at the foundation of economic activity.

This study can provide an organizational heuristic to complement the conceptualization of a coherent carbon reduction mechanism, such as carbon trading, and understand how it can be implemented in a hydrocarbon-rich country. Despite their similarities, the study acknowledges that not all Gulf countries are the same, and significant structural differences exist between them. The specific national contexts must first be analyzed and assessed in order to weigh the relative robustness of their institutions. Therefore, this work contributes to a distinctive understanding of the three selected countries' different economic and organizational dynamics.

This thesis demonstrates that while governments may pledge to adhere to specific carbon reductions, having a clearly designed carbon abatement framework is an important signal to determine whether a signed treaty is going to be implemented or not.

With the utilization of CAS, I analyzed the various (and somewhat) competing interests that operate in the three selected countries, such as the national oil companies, the regulatory agencies, and the government. I illustrated how the decisions evolved to combat and manage macroeconomic decarbonization with the interaction between these heterogeneous agents. Initially, each agent would decide what should be done in terms of decarbonization. My research showed how they developed and the "emergence" of the three selected countries' carbon emissions reduction and renewable energy development frameworks. This is applied to the interaction between renewable energy development, international treaties (e.g., the Paris Agreement), and domestic regulations, and the establishment of climate change agencies that created a model in Chapter 9.4-9.6.4 of how these groups relate to each other towards the goal of carbon emissions reductions.

My findings also confirm that the Gulf countries have taken decarbonization seriously and are telegraphing their intent to reduce their carbon emissions. However, as my research has shown, the initial impetus was their vested interest in reducing their total hydrocarbon consumption rather than environmental stewardship.[953] This has been confirmed by the fact that within the three selected countries NDCs there are provisions for reducing their pledged emissions reductions if a negative economic impact were to occur, and as Saudi Arabia and the UAE have announced large increases in their oil production to take place while they simultaneously are engaging in decarbonization.[954] Another contribution to the Gulf carbon literature is a detailed analysis of the Gulf countries' changing participation strategy in international climate negotiations, from one where they questioned the very legitimacy of climate change science and obstructed the progress of the climate forums to one where they are "joining in" the negotiations to become active participants and shape the future contours of global decarbonization.

I have also empirically showed how the three selected Gulf countries are entering a period of far-reaching macroeconomic change. They attempt to reform their national economies while meeting diversification, liberalization, educational investment, and renewable energy development. As a result, the three selected countries, especially Saudi Arabia and the UAE, focus on creating a pathway dependency that is highly beneficial to them, also what Lindberg

[953] This may be witnessed by the fact that even though the Gulf countries have ratified the international climate treaties and made various pledges to reduce their carbon emissions, they still plan to maintain-and even increase-their oil exports to the global market. Aya Batrawy, *Gulf Arab States, Squeezed by Climate Change, Still Tout Oil*, AP News (Oct. 27, 2021); For a detailed analysis of Saudi Arabia's climate and industrialization goals, see, generally, Haider Mahmood, *et al*, "Industrialization, Urbanization and CO2 Emissions in Saudi Arabia: Asymmetry Analysis," *Energy Reports*, Volume 6, 2020, pp. 1553-1560; A. Algarini, "The Relationship Among GDP, Carbon Dioxide Emissions, Energy Consumption, and Energy Production from Oil and Gas in Saudi Arabia. International," *Int. J. Energy Econ. Policy*, 10 (1) (2020), pp. 280-285, Reda Cherif and Fuad Hasanov, *Soaring of Gulf Falcons: Diversification in the GCC Oil Exporters in Seven Propositions*, International Monetary Fund (2014).

[954] Saudi Arabia announced in October 2021, prior to COP26, that its flagship national oil company, Aramco, would substantially increase its oil production capacity from 12 million barrels per day to 13 million barrels per day by 2027. Following that announcement, the UAE declared in December 2021 that it would meanwhile invest a $127 billion capital spending plan for 2022-2026 in its oil and gas sector. It is likely that the impetus behind these oil investment policies is that the hydrocarbon-rich Gulf countries foresee that subsequent multilateral climate negotiations will increasingly target the emission sources, rather than simply aggregate emissions, and would diminish the future value of their oil reserves. Offshore Technology, 'Saudi Aramco Commits to Reach 13 MMbpd Capacity by 2027' (2021); UAE's ADNOC to invest $127 bln in 2022-26 as Oil, Gas Reserves Rise, Reuters (Dec. 1, 2021)

et al. (2018) termed a "low disruption transitions pathway." It is not yet certain whether the three selected countries will succeed without a significant cost to their hydrocarbon industries.

My research challenges the contention that the Gulf countries are currently undertaking decarbonization simply for “greenwashing” or improving their global image; however, that should not be taken to mean that the three selected countries do not recognize a modicum of self-interest in the process. Initially, Saudi Arabia, Qatar, and the UAE decided to participate fully in international climate negotiations in the early 2010s and make incremental commitments. However, since the late 2010s, they are taking a more proactive role as they recognize that climate change can severely impact them and that the global progress towards decarbonization is nearly inevitable. Furthermore, the Gulf countries recognize that there are clear benefits to engage in the decarbonization process, such as domestic hydrocarbon demand reduction which facilitates a gradual subsidy removal and allows them to preserve more natural gas inputs for the downstream natural gas industries and also would allow them to maintain or even increase their hydrocarbon exports.[955] The ability to reduce domestic hydrocarbon demand allows them to recoup the opportunity cost that results from below market price allocation and instead sell the incremental supply on the global market for international prices. This also serves as a method of “rent protection” as the Gulf countries seek to obtain as much hydrocarbon-based export revenue as possible before global oil demand peaks and begins its inexorable decline.[956]

And as my research has illustrated, the three Gulf countries perceive that decarbonization presents, as Sultan Al Jaber, the Emirati Minister of Industry and Advanced Technology, termed it, “a unique opportunity” to capitalize on their financial strengths and develop innovative technology, especially that in new economic sectors such as carbon removal and

[955] The 2050 strategy which plans to produce 44% of power from renewables, 6% from nuclear, 12% from clean coal and the rest from natural gas, while reducing the Emirati power generation carbon footprint by 70%, will lead to $190.6 billion in governmental budget savings. *The UAE Expects that 20% of Power Generation to Come from Clean Energy in Three Years: Official*, S&P Global Platts (May 17, 2021).

[956] For an expansive assessment of how the Gulf countries would see to protect their rent in the age of climate-change mitigation, see, Aisha Al-Sarihi & Michael Mason (2020) Challenges and opportunities for climate policy integration in oil-producing countries: the case of the UAE and Oman, Climate Policy, 20:10, 1226-1241

renewable energy technology.[957]

Moreover, my research showcased the tremendous scope for the three selected Gulf countries to leverage their investments in renewable energy development/export projects and carbon emissions reductions to parlay into a type of "soft power" in its engagement with the broader MENA region and Global South. Qatar and the UAE have already taken steps to do so, with it likely that Saudi Arabia would follow after that.

The conceptual model which was developed in this study can be expanded to better understand the organizational structure in the Gulf and their risk perceptions, in the sense of how Gulf governments may react to global pressure to adopt specific policies which may appear to be inimical to their economic growth and political stability. Future regional carbon and climate change research can utilize this study as a stepping-stone to create a detailed system for assessing the factors that influence how the Gulf governments engage in macroeconomic reform by attempting to link their strategic goals with external obligations.

10.3 Contributions to Policy

This dissertation supports the view that the development of a robust carbon reduction program would be of enormous benefit to the three selected countries as it would support their efforts to diversify their economies, expand their industrial base, reduce their hydrocarbon demand, and allow them to play a role in mitigating global warming that would disproportionately affect their countries. Policymakers in the three selected countries should ensure that they take heed of the design mechanics of the EU ETS and other countries that have established successful carbon abatement programs. This will ensure that they do not repeat the mistakes that could be easily avoided, in short, so that they do not reinvent the wheel.

[957] Stanley Reed, *A Major Persian Gulf Oil Producer Tries to Burnish its Climate Credentials*, New York Times (Oct. 30, 2021).

While the U.S. Acid Rain program and the EU ETS encountered undeniable hurdles upon their implementation, there were many successes. Numerous reports have detailed that the U.S. Acid Rain program has been shown to reduce particulate pollution in American skies. At the same time, the EU ETS has shown that a multi-country carbon trading platform can be implemented and effectively reduce carbon emissions. As with China, Gulf policymakers would learn and collaborate with the U.S. and the EU to develop their carbon abatement frameworks. Additionally, the EU ETS provides a wealth of empirical evidence on what is required to construct a well-designed carbon mitigation framework, such as acquiring quality data and establishing an adequate regulatory regime that could deploy a credible MERV system. By studying the EU ETS, as well as China's foray into carbon mitigation, the Gulf countries would be able to bypass their most glaring deficiencies such as lack of policy coordination, lax enforcement of environmental regulations, incoherent methodologies, and weak/inconsistent data by cooperating with officials from other jurisdictions before creating a carbon abatement system. Learning the best practices can prepare the ground for an effective future carbon abatement scheme.

For the UAE to establish a national carbon market, an initial phase would be essential, as other emirates besides Dubai and Abu Dhabi would need to create GHG inventories, which would take some time. In addition, standardized GHG assessment methodologies would need to be established according to the UNFCCC reporting guidelines on annual inventories. As a result, phase one would require approximately three years. After that, phase two would require an additional three years to implement a national cap and begin the national operation of the market. Phase three would operate for nearly a year to extend the cap to various other industries as they acclimate to the carbon reduction policies. In total, the UAE would require almost seven years from inception to be fully operational.

In Saudi Arabia, the first phase would require the Saudi government to establish basic coordination among the country's myriad environmental and energy agencies. Moreover, the Saudi government would need to improve regulatory compliance in the industrial sector and implement capacity building for regulatory officials. Phase one would require about four years to operate effectively as the pilot schemes in the country's industrial centers begin to be established. Phase two would necessitate the Saudi government to create a national baseline and facilitate mock trading at the national level. Therefore, this phase would require three years to operate successfully. And phase three, which would herald the launch of the national market, would need approximately two to three years as the Saudi regulatory authorities extend the cap to the relevant sectors in the macroeconomy.

In Qatar, the first phase would require the development of a governance framework to regulate and standardize the exchange of information between the various ministries and relevant companies. This phase would also include the collection of GHG emissions data and would be valid for three years. The second phase would determine which companies adhere to the zero flaring policy and use energy-efficient industrial equipment, which would be valid for two years. After that, Qatar's regulatory framework would determine whether greenhouse gas emissions need to be reduced further and what additional regulations the government should promulgate.

With Phase One data in hand, Gulf policymakers could be well placed to initiate a viable Phase Two, potentially transitioning from the voluntary carbon limitations in Phase One to binding commitments on companies. Phase Two would enable a gradual tightening of the annual cap and encourage technological adaptation. When Phase Three is launched, policymakers would set more ambitious targets since the economic and industrial sectors would already understand how the trading platform works and have already invested in carbon mitigation technology. In summary, while the selected Gulf countries have intuitional deficiencies, they are not insurmountable, and if the policymakers desire, they would be able to implement effective national carbon abatement schemes. But it should be reiterated that the complete process would take a little less than a decade for Saudi Arabia and the UAE. At the same time, Qatar could establish a viable command-and-control regulatory structure much more quickly.

Policymakers should ensure that they put in place a robust regulatory framework to monitor and enforce the appropriate rules and technical benchmarks on both a direct and indirect level. There should also develop long-term incentives to encourage and stimulate the relevant companies and organizations to invest in renewable energy and energy-efficient technologies to mitigate carbon emissions. Overall, there would need to be clear political will, alongside the granting of incentives, that telegraphs the governmental aims that must be followed.

Additionally, the policymakers of the three selected countries must make sure that their regulatory agencies are given a clear mandate and sufficient powers to promulgate standards and enforce its rules.

Finally, a comprehensive plan that creates backward and forward linkages across the economy should be developed to create a synergistic dynamic that would provide the impetus for further economic growth.

10.4 Limitations and Suggestions for Future Research

While the three selected countries have begun to liberalize and privatize their economies and become proactive members in multilateral negotiations, they have allowed more information about their respective energy sectors to become open to researchers. However, there are still limitations that confront researchers when assessing their energy sectors and carbon emissions. This dissertation should be taken as an early contribution to – rather than the last word on - the academic research on carbon market development in the Gulf region,

Theoretical Limitations

Some other approaches could have been used in this research. A key question for policymakers is integrating emissions trading with existing environmental laws/regulations and tax structures (subsidies, tax credits, etc.). For example, it would be necessary to consider when an emissions trading framework would work in concert with the present environmental regulatory structure or when it could encounter some perverse outcomes. This point of policy overlap is essential to consider. Many environmental codes are meant to reduce pollution, while tax codes may also incentivize the production or consumption of carbon-intensive fuels. It is vital to analyze the impact that complementary policies would have on the total carbon emissions coverage and the overall operational efficiency of the carbon markets. Complementary approaches can lead to significant reductions in carbon emissions, but could also result in an oversupply of carbon credits, such as the "waterbed" effect, leading to downward pressure on the market for carbon credits.

It isn't easy to be able to predict and analyze the potential interaction between these policy instruments. As a result, it could be beneficial to address this limitation to guide future carbon market designs. And, as a corollary, future research could focus on whether the “Green Paradox” may result from international climate treaties. Therefore, would more stringent future climate accords operate as a type of announced expropriation, leading the Gulf countries to expedite their oil production, thereby increasing global carbon emissions? It already appears that this is going to be the case as at the same time (prior to COP 26), Saudi Arabia announced its net-zero pledge, it also announced that it plans to complete an increase in daily oil production capacity up to 13 million barrels per day, from 12 million, by 2027.[958]

Furthermore, there is also a question of how best the government should utilize any revenue obtained from the carbon market. Additionally, there are reasonably significant limitations on applying Islamic financial and regulatory norms about carbon trading. Thus far, most scholarship on carbon trading is based upon and assumes certain Western-centric models and economic philosophies. It would be of scholarly interest for future research to analyze indigenous modes of financial frameworks in developing carbon trading schemas.

Methodological and Data Limitations

There are still challenges with the usefulness of current primary data, as many Gulf countries do not always accurately report their energy consumption and production. And, very often, there are no statistics at all, especially regarding sectoral demand and domestic energy prices. Comprehensive and accurate nationwide data on energy-related data and forecasts are difficult to obtain in the region. Due to the OPEC quota system and other issues, basic energy data reporting tends to be politicized and not always entirely transparent. However, this is changing as Gulf governments reform the corporate models of their state-owned enterprises to adopt Western best practices. Aramco's public listing and ADNOC's corporate restructuring are prime examples of the aforementioned.

[958] Fareed Rahman, *Saudi Aramco to Boost Capacity to 13 mbpd by 2027*, The National (Oct. 4, 2021)

In accessing and interpreting carbon emissions data, a researcher would encounter obstacles like those discussed above. However, most issues with data collection of carbon emissions relate to the region's relative lack of measurement mechanisms. Nonetheless, as indicated above, this situation is changing, and in the midterm, the Gulf countries will likely allow more scrutiny of their energy sectors and carbon emissions. Another line of research could compare and contrast the climate/sustainability positions of other Gulf countries, such as Bahrain, Oman, and Kuwait (and Iraq), from the three in this study. The limitations of this research were confined mainly to the sectors researched. I focused upon the hydrocarbon (principally natural gas) and power sectors. However, it may be beneficial to expand the research inquiry for other scholars into the role that transportation, building regulations, and smart systems (internet of things, smart grids, etc.) would play in developing carbon abatement frameworks in the region.

Economic, Political, and Institutional Limitations

This thesis did not assess the viability of a regional carbon trading market. This is a possibility that should be explored soon as the Gulf countries move forward with their decarbonization plans. Lastly, as the Covid 19 pandemic swept the world during the last stages of my research, I was unable to fully account for the ramifications that this will have on hydrocarbon demand/production, carbon emissions, geopolitics, and the ability of the three selected countries to meet the targets of their pledges.

There are several interesting issues for further research on this topic. For instance, as the Gulf countries begin in earnest to develop their carbon abatement programs, how would they seek to leverage that into a type of carbon "soft power"? Therefore, the emerging field of carbon diplomacy will have to consider how the Gulf countries would leverage their enormous sovereign wealth funds to influence the development of carbon abatement programs in other countries. Additionally, as the Gulf countries are attempting to become hubs of innovation and manufacture of renewable energy technologies, a further field of study could review the feasibility of renewable energy technology exports to the global market. An assessment of whether the emergent “net-zero" cities, such as Neom and Masdar, would lead to increased indigenous skillset and technical skill training dispersion within the region would be beneficial for future scholarship on this topic.

In addition, scholars should consider whether the GCC could play a leading role in establishing a regional carbon trading platform. And, if this is the case, researchers should assess whether interlocking the carbon markets of the Gulf countries would result in a GCC that more resembles the EU, as the EU initially began as an economic framework to merge the coal and steel sectors in France and Germany. A regional carbon market could play a similar role. Future research should divine whether there would need to be further economic integration that would supplement an interconnected Gulf carbon market or the obverse?

As a result, the role of potential pollical integration would need to be assessed and its potential impact on developing a regional carbon market. The GCC was founded with the express purpose to promote cultural, economic, and political coordination, perhaps leading to comprehensive integration at a later date. As the region has periodic flareups of political disputes, analyzing whether these conflicts could impact the ultimate development of a regional carbon market would need to be studied as well.

It would also be fruitful for future researchers to investigate whether Gulf decarbonization strategies would induce other countries to reduce their hydrocarbon production- not just domestic demand- as a matter of policy. Moreover, regional decarbonization among the Gulf populations is viewed strictly as a top-down, somewhat staid affair, mostly limited to government officials. The future could witness more of a broad-based push for environmental regulation from the populace as extreme climatic events (temperature and sea-level rise) occur more regularly, as we see in Europe and North America (pension funds and student/shareholder activism. And, what potential impact would that have, in terms of the speed and scope, on future decarbonization policies in the region?

And, lastly, as global inflation has increased significantly in the early 2020s, how would the Gulf countries manage the impact this would have on their economies, as it relates to their close relationship with the dollar, their hydrocarbon export policies and the efficacy of their natural gas and power pricing tariff reconfiguration geared to reducing domestic demand?

The challenges confronting research on Gulf decarbonization plans are unlikely to be as great in the future as these countries continue to modernize and become more institutionally and administratively similar to developed countries. And, as efforts to reduce carbon emissions continue on a global scale, future research should address the critical question of how the energy-rich Gulf states can implement their ambitious goals to become developed countries with sustainability at their core.

Bibliography

A Sustainable Dubai. (2016) Dubai Municipality Report 2016

Abdul Majid, A.B., Hansen, J.E., Al-Dahlan, M.N., Malik, A.R., Alharbi, M.M., Al-Suwaigh, M.K., Atwi, M.A., Shammari, N.S., Alkhaldi, M.H., Abel, J.T. and Alsalman, M.A. (2017) March. Seawater based fracturing fluid: A game changer in hydraulic fracturing applications in Saudi Arabia. In *SPE Middle East Oil & Gas Show and Conference*. OnePetro.

Abdullah, Al. and AlMubarak, I. (2019) 'Growing energy demand in the GCC countries', *Arab Journal of Basic and Applied Sciences,* 26(1), pp. 488-496.

Abdullah, Al. and Rahman, A. (2017). 'Rainfall in Qatar: Is it changing?.' *Natural Hazards*, 85(1), pp. 453-470.

Abi-Aad, N. (1998). '*Natural Gas Reserves, Development and Production in Qatar*', Oil, Gas and Petrochemicals in Qatar.

Abnett, K. (2020). 'EU Climate Plan Could See Bloc's Carbon Price Double This Decade', *Reuters*.

Aboueldahab, N. (2021) 'Social Protection, Not Just Legal Protection: Migrant Workers in the Gulf,' *Brookings Institution*

Abu Dhabi National Oil Company. (no date). '*Fugitive Emissions Monitoring at Upper Zakum Field*', website. Available at https://www.protenders.com/companies/abu-dhabi-national-oil-company/projects/fugitive-emission-monitoring- at-upper-zakum-field

Abu Dhabi Technical Report – Greenhouse Gas Emissions. *Abu Dhabi Quality and Conformity Council. June, 2015*. https://www.qcc.gov.ae/-/media/Project/QCC/QCC/Documents/Quality-Infrastructure-Documents/Abu-Dhabi-Specification/Abu-Dhabi-Technical-Repor/ADTR-3---Greenhouse-Gas-Emissions-Factors.pdf

Adal, M. (2020). 'Energy Markets Underestimate Middle East Supply Vulnerability', *Atlantic Council*, https://www.atlanticcouncil.org/blogs/new-atlanticist/energy-markets-underestimate-middle-east-supply-vulnerability/

Adnoc Intends to Go Ahead with Al Hosn Sour Gas Expansion. (2016) *Adnoc*, https://www.adnoc.ae/en/news-and-media/press-releases/2016/adnoc-intends-to-go-ahead-with-al-hosn-sour-gas-expansion

Agou, Gomez *et al*., (2016) 'Financing Fiscal Deficits in Selected MENAP and CCA Oil Exporters' *International Monetary Fund*.

Agreement on Subsidies and Countervailing Measures. *World Trade Organization Website*. http://www.wto.org/english/docs_e/legal_e/24-scm.pdf

Ahmed, A., Hakami, A., Leyva, I. and Kurison, C. (2017). Saudi Arabia's Unconventional Program in the Jafurah Basin: Transforming an Idea to Reality With the Jurassic Tuwaiq Mountain Formation', In *22nd World Petroleum Congress*. World Petroleum Congress.

Al Hashemi, H. *et al*, (2012). 'Abu Dhabi-UAE Petrochemical Cluster', *Harvard Kennedy School*

Al-Amir, J. and Abu-Hijleh, B. (2013). 'Strategies and policies from promoting the use of renewable energy resource in the UAE', *Renewable and Sustainable Energy Reviews*, *26*, pp.660-667.

Al-Asmakh., Abdulla, M. and AL-Awainati, N.A. (2018) 'Counting the Carbon: Assessing Qatar> s Carbon Dioxide Emissions', In *Qatar Foundation Annual Research Conference Proceedings,* 2018(1), p. EEPP592. Hamad bin Khalifa University Press (HBKU Press).

Alex, P. (2015). 'Arabia Submits Climate Pledge to UN Deal', *The Guardian*, https://www.theguardian.com/environment/2015/nov/10/saudi-arabia-submits-climate-pledge-to-un-deal

Alex, P. (2015). 'Brazil Minister Calls Out Emerging Economies Over Weak Climate Pledges', *Climate Home News*, https://www.climatechangenews.com/2015/10/28/brazil-minister-calls-out-emerging-economies-over-weak-climate-pledges/

Alex, P. (2015). 'Saudi Arabia Submits Climate Pledge to UN Deal', *The Guardian*.

Alexis, W. and Thomson, A. (2013). '*A Guide for Environmental Regulation in Dubai and the Wider UAE*', Clyde and Company, LLP.

Al-Falih, K. (2011) 'Asia Business Council', *Asia Business Council*. Accessed March 3, 2020. http://www.asiabusinesscouncil.org/docs/Al-FalihDCMay2011.pdf

Al-Garni, H.Z., et al, (2021) "Design and economic assessment of alternative renewable energy systems using capital cost projections: A case study for Saudi Arabia," *Sustainable Energy Technologies and Assessments*, Volume 48

Alharbi, B.H., Pasha, M.J. and Tapper, N. (2014). 'Assessment of ambient air quality in Riyadh City, Saudi Arabia'. *Current World Environment*, *9*(2), p.227.

Al-Hilal, H. (2014). 'Saudi Aramco Leak Detection and Repair Program, Environmental Protection Department', *Saudi Aramco (undated); Saudi Arabia-Oil and Gas's Activities on Methane Mitigation (undated).* Available at https://www.globalmethane.org/documents/Saudi-Arabia-Methane-Initiative-Oil-Gas-2014.pdf

Alliance of Small Island States (AOSIS) Declaration on Climate Change 2009. *United Nations website*. Accessed on December 2, 2017. https://sustainabledevelopment.un.org/content/documents/1566AOSISSummitDeclarationSept21FINAL.pdf

Almarri, A.N. (2016). 'November. Climate change in Qatar',. In *Qatar University Life Science Symposium 2016: Biodiversity, Sustainability and Climate Change, with Perspectives from Qatar,* 2016(4), p. 4, Hamad bin Khalifa University Press (HBKU Press).

Alnaser, W.E. and Alnaser, N.W. (2020). 'The impact of the rise of using solar energy in GCC countries', In *Renewable energy and sustainable buildings* (pp. 167-183). Springer, Cham.

Al-Saleh, Y.M. (2011). 'An Empirical Insight into the Functionality of Emerging Sustainable Innovation Systems: The Case of Renewable Energy in Oil-Rich Saudi

Arabia', *International Journal of Transitions and Innovation Systems,* 1(3).

Al-Sarihi, A. and Mason M. (2020) 'Challenges and opportunities for climate policy integration in oil-producing countries: the case of the UAE and Oman', *Climate Policy*, 20:10, 1226-1241

Alsiary, W. (2015). '*A critical investigation into the barriers and opportunities for environmental management systems 'EMSs' implementation for the delivery of environmental benefits to the Industrial City in Jeddah, KSA'* (Doctoral dissertation, University of East Anglia).

Al-Soliman, T.M. (1993). 'Environmental Impacts and the Need for a National Environmental Policy in Saudi Arabia', *Journal of Architectural and Planning Research*, 10(3): 219–41. http://www.jstor.org/stable/43028748.

Amott, N. and Mogose S. (2016). 'Examples Illustrate Sour-Gas Processing Megaproject Metrics', *Oil and Gas Journal*.

Anchondo, C. (2022). 'CCS 'Red Flag?' World's Sole Coal Project Hits Snag', *Energy Wire*.

Andrew, T. and Lester, C. (2009). '*Dubai's legal system. Creating a legal and regulatory framework for a modern society'*. Motive Publishing.

Ansari, D. and Holz, F. (2020). 'Between stranded assets and green transformation: Fossil-fuel-producing developing countries towards 2055', *World Development*, *130*, p.104947.

Anthony, M. (2016). 'ADNOC Weighs Ambitious Downstream Expansion', *The National*.

Anthony, M. (2017). 'Gas Supplies Keep Flowing as Qatar Diplomatic Spat Flares', *The National*.

Anwar, A. (2018). 'UAE Mulls Cancelling Energy Subsidies' *Gulf News*.

Anwer, M. and Matar, W. (2017). 'Reforming Industrial Fuel and Residential Electricity Prices in Saudi Arabia', *Kapsarc*.

Aramco Completes its Acquisition of a 70% Stake in Sabic. (2020) *Saudi Aramco Website*, https://www.aramco.com/en/news-media/news/2020/saudi-aramco-completes-acquisition-of-70-percent-stake-in-sabic

Aramco Lets Contract for Wasit Gas Plant. (2018) *Oil and Gas Journal*. https://www.ogj.com/refining-processing/gas-processing/new-plants/article/17297297/aramco-lets-contract-for-wasit-gas-plant

Arouri, M.E.H., Youssef, A.B., M'henni, H. and Rault, C. (2012). 'Energy consumption, economic growth and CO2 emissions in Middle East and North African countries', *Energy Policy*, *45*, pp.342-349.

Arrow, K. (No date). 'The Organization of Economic Activity: Issues Pertinent to the Choice of Market Versus Nonmarket Allocation', In *The Analysis and Evaluation of Public Expenditures: the PBB System*, Joint Economic Committee Compendium, 91st Congress, 1st Section, Vol. 1. Government Printing Office: Washington, D.C.

Atlee, T. and Mercer, K. (1996). '*The First Little Book on Co-Intelligence,* The Co-Intelligence Institute.

Avena, J. (2014). 'Qatar: From Strategy to Implementation', *Oil and Gas Financial Journal*.

Ayswarya, M. (2016). '*Qatar and the Climate Debate*', Orxy Publishing, https://earthjournalism.net/stories/qatar-and-the-climate-debate.

Azhar, S. (2021). 'Saudi Arabia to Launch Voluntary Middle East Carbon Trading Platform', *S&P Global Platts*.

Babiker, M. et al., (1999). '*The Kyoto Protocol and Developing Countries, MIT Joint Program on the Science and Policy of Global Change*', Report No. 56

Badi, A.A. and AlMubarak, I (2019). 'Energy Demand in the GCC Countries', *Arab Journal of Basic and Applied Sciences*, 26,(1).

Baldwin, R. *et al*, (2011). '*Understanding Regulation: Theory, Strategy and Practice*. 2nd ed. Oxford University Press.

Bali Action Plan, https://www.env.go.jp/earth/ondanka/10year/cp_bali_action_plan.pdf

Barkindo, M. (2006). 'The Clean Development Mechanism: Is it Meeting Expectations?', *OPEC*.

Barnett, A. *et al*, (2013). 'Regulation, Trust, and Cronyism in Middle Eastern Societies: The Simple Economics of "Wasta', *The Journal of Socio-Economics*, 44: pp. 41-46

Barnett, J. and Dessai, S. (2002). 'Articles 4.8 and 4.9 of the UNFCCC: adverse effects and the impacts of response measures', *Climate Policy*, *2*(2-3), pp.231-239.

Barnett, J. (2008). 'The worst of friends: OPEC and G-77 in the climate regime', *Global Environmental Politics*, *8*(4), pp.1-8.

Barnett, J., Dessai, S. and Webber, M. (2004). 'Will OPEC lose from the Kyoto Protocol?', *Energy Policy*, *32*(18), pp.2077-2088.

Batrawy, A. (2021). 'Gulf Arab States, Squeezed by Climate Change, Still Tout Oil, *AP News*.

Baumol, W.J. (1972). 'On taxation and the control of externalities', *The American Economic Review*, *62*(3), pp.307-322.

Belbagi, Z. (no date). '*Renegotiating the Social Contract in the GCC: Lessons from the Rousseau Playbook*', The Oxford Gulf and Arabian Studies Forum, p.4.

Bennett, L. (2010). 'Are Tradable Carbon Emissions Credits Investments? Characterization and Ramifications Under International Investment Law', *New York University Law Review, 85*, 1581–1617.

Benton, A., Healy, K., Jiang, Z., LeClere, D., McLaughlin, L., Roberts, J. and Steadman, M. (2014) 'Water use in the Eagle Ford Shale: an economic and policy analysis of water supply and demand'.

Berdikeeva, S. (2019). 'Cautious Activism: Arab Youth's Cautious Rise Against Climate Change'*, Inside Arabia*.

Berger, M.T. and Weber, H. (ed). (2014). '*Rethinking the Third World: International Development and World Politics',* Palgrave Macmillan.

Bergeson, L.L., Antolini, D. and Hester, T. (2007). '*Creative common law strategies for protecting the environment*', Environmental Law Institute.

Berkeley Global Science Institute, https://globalscience.berkeley.edu/centers/KFUPM-SA

Beyerlin, U. (no date). *'Different Types of Norms in International Environmental Law Policies, Principles and Rules',* The Oxford Handbook of International Environmental Law.

Black, R. (2009). 'Climate E-Mail Hack 'Will Impact on Copenhagen Summit', *BBC News*.

Black, R. (2010). 'Copenhagen Climate Deal "Satisfies" Saudi Arabia', *BBC.*

Böcher, M. (2012). 'A theoretical framework for explaining the choice of instruments in environmental policy', *Forest Policy and Economics*, *16*, pp.14-22.

Boersma, T. and Griffiths, S. (2016). 'Reforming Energy Subsidies-Initial Lessons from the United Arab Emirates', *The Brookings Institution,*

Boersma, T. and Griffiths, S. (2017). '*Reforming Electricity, Water and Fuel Subsidies in the United Arab Emirates*', The Oxford Energy Forum Issue 108.

Bohra, M. and Shah, N. (2019). 'Optimizing Qatar's Energy System for a Post-Carbon Future', *Energy Transition*

Bolinger, M., Seel, J., Robson, D. (2019) 'Utility-Scale Solar: Empirical Trends in Project Technology, Cost, Performance, and PPA Pricing in the United States.'

Borger, J. (2017). 'Trump Will Drop Climate Change from National Security Strategy', *The Guardian*.

Bousso, R. (2018). 'Big Oil Pledges to Slash Potent Greenhouse Gas Emission', *Reuters*.

Bowen, A. and Hepburn, C. (2014). 'Green Growth: An Assessment', *Oxford Review of Economic Policy*, 30(3), pp. 407–422.

BP Statistical Review of World Energy (2020)

BP Statistical Review of World Energy (2021).

Bradshaw, M. (2010). 'Global Energy Dilemmas: A Geographical Perspective', *The Geographical Journal* 176(4): 275–290.

Brian, W. *et al.*, (2020). 'New Decade, New OPEC Oil Curbs. Same Mixed Results', *Bloomberg*.

Bridge, G. (2011). 'Resource Geographies I: Carbon Economies Old and New', *Progress in Human Geography* 35, 820–834.

Bridge, G. *et al*, (2013). 'Geographies of Energy Transition: Space, Place and the Low-Carbon Economy', *Energy Policy,* 53: 333

Brimblecombe, P. (1976). 'Attitudes and Responses Towards Air Pollution in Medieval England', *Journal of the Air Pollution Control Association*, 26:10, pp. 941-945,

Brockway, P.E., (2019) *et al*, "Estimation of global final-stage energy-return-on-investment for fossil fuels with comparison to renewable energy sources," *Nat Energy*,;4(7):612-621

Broder, J. (2011). 'Climate Talks in Durban Yield Limited Agreement, *New York Times*.

Brown, L.M. et al, (2012). 'The EU Emissions Trading System: Results and Lessons Learned', *Environmental Defense Fund*, p. 12.

Brown, N. (1997). 'Sharia and State in the Modern Muslim Middle East', *International Journal of Middle East Studies,* 29(3): 359-76.

Burgengruen, V. (2022) 'How the Anti-Vax Movement is Taking Over the Right', *Time*

Butzengeiger, S. and Michaelowa, A. (2004). 'Greenhouse gas emissions trading in the European Union—Background and implementation of a "new" climate policy instrument', *Intereconomics*, *39*(3), pp.116-118.

Cafiero, G. (2016) 'Qatar cuts spending to cope with low oil prices', *Middle East Institute*.

CAG, Dubai Carbon Centre Sign Deal for UAE Carbon Market. (2013) *Emirates 24/7*.

Carbon Ambassadors Program, http://dcce.ae/wp-content/uploads/2015/04/CAP.pdf

Carbon Credits Drive Green Funding in Dubai. (2017) *Emirates 24/7*.

Carbon Credits for Dubai Landfill Earn Money from Norway. (2016) *Gulf News*. https://gulfnews.com/uae/environment/carbon-credits-for-dubai-landfill-earn-money-from-norway-1.1948514

Carbon Market Watch. (2017). '*Pricing Carbon to Achieve the Paris Goals*.'

Carbon Markets Express website, https://www.carbon-markets.go.jp/eng/

Carlo, A. and Ferrara, M. eds.(2014) *The Economic and Political Aftermath of the Arab Spring: Perspectives from Middle East and North African Countries*. Edward Elgar Publishing.

Carr, M. (2018). 'China's Carbon Emissions May Have Peaked', *Bloomberg*.

Carson, R. (1962). '*Silent Spring*', Houghton Mifflin Company.

Catherine, C. and Frantz, D. (2018) 'The Long Shadow of AQ Khan', *Foreign Affairs*.

Catherine, M. (2016). 'Transparency: the backbone of the Paris Agreement', *Yale Center for Environmental Law and Policy*. *Retrieved from http://www.envirocenter.yale.edu*.

Chandran, S. (2017). 'Qatar to Host a Carbon-Neutral WC in 2022', *Qatar Tribune*.

Charlez, P. (2016). Geopolitics of Unconventional Gas Resources Outside America', *Society of Petroleum Engineers,* Available at https://www.onepetro.org/conference-paper/SPE-181405-MS

Chiesa, M. *et al*, (2021) 'What is Going On with Middle Eastern Solar Prices, and What Does it Mean for the Rest of Us?', *Progress in Photovoltaics*, Vol. 29, Issue 6 (June 2021) pp.638-648

Chemical Outlook by Region. (2016). *Chemical and Engineering News*, 94(2) pp. 9-15

Chevron to Establish Sustainable Energy Efficiency Center in Qatar. *Chevron Website*, https://www.chevron.com/stories/chevronto-establish-sustainable-energy-efficiency-centerin-qatar

China ETS in Force. (2018) *International Carbon Action Partnership*.

China to Introduce Environmental Tax for Enhanced Pollution Control. (2016) *Xinhua*.

China's Plan to Launch the World's Largest Carbon Trading Scheme By 2025. (2020).

Reuters.

China's Industrial Clusters. (2012) *China Briefing*.

Chrystal, J. (1995). *'Oil and Politics in the Gulf: Rulers and Merchants in Kuwait and Qatar',* Cambridge University Press, p.158

Clara, S.D. and Mayr, K. (2018). 'The EU ETS Phase IV Reform: Implications for System Functioning and for Carbon Price Signal', *The Oxford Institute for Energy Studies,* p. 3.

Clark, G. *et al*, (2006). 'Geographically Dispersed Ownership and Inter-Market Stock Price Arbitrage: Ahold's Crisis of Corporate Governance and its Implications for Global Standards', *Journal of Economic Geography*, 6: 303-322.

Clark, P. (2015). 'Kingdom Built on Oil Foresees Fossil Fuel Phase-Out This Century', *Financial Times*.

Clark, P. (2016). Saudi Arabia Will Stick to Paris Accord Climate Change Pledges', *Financial Times*.

Clifford, K. (2018). 'Halliburton and Saudi Aramco Reach Deal to Increase Gas Output', *New York Times*.

Climate Action Tracker (2016). https://www.climate-transparency.org/wp-content/uploads/2016/09/Saudi-Arabia_Country- Profile.pdf

Climate Action Tracker, UAE. http://climateactiontracker.org/countries/uae.html

Coase R. (1960). 'The Problem of Social Cost', *Journal of Law and Economics*, The University of Chicago Press.

Coase, R.H. (1984). 'The New Institutional Economics', J. *Inst.Theor. Econ.* 140 (1), 229 – 231

Commitments to Netzero Double in Less than a Year. (2020) *UN Climate Press Release*.

Countries In and Around the Middle East are Adding Coal-Fired Power Plants. (2018) *U.S. Energy Information Administration*.

Craig, W. (2015). 'The Good, the Bad, the Bewildering: 10 Countries' Climate Pledges', *National Geographic*.

Cramton, P. and Kerr, S. (2005). 'Tradeable Carbon Permit Auctions: How and Why to Auction Not Grandfather', *Energy Policy* 30, pp. 333-345

Crooks, Ed, (2012). 'US Shale Gas Sparks a Chemical Revolution', *Financial Times*.

Crystal, J. (1990). '*Oil and Politics in the Gulf: Rulers and Merchants in Kuwait and Qatar',* Cambridge: Cambridge University Press.

Daisuke, S., Matsuo, G., Khatib, S.E. and Nakayama, M. (2016). 'The Effect of Implementing a Feed-in Tariff in Abu Dhabi UAE', *Applied Economics and Finance,* 4(2), 38-43.

Damian, C. (2013) 'EU Carbon Price Crashes to Record Low', *The Guardian*.

Daniel, B. et al. (ed), (2008). *The Oxford Handbook of International Environmental Law*.

Dargin, J. (2008). 'The Dolphin Project: The Development of a Gulf Gas Initiative', *Oxford Institute for Energy Studies*.

Dargin, J. (2009). 'A Model in Preparation for a 'Post-Oil' World', *The National*.

Dargin, J. (2011). '*The Gulf Natural Gas Dual Pricing Regime: WTO Rules and Economic Growth in the Gulf Cooperation Council',* Nova Science Publishers, Inc.

Dargin, J. (2011). 'The UAE Gas Sector: Challenges and Solutions for the 21st Century" in (ed) Bassem Fattouh and Jonathan Stern, *Natural Gas Markets in the Middle East and North Africa*, OIES Press.

Dargin, J. (2012), *'Desert Dreams: The Quest for Arab Integration from the Arab Revolt to the Gulf Cooperation Council,'* Republic of Letters.

Dargin, J. (2012). 'Energy as the Driver for Gulf Integration: The Gulf Power Grid', *Middle East Economic Survey,* Energy Trading, Gulf Cooperation Council Interconnection Authority. Available at http://www.gccia.com.sa/p/energy_trading/79

Darwish, M. and Mohtar, R. (2013). 'Prime energy challenges for operating power plants in the GCC', *Energy and Power Engineering*, *5*(01), p.109.

Das, A.B. (2014). 'A Guide to Solar Power Generation in the United Arab Emirates', *Middle East Solar Industry Association MESIA: Dubai, UAE*.

Davide, M. and Vesco, P. (2016) 'Assessing the INDCs: a comparison of different approaches', *Climate Observer*.

Davidson, C. (2012). '*After the Sheikhs: The Coming Collapse of the Gulf Monarchies',* London: Hurst.

Davidson, C. M. (2005). '*The United Arab Emirates: a study in survival',* Lynne Rienner.

Davis, S.J. and Caldeira, K. (2010). 'Consumption-based accounting of CO2 emissions', *Proceedings of the national academy of sciences*, *107*(12), pp.5687-5692.

De Clercq, G. (2019). 'Exclusive: Qatar Asks IAEA to Intervene Over 'Threat' Posed by UAE Nuclear Plant', *Reuters*.

Decision Making Frameworks: Working Group III. *Intergovernmental Panel on Climate Change Website*. http://www.ipcc.ch/ipccreports/tar/wg3/index.php?idp=445

Deena, K. (2020). 'Sharjah Reveals First New Onshore Natural Gas Discovery in Three Decades', *The National*.

Demirbas, A., Ayman, A., Hashem, and Bakhsh, A.A. (2017) 'The cost analysis of electric power generation in Saudi Arabia, Energy Sources', *Part B: Economics, Planning, and Policy*, 12:6, 591-596

Demirbas, A., Hashem, A.A. and Bakhsh, A.A. (2017). 'The cost analysis of electric power generation in Saudi Arabia', *Energy Sources, Part B: Economics, Planning, and Policy*, *12*(6), pp.591-596.

Deng, Z. *et al*,(2018). 'Effectiveness of pilot carbon emissions trading systems in China', *Climate Policy*, 18(8), pp. 992-1011

Dennis, B. (2017). 'As Syria Embraces Paris Climate Deal, It's the United States Against the World', *Washington Post*, https://www.washingtonpost.com/news/energy-environment/wp/2017/11/07/as-syria-embraces-paris-climate-deal-its-the-united-states-against-the-world/

Depledge, J. (2008). 'Striving for No: Saudi Arabia in the Climate Change Regime', *Global Environmental Politics,* 8(4): 9-35

Dessai, S. (2001). 'The Climate Regime from The Hague to Marrakech: Saving or Sinking the Kyoto Protocol? *Tyndall Centre Working Paper No. 12*. The University of East Anglia, Norwich, pp. 231-239

Dessai, S. (2004). 'An Analysis of the Role of OPEC as a G77 Member at the UNFCCC', *World Wildlife Fund.*

Developing Countries are Responsible for 63 Percent of Current Carbon Emissions. (2015) *Center for Global Development*. https://www.cgdev.org/media/developing-countries-are-responsible-63-percent- current-carbon-emissions

Devlin, J. (2010). 'Challenges of Economic Development in the Middle East and North Africa Region', *World Scientific,* pp. 3-10.

DEWA and Dubai Carbon Win Carbon Credits for Renewable Energy Production. (2015) *Zawya.*

DEWA Announces Selected Bidder for 800 MW Third Phase of the Mohammed bin Rashid Al Maktoum Solar Park. (2016) *Dubai Electricity and Water Authority*

DEWA Receives World's Lowest Bid of 1.69 per kW/h for 900MW 5th Phase of MBR Solar Park. (2019) *Emirates News Agency*.

Diab, T. (2017). 'Dubai: Pioneering a Sustainable Energy Model for Sustainable Development and Security of Supply', *Cornerstone*, 4(4).

Diarmaid, W. (2017). 'Dubai Carbon Links Up with Innogy on Crowdfunded Blockchain Energy Initiative', *Power Engineering International.*

DiPaola, A. (2015). 'Saudi Arabia Delays $109 Billion Solar Program Eight Years', *Bloomberg*.

DiPaola, A. (2017). 'Saudi Arabia Gets Cheapest Bids on Solar Power in Auction', *Bloomberg*.

Dixon, T., Leamon, G., Zakkour, P. and Warren, L. (2013). 'CCS Projects as Kyoto Protocol

CDM Activities', *Energy Procedia*, 37(2013), Pages 7596-7604,

Doha Amendment to the Kyoto Protocol, available at http://unfccc.int/files/kyoto_protocol/application/pdf/kp_doha_amendment_english.pdf

Doug, K. (2009). *'Measuring Energy Subsidies using the Price-Gap approach: what does it leave out?'*, IISD Trade, Investment and Climate Change Series .

Druzin, B. (2016) 'A Plan to strengthen the Paris Agreement', *Fordham Law Review*.

Dubai Carbon Centre of Excellence website, http://dcce.ae/

Dubai Gets Certified by C40 Cities Climate Leadership Group in Reducing Climate Change. (2017) *Dubai Electricity and Water Authority*.

Dubai to Double Energy Efficiency by 2030. (2016) *Khaleej Times*.

Dubai's Energy Demand Climbs 9.8% as Renewables Gain Bigger Share, S&P Global Platts (Jan. 24, 2022).

Dubai's Carbon Abatement Strategy, Supreme Council of Energy (no date). http://dcce.ae/wp- content/uploads/2015/08/Dubais-Carbon-Abatement-Strategy.pdf

Dudek, D.J. and Wiener, J.B. (1996). '*Joint Implementation and Transaction Costs Under the Climate Change Convention*', Restricted Discussion Document ENV/EPOC/GEEI (96)1, Paris: OECD.

Dunkley, C. (2019). 'Saudi Gas Drive Goes Unconventional', *Petroleum Economist*.

Durban: Towards Full Implementation of the UN Climate Change Convention. *United Nations Framework Convention on Climate Change,* https://unfccc.int/.

Early, B.R. (2009). *'Export Control Development in the United Arab Emirates: From Commitments to Compliance',* Belfer Center for Science and International Affairs at the Harvard Kennedy School, http://belfercenter.ksg.harvard.edu.

Eaton, C. (2018). 'Saudi Aramco Touts Carbon Capture as Policymakers Push Investments', *Houston Chronicle*.

Economic Diversification Initiative: Decision 24/CP.18 http://www.ciesin.columbia.edu/repository/entri/docs/cop/FCCC_COP18_dec24.pdf

Economic Diversification Initiative: Decision 24/CP.18 Available at http://www.ciesin.columbia.edu/repository/entri/docs/cop/FCCC_COP18_dec24.pdf

El Katiri, L. (2012). 'The GCC and the Nuclear Question', *Oxford Energy Comment*.

Ellerman, A. D. and Paul L.J. (2008). '*The European Union's emissions trading system in perspective*', Arlington, VA: Pew Center on Global Climate Change.

Ellerman, D. (2007). 'Review of Pilot Phase of European Union Emissions Trading Scheme Finds it to be Successful', *Oxford University Press*, https://www.eurekalert.org/pub_releases/2007-05/oup-rop052407.php.

El-Malakh, R. (1979). '*Qatar: Development of an Oil Economy',* Taylor & Francis, pp.59–65.

Emiliano, B. (2018). 'Dubai: Tariff for Large-Scale PV Hits New Low at $0.024/kWh', *PV Magazine*.

Emissions Trading: European Commission and China Hold First Policy Dialogue. (2018) *Climate Action*.

Energy and Environment in Saudi Arabia: Concerns & Opportunities. p. 14

Energy Price Reform in the GCC: Long Road Ahead. (2016) *APICORP Energy Research*, 1(4).

Energy Price Reform in the GCC: Long Road Ahead. (2016). *APICORP Energy Research*, 1(4). p.2.

Energy Pricing Reforms in the Gulf: A Trend but Not (Yet) a Norm. (2018) *Global Subsidies Initiative*.

Enhancing NDCs: A Guide to Strengthening National Climate Plans by 2020', (2019). World Resources Institute.

Environmental Authorities in UAE, Beeatna. Available at https://beeatna.ae/en/environmental-authorities-in-uae

Environmental Law and Practice in the United Arab Emirates: Overview. (2017) *Environmental Global Guide 2017-2018*. https://www.stalawfirm.com/en/blogs/view/environmental-global-guide-2017-2018.html

Environmental Protection Agency. (2018). '*ExxonMobil Shute Creek Treating Facility Subpart RR Monitoring, Reporting and Verification Plan',* Available at https://www.epa.gov/sites/default/files/2018-06/documents/shutecreekmrvplan.pdf

Ernst and Young. (No Date). 'How Do Companies Do Business in a Carbon-Constrained World'.

EWEC, Abu Dhabi Power Corporation Announces Lowest Tariff for Solar Power in the World (2020). *Emirates Water & Electricity Co.*

Eyre, N. *et al*, (2010). 'The Way We Live From Now On: Lifestyle and Energy Consumption', Eds. Jim Skea, Paul Ekins, Mark Winskel, *Energy 2050: The Transition to a Secure Low Carbon Energy System for the UK,* London: Earthscan.

Faraj, O. et al, (2013). 'First Shale Gas Experience in Saudi Arabia: Lessons Learned', *Journal of Engineering Research Year* 1(2), pp.29-42.

Fareed, R. (2015). 'UAE Aims to Increase Contribution of Non-Oil GDP to 80 Percent', *Gulf News*.

Fareed, R. (2016). 'Production at Abu-Dhabi Shah Field to be Ramped Up', *Gulf News*. https://gulfnews.com/business/energy/production-at-abu-dhabis-shah-gasfield-to-be-ramped-up-1.1700283

Farrell, J. (2018). 'Carbon Capture', *Journal of Science, Policy and Governance*, 12(1).

Fattouh, B. and Shabaneh, R. (2019). 'The Future of Gas in Saudi Arabia's Transition', In (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change,* OIES.

Fattouh, B. and Shabaneh, R. (2019). 'The Future of Gas in Saudi Arabia's Transition', In (ed) Jonathan Stern, *The Future of Gas in the Gulf: Continuity and Change,* OIES.

Fawkes, S. Marzio, G, Nicholas, H., Moncef, K., Alessandro L. and Padu, P. (2017). '*Growth Through Diversification and Energy Efficiency: Energy Productivity in Saudi Arabia',* No. ks-2017--dp024.

Feygin, M. and Satkin, R. (2004). 'The oil reserves-to-production ratio and its proper interpretation', *Natural Resources Research*, *13*(1), pp.57-60.

Finizio, S. *et al, (2020)*. 'Trends in LNG Supply Contracts and Pricing and Pricing Disputes in the Asia Pacific Region', *Oil, Gas and Law Energy Intelligence*, 8(3).

Florian, N. (2012). 'Petrochemical expansion to fuel 'quality jobs' for the UAE', *The National*.

Fourcade, M. (2009). '*Economists and Societies: Discipline and Profession in the United States, Britain, and France, 1890s to 1990s',* Princeton: Princeton University Press.

Foxman, S. (2021). 'Qatar Criticizes Nations for Making Vague Net-Zero Pledges', *Bloomberg*.

Francis, I. (2015). 'Laudato Si'of the Holy Father Francis on care for our common home [Encyclical letter]', *Retrieved from The Holy See website: http://w2. vatican. va/content/francesco/en/encyclicals/documents/papafrancesco_20150524_en ciclica-laudato-si. html* (2015).

Frazin, R. (2021). 'US, UAE Say They'll Invest in Middle East Decarbonization'.

Freidman, L. (2012). 'Qatar and Some Other Persian Gulf Nations Begin to Walk Their Climate Talk', *E&E News*

Friedman, L. (2010). 'Leaked Cables Show U.S. Pressured Saudis to Accept Copenhagen Accord', *New York Times*.

Friedman, L. (2012). 'Qatar Pressured to Cut Emissions as New Climate Talks Begin', *Scientific America*.

Fromherz, A.J. (2012). *Qatar: A Modern History,* I.B. Tauris, pp.62-64.

Gamal, R. (2019). 'Saudi Arabia Plans to Launch a Carbon Trading Scheme', *Reuters*.

Gamal, R.E. and Lawler, A. (2018). 'Audit Finds Aramco Oil Reserves Slightly Higher Than Reported: Sources', *Reuters*.

Gamal, R.E. and Webb, S. (2020). 'Saudi Arabia Launches Largest Shale Gas Development Outside the U.S', *Reuters*.

Gardner, T. (2009). 'U.S. Cap and Trade Plans Risk European Mistakes', *Reuters*.

Gas Flaring Data 2013-2017, *World Bank Global Gas Flaring Reduction Partnership*, http://pubdocs.worldbank.org/en/986751531755695202/GGFR-1.pdf

Gas Supplies Keep Flowing as Qatar Diplomatic Spat Flares. (2017) *The National*.

Gause, G, F. III. (no date). 'The Political Economy of National Security in the GCC States', In Gary Sick and Lawrence.

General Environmental Regulations and Rules for Implementation (Translated from Official Arabic Version), Kingdom of Saudi Arabia Presidency of Meteorology and Environment , Oct. 15, 2001, https://www.pme.gov.sa/Ar/DataLists//DocumentLibrary

Geoffrey, P. (1992). 'Earth summit: What went wrong at Rio', *Wash. ULQ* 70: 1005.

Gerard, W. (2009). 'U.N. Climate Talks Threaten Our Survival: Saudi Arabia', *Reuters*.

Gernot, W. and Martin L. (2015). *'Weitzman. Climate shock: the economic consequences of a hotter planet*. Princeton University Press.

Ghanem, S. (2001). 'Industrialization in the UAE in (ed) Ibrahim Abed, Peter Hellyer, *United Arab Emirates: A New Perspective* (Trident Press Ltd, 2001).

Ghawar Field Reserves Decline Overstated, Survey Says. (2007) *Oil and Gas Journal*.

Gina, R. (2010). 'Carbon Market Poised for Growth, More Cases of Carbon Credit Fraud', *Environmental Leader*.

Givetash, L. (2018) 'Water Scarcity Fuels Tension Across the Middle East', *NBC*.

Glimcher, P., Dorris, M. and Bayer, H. (2005). 'Physiological Utility Theory, and the

Neuroeconomics of Choice', *Games and Economic Behavior,* 52, 213-256.

Global Carbon Trust website, available at http://www.gct.qa/en/service

Global Carbon Trust website, http://www.gct.qa/en/service

Global CCS Institute. *'CCS Under the Clean Development Mechanism*, Available at https://hub.globalccsinstitute.com/publications/international-climate-change-legislation-kyoto-protocol-1997/ccs- under-clean-development-mechanism

Global Wholesale Gas Price Survey 2021, (2021). *International Gas Union*. p.36;

Goldenberg, S. (2015). Saudi Arabia Accused of Trying to Wreck Paris Climate Deal', *The Guardian*.

Goldthau A. and Westphal, K. (2019). 'Why the Global Energy Transition does not mean the End of the Petrostate', *Global Policy, Policy Insights*

Goulder, L., et al, (2017). 'China's National Carbon Dioxide Emission Trading System', *Economics of Energy & Environmental Policy*, 6(2)

Governments Adopt Bonn Agreement on Kyoto Protocol Rules. (2001) *United Nations*.

Gowdy, J. (2007). '*Behavioral Economics and Climate Change Policy*, Rensselaer Working Paper in Economics, Number 0701.

Green Saudi Company for Carbon Services to Focus on Emissions Reduction. (2017) *Gulf News*.

Greenhouse Gas Emissions Trading in Europe: Conditions for Environmental Credibility and Economic Efficiency, CEPS Task Force Report (2002) no.43 p.6.

Greenhouse Gas Inventory for Abu Dhabi Emirate. (2012) *Environmental Agency-Abu Dhabi*.

Grossman, M. (1995). '*Encyclopedia of the Persian Gulf War',* ABC-CLIO, p. 233

Guan, D., Meng, J., Reiner, D.M., Zhang, N., Shan, Y., Mi, Z., Shao, S., Liu, Z., Zhang, Q. and Davis, S.J. (2018). 'Structural decline in China's CO2 emissions through transitions in industry and energy systems', *Nature Geoscience*, *11*(8), pp.551-555.

Gulf Carbon Trust website, available at http://www.gct.qa/en/gulf-carbon-trust

Güth, W., Schmittberger, R. and Schwarz, B. (1982). 'An Experimental Analysis of Ultimatum Game Bargaining', *Journal of Economic Behavior and Organization,* 3: 367-88.

Habboush, M. (2018). 'Saudi Arabia Plans Up to $7 Billion of Renewable Energy Projects This Year', *Bloomberg*.

Hafner, M. and Tagliapietra, S. (2020). 'The Global Energy Transition: A Review of the Existing Literature', In: Hafner M., Tagliapietra S. (eds) *The Geopolitics of the Global Energy Transition*. Lecture Notes in Energy.

Hakami, A. *et al* (No date). 'Characterization of Carbonate Mudrocks of the Jurassic Tuwaiq Mountain Formation, Jafurah Basin, Saudi Arabia: Implications for Unconventional Reservoir Potential Evaluation', *Journal of Natural Gas Science and Engineering*: 1149-1168.

Hakami, A., Al-Mubarak, A., Al-Ramadan, K., Kurison, C. and Leyva, I. (2016). 'Characterization of carbonate mudrocks of the Jurassic Tuwaiq Mountain Formation, Jafurah basin, Saudi Arabia: Implications for unconventional reservoir potential evaluation'. *Journal of Natural Gas Science and Engineering*, *33*, pp.1149-1168.

Halder, H. (2016). 'Abu Dhabi Soon to Have Low Emission Vehicles', *Khaleej Times*.

Hamaizia, A., Moerenhout. T, (2022) 'Five Takeaways from a Decade of Energy Subsidy Reform in MENA,' *Chatham House*

Hamid, M. (2009). 'Climate change in the Arab world: Threats and responses', *Troubled Waters: Climate Change, Hydropolitics, and Transboundary Resources*.

Hanergy To Set Up Region's First Thin-Film Solar Power Industrial Park in Saudi Arabia. (2019) *Technical Review Middle East*.

Haque, K. 2021). '*Outlook 2021: UAE's Economic Growth in 2021*', Gulf Business.

Harald F. and Daniela G. (2014). 'Toward New Horizons: Arab Economic Transformation amid Political Transition', *International Monetary Fund,* pp1-5; 61-79

Harrington, W. and Morgenstern, R. (2004). 'Economic Incentives Versus Command and

Control: What's the Best Approach for Solving Environmental Problems', *Resources*.

Hartwell, C.A. (2017). 'Understanding "Development": Insights from Some Aspects of Complexity Theory.' *Homo Oecon* 34, 165–190.

Hassyan Clean Coal Project. (2020). *Dubai, Power and Technology*.

Hayek, F. (1976). *'Law, Legislation, and Liberty, Volume 2: The Mirage of Social Justice*, Chicago: University of Chicago Press.

Health and the Environment in Arab Countries: Hope for the Future, Arab Youth Survey (2021) Available at http://arabyouthsurvey.com/en/findings/

Hegghammer, T. (2010). *Jihad in Saudi Arabia: Violence and Pan-Islamism since 1979,* Cambridge University Press.

Helbing, T. *et al*., (2011). 'Oil Scarcity, Growth and Global Imbalances', *International Monetary Fund*.

Henrich, J. (2006). 'Cooperation, Punishment, and the Evolution of Human Societies', *Science,* 312, 60-61.

Heykal, B. (2013). '*Saudi Arabia and Qatar in a Time of Revolution*', Gulf Analysis Papers.

Hildebrandt, J. *et al*, (2021). 'Are Consumers in the Gulf States Ready to Go Green?, *Boston Consulting Group*.

HIS Markit. (2021). 'Saudi Arabia to Launch a Regional Carbon Trading Platform'.

Hobbes, T. (2017). *Leviathan*, Penguin Books Limited.

Hofstadter, D. (1979). '*Gödel, Escher, Bach: An Eternal Golden Braid,* New York: Basic Books.

Holland, J. H. (2006). 'Studying complex adaptive systems', *Journal of systems science and complexity*, *19*(1), 1-8.

Holmey, O. (2018). 'Gulf Regulators Push for Modernization, *Euromoney*'.

Hong, B.D. and Slatick, E.R. (No date). 'Carbon Dioxide Emissions Factors for Coal', *U.S.*

Energy Information Administration. Available at https://www.eia.gov/coal/production/quarterly/co2_article/co2.html

Hope for the Future, Arab Youth Survey (2021) Available at http://arabyouthsurvey.com/en/findings/

Horowitz, J. (2022). 'Ditching Fossil Fuel Subsidies Can Trigger Unrest, Keeping them Will Kill the Climate', *CNN*.

Hultman, N. (2014). 'The Cancun Agreements on Climate Change', *The Brookings Institution*.

'Impact of Subsidy Reform on the Kingdom of Saudi Arabia's Economy and Carbon Emissions', (2020) *Energy Strategy Reviews*, Volume 28, 2020,

Implementing Effective Emissions Trading Systems, Lessons from International Experiences (2020). *International Energy Agency*.

Infrastructure Investments to Modernise Qatar's Electricity Network, (2018) *Gulf Times*.

Initial National Communication to the United Nations Framework Convention on Climate Change. (2011). *Ministry of Environment: State of Qatar* p. 18.

Intended Nationally Determined Contribution of the United Arab Emirates. (2015). United Nations Framework Convention on Climate Change. p.2. Available at http://www4.unfccc.int/ndcregistry/PublishedDocuments/United%20Arab%20 Emirates%20First/UAE%20INDC%20

IPCC Fact Sheet: What is the IPCC, *The International Panel on Climate Change Website* at http://www.ipcc.ch/news_and_events/docs/factsheets/FS_what_ipcc.pdf

Iran's Nuclear Program: Status. (2019). Congressional Research Service, Available at https://fas.org/sgp/crs/nuke/RL34544.pdf

Islamic Carbon Trading: Goldmine or Minefield? (2013). *Islamic Finance* p.5

Islamic Declaration on Global Climate Change, available at http://www.ifees.org.uk/declaration/

Jaffe, A.M., Elass, J. and Miller, K. (2013). *'The Gulf Cooperation Council Natural Gas*

Conundrum: Geopolitics Drive Shortages Amid Plenty.

Jaffe, A.M.*et al*., (2013). '*The Gulf Cooperation Council Natural Gas Conundrum: Geopolitics Drive Storages Amid Plenty*', Belfer Center: Harvard University.

Janzen, B.G. (2009). *'Climate Change, Emissions Caps, and Carbon Leakage: Cracking a Tough Policy Nut,* Presentation for Copenhagen and Beyond Panel," ABA Section International Law, 2009 Spring Meeting. Washington DC.

Jareer, E. (2019). 'Saudi Arabia Forges Ahead on Ambitious LNG Expansion Plans', *The Arab Weekly*.

Jeff, B. et al, (2013). 'Understanding the Plunge in Oil Prices: Sources and Implications, Economic Prospects and Policy Challenges for the GCC Countries', *International Monetary Fund*

Jeff, S. (2016). 'China's National Emissions Trading System: Implications for Carbon Markets and Trade', *Global Economic Policy and Institutions*, p.1

Jeff, St. J. (2018). 'Saudi Arabia and Softbank's 200-Gigawatt Solar Plan Offers 'So Many Questions, So Few Details', *Greentech Media*.

Jenks, B. (2017). 'How a Nobel Prize in Economics can Help Solve the Climate Crisis', *Stanford Social Innovation Review*.

Jim, K. (2020). '*Climate Strategy for Producer Countries: The Case of Saudi Arabia'*.

Jiusto, S. (2009). 'Energy transformations and geographic research', In *A Companion to Environmental Geography*, eds. Noel Castree, David Demeritt, Diana Liverman, Bruce Rhoads, Oxford: Wiley-Blackwell, 533–551.

Kahneman, D. (2003). 'Maps of bounded rationality: psychology for behavioral economics', *The American Economic Review,* 93(5): 1449–75.

Kahneman, D., Slovic, P. and Tversky, A. (1982). '*Judgment under Uncertainty: Heuristics and Biases',* Cambridge University Press.

Kahramaa Reduces 8.5 M Tonnes of Carbon Emissions (2017) *The Peninsula*.

Kamrava, M. (2014). *'Beyond the Arab Spring: The Evolving Ruling Bargain in the*

Middle East', Oxford University Press.

Kanani, A.A. *et al*. (2017). 'Energy Efficiency in Residential Buildings in the Kingdom of Saudi Arabia', In (ed) M. Dastbaz *et al*., *Building Information Modelling, Building Performance, Design and Smart Construction*.

Kapur (2011). 'Arab Spring Cost GCC $150bn', *Emirates 24/7*.

Key Business Areas in Saudi Arabia, Doing Business in Saudi Arabia Guide. Available at: http://www.saudiarabia.doingbusinessguide.co.uk/the-guide/key-business-regions-in-saudi-arabia/

Khaleej Times. (2022). Dubai Reduces 33% of its Carbon Emissions in 2020.

Khan, M.I. and Yen-Chiang, C. (2018). 'Environmental challenges and current practices in China—a thorough analysis'," *Sustainability,* 10(7), 2547.

Khondaker, A.N. and Rahman*, S.M.et al*, (2015). 'Dynamics of Energy Sector and GHG Emissions in Saudi Arabia," *Climate Policy*, 15(4).

Khondaker, A.N., Rahman, S.M., Malik, K., Hossain, N., Abdur Razzak, S. and Khan, R.A. (2015). 'Dynamics of energy sector and GHG emissions in Saudi Arabia', *Climate Policy*, *15*(4), pp.517-541.

King, Ed, (2016). 'Saudi Arabia Says Oil Industry Must Meet Climate Goals', *Climate Change News*,. https://www.climatechangenews.com/2016/10/19/saudi-arabia-says-oil-industry-must-meet-climate-goals/

Kloosterman, K., (2009). 'Qataris Get Seminar on Carbon Market Trading from UK Specialists', *Green Prophet*.

Knight, E. (2011). 'The Economic Geography of European Carbon Market Trading', *Journal of Economic Geography* 11(5): 817-841.

Knox-Hayes, J. (2008). '*Constructing Carbon Market Space-Time: Implications for Neomodernity*', Oxford University Centre for the Environment Working Paper Series.

Knox-Hayes, J. (2016). '*The Culture of Markets: The Political Economy of Climate Governance'*. OUP.

Kollmuss, A. and Agyeman, J. (2002). 'Mind the Gap: Why Do People Act Environmentally and What Are the Barriers to Pro-Environmental Behavior?', *Environ. Educ. Res.* 8, 239–260

Kondash, A.J., Lauer, N.E. and Vengosh, A. (2018). 'The intensification of the water footprint of hydraulic fracturing', *Science Advances,* 4(8): eaar5982.

Koplow, D. (2009). 'Measuring Energy Subsidies Using the Price Gap Approach: What Does it Leave Out?' *International Institute of Sustainable Development.*

Kossoy, A. and Guignon, P. (2012). '*State and Trends of the Carbon Market 2012*', Washington D.C.: World Bank Carbon Finance Unit.

Krane, J. (2015). 'Stability versus Sustainability: Energy Policy in the Gulf Monarchies', *The Energy Journal, International Association for Energy Economics.*

Krane, J. (2016). 'The Political Economy of Subsidy Reform in the Persian Gulf Monarchies', *Baker Institute for Public Policy.*

Krane, J. (2019*). 'Energy Governance in Saudi Arabia: An Assessment of the Kingdom's Resources, Policy and Climate Approach',* Center for Energy Studies.

Krane, J. (2019). '*Energy Kingdoms: Oil and Political Survival in the Persian Gulf*', Columbia University Press.

Krane, J. (2019). '*Too Much of a Good Thing: Subsidy Reform and Tax Increases Defy Academic Theory on the Rentier Middle East',* Center for Energy Studies.

Krane, J. (2019). '*Too Much of a Good Thing: Subsidy Reform and Tax Increases Defy Academic Theory on The Rentier Middle East*', Center for Energy Studies.

Krane, J. (2020). 'Dubai's Coal Push Upends Abu Dhabi's Clean Energy Strategy', *Middle East Petroleum and Economics Publications.*

Krane, J. (2020). *Climate Strategy for Producer Countries: The Case of Saudi Arabia.*

Krane, J. and Hung, S.Y. (2016). 'Energy Subsidy Reform in the Persian Gulf: The End of the Big Oil Giveaway', *Baker Institute for Public Policy, Issue Brief,* p. 4.

Krane, J. and Monaldi, F. (2017). 'Oil Prices, Political Instability, and Energy Subsidy Reform in MENA Oil Exporters', *Center for Energy Studies*.

Krane, J. and Yu Hung, S. (2016). 'Energy Subsidy Reform in the Persian Gulf: The End of the Big Oil Giveaway'*, Baker Institute for Public Policy, Issue Brief,* p. 4

Krane, J. and Yu Hung, S. (2017). 'Oil Prices, Political Instability, and Energy Subsidy Reform in MENA Oil Exporters', *Center for Energy Studies*, p. 18.

Kruger, J. and Pizer, W. (2004). *'The EU Emissions Trading Directive: Opportunities and Potential Pitfalls*. RFF Report DP 04-24. Resources for the Future.

Lamanauskas, T. (no date). 'Regional Harmonization of Telecommunications Regulatory Frameworks Outside the European Union: A Case of the Gulf Cooperation Council States, Telecommunications Regulatory Authority, Kingdom of Bahrain'.

Larbi, H. (2016). 'Rewriting the Arab Social Contract', *Belfer Center*.

Large Scale CCS in Saudi Arabia, Global CCS Institute (August 5, 2015).

Lessons Learned from China's Regional Carbon Market Pilots. p. 5; *China's National Emissions Trading System: Implications for Carbon Markets and Trade*.

Levin, K., et al, (2015). 'Designing and Preparing Intended Nationally Determined Contributions', *World Resource Institute*

Levy, P. (2009). *'Toward a Self-referential Collective Intelligence: Some Philosophical Background of the IEML Research Program*', Computational Collective Intelligence, Semantic Web, Social Networks and Multiagent Systems Lecture Notes in Computer Science, Volume 5796, pp 22-35.

Li, R. Y. M. (2014). 'The Institutional Analysis of Fittings in Residential Units. In *Law, Economics and Finance of the Real Estate Market',* (pp. 45-61). Springer, Berlin, Heidelberg.

Linden, N.H., van Der, N.H. et al., (2004). 'Analysis of the Impact of the Kyoto Protocol on the Export Revenues of OPEC Member States', *Netherlands Energy Research Foundation* (ECN).

Lo, J. (2021). 'Saudi, U.S. Net-Zero Oil Producer Initiative Meets Skeptical Response', *Climate Home News*.

Loewnstein, G. (2004). 'Out of Control: Visceral Influences on Behavior', In C. Camerer, G. Loewenstein and M. Rabin, eds. *Advances in Behavioral Economics,* Princeton University Press.

Luomi, M. (2015). *'The International Relations of the Green Economy in the Gulf: Lessons From the UAE's State-Led Energy Transition*', Oxford Institute for Energy Studies (OIES), OIES paper: MEP 12.

Luomi, M. (2018). '*The Foreign Relations of Energy Transitions – Framing the Issue for the UAE'*, Emirates Diplomatic Academy (EDA), EDA Insight.

Mabro, R. (No date). 'Saudi Arabia's Natural Gas: A Glimpse of Complex Issues', *The Oxford Institute for Energy Studies*.

Mahdi, W. and Nereim, V. (2017). 'Saudi Arabia Plans to Raise Prices by 80 Percent in January', *Bloomberg*.

Mahmood, H., Alkhateeb, T.T.Y and Furqan, M. (2020). 'Industrialization, Urbanization and CO2 Emissions in Saudi Arabia: Asymmetry Analysis', *Energy Reports*, 6(2020): 1553-1560

Mahmoud, M. (2017). '*Weathering Climate Change in the Gulf*', *The Arab Gulf States Institute in Washington*.

Malik, T. (2008). 'Gulf Eyes Use for Gas Flares', *Arabian Business*.

Masdar Celebrates Fifth Anniversary of Shams 1, Emirates 24/7 (March 23, 2018).

Masnadi, M.S., El-Houjeiri, H.M., Schunack, D., Li, Y., Englander, J.G., Badahdah, A., Monfort, J.C., Anderson, J.E., Wallington, T.J., Bergerson, J.A. and Gordon, D. (2018). 'Global carbon intensity of crude oil production', *Science*, *361*(6405), pp.851-853.

Mason, R. (2011). 'European Carbon Market Suspended Over Fraud Fears', *The Telegraph*.

Mazzettii, M., Hager, E. (2011). ‘Secret Desert Base Set Up by Blackwater’s Founder,’ *The New York Times*

McArdle, M. (2018). ‘Is Masdar City A Ghost Town or a Green Lab?’, *Popular Science*.

McAuley, A. (2018). ‘Qatar Petroleum Renews Shared Oilfield Concession Pact with UAE’, *Reuters*.

McCullough, D.G. (2014). ‘Saudi Arabia's Green Decree Brings Hopes of Sustainability’, *The Guardian*.

McLaughlin, T. (2018). ‘U.S. Clean Coal Program Fails to Deliver on Promised Smog Cuts’, *Reuters*.

Meeting the Challenges of Climate Change, Qatar General Secretariat for Development Planning (2012).

Meltzer, J. et al, (2014). ‘Low Carbon Energy Transitions in Qatar and the Gulf Cooperation Council Region’, *Brookings Institution*.

Methane Tracker Database: United Arab Emirates, (2020). *International Energy Agency*. Available at https://www.iea.org/articles/methane-tracker-database

Middle East and North Africa Economic Developments and Prospects, October 2012: Looking Ahead After a Year in Transition, *World Bank* (World Bank Publications, 2012).

Middle East, the Strategic Hub: A Bibliographic Survey of Literature. (1978). Volume #550, Headquarters, Department of the Army, p.230

Mills, R. (2011). ‘Doha Climate Talks Will Turn Spotlight on Gulf Countries’, *The National*.

Mills, R. (2019). ‘Appetite and Innovation: Natural Gas in the UAE’, in (ed) *The Future of Gas in the Gulf: Continuity and Change,* OIES, p.123

Mills, R. (2020). ‘Under A Cloud: The Future of Middle East Gas Demand’, *Center on Global Energy Policy,* p. 33

Mills, R. (2020). ‘US Shale Will be the First Casualty of the Price War’, *Euractiv*.

Mimura, N. and Nurse, L. *et al*, (2007). 'Small islands. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

Ministry of Climate Change and the Environment, available at https://www.moccae.gov.ae/en/about-ministry/about-the-ministry.aspx

Ministry of Environment: State of Qatar. (2011). '*Initial National Communication to the United Nations Framework Convention on Climate Change*'.

Mintzer, M. and Leonard, J.A. (1994). *'Negotiating Climate Change: The Inside Story of the Rio Convention',* Cambridge University Press.

Mirza, A. (2021). '*Qatar Sets 7mn t/yr 2030 Carbon Capture Target*', Argus.

Mission Innovation website, Available at http://mission-innovation.net/participating-countries/saudi- arabia/

Moerenhout, T. (2018). '*Energy Pricing Reforms in the Gulf: A Trend but Not (Yet) a Norm',* Global Subsidies Initiative.

Moerenhout, T. (2018). '*Energy Pricing Reforms in the Gulf: A Trend but Not (Yet) a Norm*', Global Subsidies Initiative.

Mohammed Bin Rashid Al Maktoum Solar Park Phase II, Dubai Power-Technology (2019).

Mohammed, S. (2016). 'Qatar's National Emission Inventory Report: Emission Inventories 1995-2015', *Qatar Foundation,* p.35

More Delays for UAE's Barakah Project, Nuclear Engineering International (July 6, 2018).

Morel, R. and Shishlov, I. (2014). *'Ex-Post Evaluation of the Kyoto Protocol: Four Key Lessons for the 2015 Paris Agreement',* Climate Report #44.

Morrison, R. (2019). '*Coal IPPS on Hold*', Project Finance International, Reuters.

Murphy, D. and Turak, N. (2021). 'Abu Dhabi Eyes New Partnerships for Carbon Capture and Emissions Cutting as Oil Price Climbs', *CNBC*.

Muuls, M., Colmer, J., Martin, R. and Wagner, U.J. (2016). *'Evaluating the EU Emissions Trading System: Take it or leave it? An assessment of the data after ten years',* Grantham Institute briefing paper, 21.

Nafi, Z.A. (2013). '*Economic and Social Development in Qatar*', Bloomsbury Publishing.

Nahed, T. and Hajjar, B. (2013). '*Energy and environment in Saudi Arabia: Concerns & opportunities*. Springer Science & Business Media.

Najib Saab, *Environmental Awareness in Arab Countries: A Survey* (Feb. 20, 2021).

Nakano, J. and Kennedy, S. (2021). 'China's New National Carbon Trading: Between Promise and Pessimism', *Center for Strategic and International Studies*.

National Climate Change Plan is available at https://www.moccae.gov.ae/assets/30e58e2e/national-climate- change-plan-for-the-united-arab-emirates-2017-2050.aspx

National Climate Change Plan of the United Arab Emirates 2017-2050, United Arab Emirates Ministry of Climate Change and the Environment. p. 25

National Climate Change Plan of the United Arab Emirates 2017-2050, United Arab Emirates Ministry of Climate Change and the Environment, p. 35. Available at https://www.moccae.gov.ae/assets/30e58e2e/national-climate- change-plan-for-the-united-arab-emirates-2017-2050.aspx

National Emission Inventory Report: Emission Inventories 1995-2015, (2016). Qatar Foundation.

National Renewable Energy Program, KSA Climate website. Available at https://ksa-climate.com/making-a-difference/nrep/

Nazir, N. (2012). *Carbon Trading Market: Viability for Islamic Financial Industry,* Center for Islamic Economics and Finance: Qatar Faculty of Islamic Studies.

Nehme, D. (2019). 'Qatar Plans to Boost LNG Production to 126 Mln T by 2027', *Reuters*.

Nobel Laurette Richard Thaler Headlines Behavioral Finance Conference. (2021). Rutgers Business School.

Nordhaus, W.D. (2007). 'To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming', *Review of Environmental Economics and Policy* 1(1): 26-44.

Nordhaus, W.D. (2015). 'Climate clubs to overcome free-riding', *Issues in Science and Technology*, *31*(4).

North, D.C. (1986). 'The New Institutional Economics', *Journal of Institutional and Theoretical Economics (JITE) / Zeitschrift Für Die Gesamte Staatswissenschaft*. 142(1): 230-37

Nuclear Power in Saudi Arabia. (2019). *World Nuclear Association*.

Obeid, J. (2020). 'Saudi Arabia New Renewables Giant', *Gulf Monitor*

Oil and Gas Climate Initiative Sets First Collective Methane Target for Member Companies. (2018). *Oil and Gas Climate Initiative*.

Oil and Gas Methane Partnership Reporting, *Climate and Clean Air Coalition*. Available at http://ccacoalition.org/en/content/oil-and-gas- methane-partnership-reporting

Oil and Gas Methane Partnership. (2017). *Climate and Clean Air Coalition* (2015); Reducing Methane Emissions Across the Natural Gas Value Chain-Guiding Principles, Climate and Clean Air Coalition.

Oil Prices. (2017). Political Instability, and Energy Subsidy Reform in MENA Oil Exporters.

O'Keefe, P. *et al*, (2010). The Future of Energy Use, *Earthscan, 2010*, p.268

OPEC Fears Attack on Oil Trade at Earth Summit. (1992). *China Daily*.

OPEC Member Qatar Says to Start Embracing Solar Energy. (2012). *Reuters*.

Organization of Arab Petroleum Exporting Countries. (1979). *OAPEC News Bulletin*, Volumes 5-7 (Information Department, OAPEC., 1979).

Organization of Petroleum Exporting Countries (OPEC), (2008). OPEC Annual Report 2007. p.49

Outcome of the Work of the Ad Hoc Working Group on Further Commitments for Annex

I Parties under the Kyoto Protocol, United Nations Framework Convention on Climate Change (2012). p. 3. Available at http://unfccc.int/resource/docs/2012/cmp8/eng/l09.pdf

Pa, J. and Eltahir, E.A.B. (2016). 'Future Temperature in Southwest Asia Projected to Exceed a Threshold for Human Adaptability', *Nature Climate Change,* 6, 197-200.

Pamuk, H. (2012). 'Saudi Arabia Sees Need to Act on Climate Change', *Reuters*.

Paraskova, T. (2020). 'Oil Demand Growth Won't Be Saved by Petrochemical Boom', *Oil Price*.

Paris Agreement is available at: http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

Paris Agreement: Status of Ratification, *United Nations Climate Change* Website. Available at http://unfccc.int/paris_agreement/items/9444.php

Paris Decision Text is available at http://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf

Parking Lot: Dhahran. Available at https://www.sma.de/fileadmin/content/global/Products/Documents/Referenzanlagen/EN_ARAMCO.pdf

Parnell, J. (2012). 'COP 18: Qatar Emissions Pledge Could Soothe Climate Talks Tension', *Climate Home News*.

Paul, A, S. (2010). *Economics*. Tata McGraw-Hill Education.

Paul, S. and Lahn, G. (2011). *'Burning oil to keep cool: The hidden energy crisis in Saudi Arabia',* Chatham House, London.

Petrochemicals Set to Become the Largest Driver of World Oil Demand. (2019). *Latest IEA Analysis Finds, International Energy Agency*.

Pigou, A. (1924). '*The Economics of Welfare',* New Brunswick: Transaction Publishers.

Pigou, A.C. (1920). 'The economics of welfare Macmillan and Co'. *London, United Kingdom*.

Pigou, A.C. (1954). 'Some aspects of the welfare state' *Diogenes*, *2*(7), pp.1-11.

Pizer, W. and Zhang, X. (2017). *'China's New Carbon Market*', Georgetown University U.S. China Initiative.

Plato (1953). '*The Dialogues of Plato: The Laws, 4th ed*. Benjamin Jowett, Oxford: Clarendon Press.

Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy Available at https://www.uae-embassy.org/sites/default/files/UAE_Policy_Peaceful_Nuclear_Energy_English.pdf

Population and Demographic Mix, The Official Portal of the UAE Government website. Available at https://www.government.ae/en/information-and-services/social-affairs/preserving-the-emirati-national- identity/population-and-demographic-mix

Population and Vital Statistics, Housing Survey, General Authority for Statistics: *Kingdom of Saudi Arabia website*. Available at https://www.stats.gov.sa/en/indicators/228

PourMirza, A. (2017). 'Gas flaring status, trend and policy around the Persian Gulf. *Energy Sources, Part B: Economics, Planning, and Policy*', *12*(3), pp.250-259.

Powering down coal: Navigating the economic and financial risks in the last years of coal power (2018). Carbon Tracker

Promoting Low Carbon Development in Dubai. (2014). United Nations Development Programme.

Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources, (2011). National Petroleum Council.

Qatar CO2 Emissions Per Capita, *Knoema*. Available at https://knoema.com/atlas/Qatar/CO2-emissions-per- capita

Qatar Develops a 500-MW Solar Plant. (2019). Oxford Business Group (The Report

Qatar).

Qatar Doubles Down on Economic Diversification. (2019). Oxford Business Group.

Qatar Foundation. (2016). '*Qatar's National Emission Inventory Report: Emission Inventories 1995-2015*'.

Qatar General Secretariat for Development Planning. (2011). '*Qatar National Development Strategy 2011-2016*'.

Qatar Joins World Bank's Global Gas Flaring Reduction Partnership. (2009). IISD.

Qatar National Development Strategy 2011-2016. Available at https://www.psa.gov.qa/en/knowledge/Documents/Qatar_NDS_reprint_complete_lowres_16May.pdf

Qatar National Development Strategy: 2018-2022, Ministry of Planning, *Development and Statistics webpage*. Available at: https://www.mdps.gov.qa/en/knowledge/Documents/NDS2Final.pdf

Qatar National Vision 2030. Available at https://www.gco.gov.qa/en/about-qatar/national-vision2030/

Qatar Natural Gas Profile. (2015). Energy Information Administration. Accessed November 13, 2021.

Qatar Petrochemical Production Figures. (No date). Gulf Petrochemicals and Chemicals Association, Available at http://www.gpca.org.ae/qatar/

Qatar Petroleum Signs Deal with Abu Dhabi for Al-Bunduq Oil Field Operation. (2018). *The Peninsula*.

Qatar Pressured to Cut Emissions as New Climate Talks Begin

Qatar Science and Technology Park webpage, available at https://qstp.org.qa/

Qatar to Reduce Carbon Footprint with Major Projects. (2015). Oxford Business Group.

Qatar INDC Report (Nov. 19, 2015). Available at http://www4.unfccc.int/submissions/INDC/Published%20Documents/Qatar/1/Qatar%20INDCs%20Report%20- English.pdf

Qatar: First Gulf Country Joins World Bank-led Effort to Reduce Greenhouse Gas Emissions from Gas Flaring. (2009). Global Gas Flaring Reduction Partnership Home Page, Available at <http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:22044056~menuPK:34463~pagePK:34370~piPK:34424~theSitePK:4607,00.html>

Qatar: The Other Wahhabi State. (2016). *The Economist*.

Qatar: Indicators for 2015, *International Energy Agency Website*. Available at https://www.iea.org/statistics/statisticssearch/report/?country=Qatar&product=indicators

Qatar's Carbon Dioxide Emissions. (2018). Qatar Foundation Annual Research Conference Proceedings.

Qatar's National Emission Inventory Report: Emission Inventories 1995-2015. (2016). Qatar Foundation.

Qi, S. and Cheng, S. (2018). 'China's National Emissions Trading Scheme: Integrating Cap, Coverage and Allocation', *Climate Policy*.

Qiao, Y. (2016). '*An Evaluation of China's Tax System: Insights for Future Reform',* Missouri State University.

QP Joins WB in Global Fight Against Routine Flaring. (2021). *Gulf Times*.

Raffoul, A. and Hewaidi, F.A.Z. (2021). 'How Industrialization Could Future-Proof MENA's Gulf Economies'*, World Economic Forum*.

Rahman, F. (2021). Saudi Aramco to Boost Capacity to 13 mbpd by 2027, *The National*.

Ramakrishnan, J. (2008). "EU ETS- An introduction. *International Environmental Science Center*. Available at http://www.internationalprofs.org/iesc/index.php?option=com_content&view=ar ticle&id=118:eu- ets&catid=908:eu-ets&Itemid=88

Ratcliff, V. and Paola, A.D. (2019). 'Saudi Aramco See Shale Gas As Kingdom's Next Energy Bonanza, *Bloomberg*'.

Ratcliffe, R. *et al*, (2020). 'Petrochemical Plan After Oil Crash', *Bloomberg*.

Recommended Practices for Sour Gas Development Planning and Proliferation Assessment. (2004). *Canadian Association of Petroleum Producers*.

Reducing Methane Emissions Across the Natural Gas Value Chain, Climate and Clean Air Coalition (2017). Website available at http://ccacoalition.org/en/resources/reducing-methane-emissions-across-natural-gas-value-chain- guiding-principles

Reducing Methane Emissions Across the Natural Gas Value Chain. (2017). Climate and Clean Air Coalition. Website available at http://ccacoalition.org/en/resources/reducing-methane-emissions-across-natural-gas-value-chain- guiding-principles

Reducing Methane Emissions Across the Natural Gas Value Chain. (2017). Climate and Clean Air Coalition. Website available at http://ccacoalition.org/en/resources/reducing-methane-emissions-across-natural-gas-value-chain- guiding-principles

Reed, S. (2021) 'A Major Persian Gulf Oil Producer Tries to Burnish its Climate Credentials', *New York Times*

Regional Economic Outlook Middle East and Central Asia. (2018). International Monetary Fund.

Renewable Energy Prospects: United Arab Emirates. (2015). International Renewable Energy Agency,

Renewables in the Arab World: Maintaining Momentum. (2018). *APICORP Energy Research*, 3(08), p.3

Rogers, H. (2019). 'Qatar: LNG Expansion Following the Ending of the Northfield Moratorium', In (ed) *The Future of Gas in the Gulf: Continuity and Change,* OIES.

Roser, M. (2020) 'Why Did Renewables Become So Cheap So Fast', *Our World in Data*

Saab, N and Habib, R. (2020). 'Arab Forum for Environment and Development', pp.174-197.

Saab, N. (2021). ‘*Environmental Awareness in Arab Countries: A Survey*.

Saba, Y. (2021).’Gulf Rebound Set as Saudi Arabia, the UAE Seen Topping 4% Growth in 2022’, *Reuters*.

Saba, Y. *et al*, (2021). ‘Top Oil Exporter Saudi Arabia Targets Net Zero Emissions by 2060’, *Reuters*.

Saiyid, A. (2021) *Oil, ‘*Gas Companies Under Pressure to Manage Scope 3 Emissions to Reach Net-Zero Goals, Analysts’, *HIS Markit*

Safi, M. *et al*, (2021). ‘So What Has the Rest of the World Decided to Do about Climate Change’? *The Guardian*.

Sanin, M. and Violante, F. (2009). *‘Understanding Volatility Dynamics in the EU-ETS Market: Lessons from the Future’,* ECORE Discussion Paper.

Sarrakh, R. et al, (2020). ‘Impact of Subsidy Reform on the Kingdom of Saudi Arabia's Economy and Carbon Emissions’, *Energy Strategy Reviews*, 28.

Sato, S. (2016). *‘Britain and the Formation of the Gulf States: Embers of Empire*’ Oxford University Press.

Saudi Arabia Aims to Increase Energy Efficiency Levels. (2018). Middle East Utilities.

Saudi Arabia and Political. (2017). Economic and Social Development, Ministry of Foreign Affairs.

Saudi Arabia and the Gulf states prefer this method of assessing carbon intensity because it would privilege oil and natural gas in comparison to coal.

Saudi Arabia Collaborates with the US on Managing its Carbon Emissions. (2017), *Asharq Al-Awsat*.

Saudi Arabia Extends Deadline for Energy Price Reform. (2017). *Gulf Base*.

Saudi Arabia Forges Ahead on Ambitious LNG Expansion Plans. (2019). *The Arab Weekly*.

Saudi Arabia Intends to Exceed Renewable Energy Target. (2017). *CNBC*.

Saudi Arabia Population. (2021). *World Population Review*. Available at https://worldpopulationreview.com/countries/saudi-arabia-population

Saudi Arabia Signs Up for Japan's JCM. (2015). *Carbon Pulse*.

Saudi Arabia Submits its Climate Action Plan Ahead of 2015 Paris Agreement. (2015). *UN Climate Change Newsroom*.

Saudi Arabia Tries to Stall Global Emissions Limits (2009), *NPR*.

Saudi Arabia Used Less Crude Oil for Power Generation in 2018. (2019). *U.S. Energy Information Administration*.

Saudi Arabia, Climate Action Tracker. Available at https://climateactiontracker.org/countries/saudi-arabia/

Saudi Arabia. (2019). Energy Information Administration.

Saudi Arabia: Government Join Forces to Implement Energy Efficiency Labels. (2017). United Nations Development Programme (UNDP), Available at http://www.sa.undp.org/content/saudi_arabia/en/home/ourwork/environmentandenergy/successstories/ee_implementation.html

Saudi Arabia: Government Join Forces to Implement Energy Efficiency Labels. (2015). United Nations Development Programme, Available at http://www.sa.undp.org/content/saudi_arabia /en/home/ourwork/environmentandenergy/successstories/ee_implementation.html

Saudi Arabia: Selected Issues. (2015). International Monetary Fund.

Saudi Arabian Law Overview: Environmental Laws, Saudi Legal (no date). Available at http://www.saudilegal.com/saudilaw/18_law.html

Saudi Arabia's Gas Discovery in Red Sea Comes at Opportune Time. (2019). *Offshore Technology*.

Saudi Arabia's Legal Framework Evolves Alongside Economic Needs. (2015). The Report Saudi Arabia.

Saudi Aramco Building Global Gas Business to Cut Carbon Footprint. (2019). *Reuters*.

Saudi Aramco Joins World Bank's Initiative: "Zero Routine Gas Flaring by 2030," (2019) *Saudi Aramco Newsletter*.

Saudi Electricity CEO Says Power Consumption Growth to Slow. (2018). *Reuters*.

Saudi Energy Minister Hones Plea to Target Carbon Emission; Not Oil and Gas. (2022). *SP Global*.

Saudi Energy Price Reforms Getting Serious. (2016). *APICORP Energy Research*, 3(65).

Saudi's Associated Gas Needs Limit its Swing Role. (2017). *Argus*.

Scott, M. (2018). 'Saudi Arabia Plans to Source 10% of its Power from Renewable Energy Within Five Years', *Forbes*.

SEC and Petroleum, Chemicals and Mining Company Sign a Partnership Agreement to Establish the Green for Carbon Services, Saudi Electricity Company Webpage. Available at https://www.se.com.sa/en- us/pages/newsdetails.aspx?NId=551

Secretary of Energy Rick Perry Announced $36 Million for Projects to Advance Carbon Capture Technologies. (2017). Department of Energy. *Energy.gov*

See the total installed solar capacity of Louisiana in 2018 at, the Solar Energy Industries Association. Available at https://www.seia.org/state-solar-policy/louisiana-solar

Seznec, J.F. (2016). 'Sharing a Pot of Gold: Iran, Qatar and the Pars Gas Field', *Middle East Institute*.

Seznec, J.F. and Kirk, M. (2010). Industrialization in the Gulf: A Socioeconomic Revolution, *Routledge*.

Shabaneh, R. and al-Suwailem, M. (2020). 'The Prospect of Unconventional Gas Development in Saudi Arabia', *KAPSARC*.

Shafi, N. (2021). 'Young People Are Leading Climate Activism in the Middle East', *The Cairo Review of Global Affairs*.

Shale Gas, Competitiveness, and New U.S. Chemical Industry Investment: An Analysis Based on Announced Projects (2013) *American Chemical Council*.

Shaozhou, Q. and Cheng, S. (2018). 'China's national emissions trading scheme: integrating cap, coverage and allocation', *Climate Policy,* 18(sup1), 45-59.

Sick, G.G. and Potter, L.G. eds. (1997). '*The Persian Gulf at the millennium: Essays in politics, economy, security and religion*', Macmillan.

Sijm, J. et al, (2006). 'CO2 Cost Pass Through and Windfall Profits in the Power Sector', *CWPE*.

Simmons, M.R. (2011). '*Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy'*, John Wiley & Sons.

Sinn, H.W. (2012). 'The Green Paradox: A Supply-Side Approach to Global Warming', *MIT Press*.

Soloman, B. (1999) 'New Directions in Emissions Trading: The Potential Contribution of New Institutional Economics', *Ecological Economics*. 30, 371-387. 10.1016/S0921-8009(99)00021-X.

Solomon, B. (1999). 'New Directions in Emissions Trading: The Potential Contribution of New Institutional', Economics, *Ecological Economics*. p.

State and Trends of Carbon Pricing, (2020). World Bank Group, p. 18-19

Stern, J. (ed) (2019). *'The Future of Gas in the Gulf: Continuity and Change*. OIES Press.

Stigler, G. (1983). '*The Organization of Industry',* Chicago: University of Chicago Press.

Strategic Plan for Financial Sector Regulation, Qatar Central Bank (No Date). Available at http://www.qfcra.com/en-us/publications/CorporateDocuments/flipbook%20pdfs/English%20Strategic%20Plan%20Book.pdf

Study Shows Record Low Carbon Intensity of Saudi Crude Oil. (2018). *Saudi Aramco*.

Submission from Bahrain, Saudi Arabia, Qatar and the United Arab Emirates, United Nations Framework Convention on Climate Change: Conference of the Parties, Eighteenth Session (2012). Available at http://unfccc.int/resource/docs/2012/cop18/eng/misc02.pdf

Sullivan, T. (2011). '*Embracing Complexity*', Harvard Business Review.

Summary of the UNFCCC Climate Change Conference in Doha, Qatar 26 November-7 December 2012, United Nations Development Programme Climate Community (UNDPCC) (2012) p.5 Available at http://www.undpcc.org/docs/UNFCCC%20negotiations/UNDP%20Summaries/2012_12%20December%20Doha/U NDP%20COP18%20summary.pdf

Sun, D., Sun, J., Zhang, X., Yan, Q., Wei, Q. and Zhou, Y. (2016). 'Carbon markets in China: Development and challenges', *Emerging Markets Finance and Trade*, *52*(6), pp.1361-1371.

Sunita Narain, (no date). *Environmentalism of the Poor Vs. Environmentalism of the Rich,* Arizona State University Lectura Series Available at https://sustainability.asu.edu/media/wrigley-lecture-series/sunita-narain/

Suparna Dutt D'Cunha, UAE and Saudi Arabia End Tax Free Living, Roll Out 5% Vat as Oil Revenue Slump, *Forbes* (2018), Value Added Tax (VAT) and Excise Tax Developments in the Gulf Cooperation Council (2017), *KPMG*.

Suratman, N. (2019). 'Saudi Arabia Signs More than $2 bln Worth of Petrochemical Deals', *ICIS*.

Svetlova, K. (2021) 'The Great Gulf Citizenship Competition,' *The Media Line*

Sweidan, O. (2021). 'The Environmental and Energy Polices to Enable Sustainable Consumption and Production in the Gulf Cooperation Council Countries', *Clean Technologies and Environmental Policy Journal*.

Sweihan Photovoltaic Independent Power Project, Abu Dhabi, Power-Technology. Available at https://www.power-technology.com/projects/sweihan-photovoltaic-independent-power-project-abu-dhabi/

Sykes, A.O. (2003). '*The Economics of WTO Rules on Subsidies and Countervailing Measures*', The University of Chicago Law School.

Taher, N. and Hajjar, B. (2013). *'Energy and Environment in Saudi Arabia: Concerns & Opportunities',* Springer Science & Business Media.

Taher, N.A. (2016). ‘UAE Plans On Exceeding Target of 24% of Renewable Energy by 2021’, *Gulf News*.

Tariq, B., Göran-Mäler, K., Grubb, M., Harold, K. Jacobson and Farhana, Y. (1995) ‘Equity and social considerations’, *Climate change,* 79-124.

Thayer and Smith. (1999). ‘Greek Lexicon entry for Katallasso’, *The NAS New Testament Greek Lexicon*.

The GCC in 2020: The Gulf and Its People. (2009). *Economist Intelligence Unit*.

The Global Competitiveness Report 2020. Available at https://u.ae/en/about-the-uae/uae-competitiveness/global-competitiveness-report-of-the-world-economic-forum

The Intended Nationally Determined Contribution of the Kingdom of Saudi Arabia Under the UNFCCC. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Saudi%20Arabia/1/KSA- INDCs%20English.pdf

The Intended Nationally Determined Contribution of the Kingdom of Saudi Arabia Under the UNFCCC <Available at http://www4.unfccc.int/submissions/INDC/Published%20Documents/Saudi%20Arabia/1/KSA- INDCs%20English.pdf

The Issue of 'Adverse Effects and the Impacts of Response Measures' in UNFCCC. (2001). *Tyndall Centre for Climate Change Research*.

The Marrakesh Accords and the Marrakesh Declaration. (2001). UNFCCC Available at http://unfccc.int/cop7/documents/accords_draft.pdf

The Middle East and North Africa 2004. (2004). *Routledge*, p.943. (Accessed July 12, 2021)

The Oil & Gas Year Qatar 2010. (2010). WildCat Publishing.

The Organization of Petroleum Exporting Countries, (2016). *OPEC Bulletin*. P. 2.

The Progress of China's Carbon Market. (2017). *Environmental Defense Fund*.

The Report Qatar 2015. (2015) Oxford Business Group.

The Resolution of the Council of Ministers No. 15 of 2011 Establishing Climate Change and Clean Development Committee and Determining its Functions

The Saudi Natural Gas Initiative. (2002). *Stratfor*.

The State of the Environment: Responsibilities and Achievements, The General Authority for Meteorology and Environmental Protection: Kingdom of Saudi Arabia (2017).

The UAE Expects that 20% of Power Generation to Come from Clean Energy in Three Years: Official. (2021) S&P *Global Platts*.

The UAE Launches its National Water and Energy Demand Management Programme (2021) *Enerdata*.

The UAE Launches Plan to Achieve Net-Zero Emissions by 2050 (2021) *Reuters*.

The UAE Ratifies the Paris Climate Agreement. (2016). *Gulf News*.

The UAE’s Response to Climate Change, *The United Arab Emirates Government Portal* Available at https://u.ae/en/information-and-services/environment-and-energy/climate-change/theuaesresponsetoclimatechange#:~:text=Due%20to%20better%20technology%20and,tonnes%20per%20person%20per%20year.

The UAE's Response to Climate Change, *The Official Portal of the UAE Government*. Available at https://government.ae/en/information-and-services/environment-and-energy/climate- change/theuaesresponsetoclimatechange

Thirteenth Five-Year Plan. (2016). Grantham Research Institute on Climate Change and the Environment.

Tolba, M.K and Saab, N.W. (2009). *‘Arab Environment: Climate Change: Impact of Climate Change on Arab Countries’,* Report of the Arab Forum for Environment and Development

Tolba, M.K. and Saab, N.W. (ed), (2009). *‘Arab Environment: Climate Change: Impact of Climate Change on Arab Countries*, 2009 Report of the Arab Forum for Environment and Development.

Tomlinson, L. (2011). '*Procedural Justice and Climate Change: Defining Who Should Be Included in Decision Making Processes of a Climate Change Negotiation*', University of Oxford.

Tripp, J.T.D. and Dudek, D.J. (1989) 'Institutional Guidelines for Designing Successful Transferable Rights Programs', *Yale J. Regul.* 6 (1), 369 – 391.

Trump Says a Fairer Deal Might Coax U.S. Back Into the Paris Climate Accord. (2018). *Reuters*.

Turak, N. (2021) 'Saudi Arabia, UAE, Could be Slowly "De-Anchoring" from Oil Price Movements, Data Suggests,' *CNBC*

Two Faces of Saudi Arabia's Climate Negotiating Position, Public Library of US Diplomacy. (2010). *Wikileaks*.

U.S. Climate Action Partnership. (2007). *A Call for Action*.

U.S. Department of State. (2009). *U.S.-UAE Agreement for Peaceful Nuclear Cooperation (123 Agreement)*, Available at https://2001-2009.state.gov/r/pa/prs/ps/2009/01/114262.htm

U.S. Ethane-Based Petrochemical Plants Challenged by Low Crude Prices. (2020). *Reuters*.

U.S.-UAE Agreement for Peaceful Nuclear Cooperation (123 Agreement), U.S. Department of State (2009). Available at https://2001-2009.state.gov/r/pa/prs/ps/2009/01/114262.htm

UAE and the Agenda 2030 for Sustainable Development. (2017). National Committee on Sustainable Development Goals.

UAE Country Nuclear Power Profiles, (2019). *IAEA*. Available at https://cnpp.iaea.org/countryprofiles/UnitedArabEmirates/UnitedArabEmirates.htm

UAE Country Nuclear Power Profiles. (2019). *IAEA*.

UAE Country Nuclear Power Profiles. (2019). *IAEA*. Available at https://cnpp.iaea.org/countryprofiles/UnitedArabEmirates/UnitedArabEmirate s.htm

UAE Country Profile. (2019). *Energy Information Administration*.

UAE Current Policy Projections, Climate Action Tracker <available at https://climateactiontracker.org/countries/uae/current-policy-projections/>

UAE Forms Council for Climate Change and the Environment, United Arab Emirates: The Cabinet. Available at https://www.uaecabinet.ae/en/details/news/uae-forms-council-for-climate-change-and-environment

UAE Launches Plan to Achieve Net Zero Emissions by 2050 (2021) *Reuters*.

UAE Launches Plan to Achieve Net-Zero by 2050. (2021). *Reuters*.

UAE Ministry of Energy. (2017). UAE State of Energy Report 2017.

UAE's SCA Proposes First-of-its-Kind Carbon Emissions Trading (2018) *Albawaba*.

UAE State of Energy Report 2017. (2017). UAE Ministry of Energy.

UAE's SCA Proposes First of its Kind Carbon Emissions Trading. (2018). *AlBawaba*.

Under A Cloud: The Future of Middle East Gas Demand. (2020). Center on Global Energy Policy.

United Arab Emirates Ministry of Climate Change, and the Environment. (no date). *'National Climate Change Plan of the United Arab Emirates 2017-2050'*.

United Arab Emirates, *International Monetary Fund website* (2020). Available at https://www.imf.org/en/Countries/ARE

United Arab Emirates, U.S. Energy Information Administration (2018) Available at https://www.eia.gov/international/overview/country/ARE

United Arab Emirates. (2018). *Nuclear Threat Initiative*.

United Arab Emirates: The Cabinet. (no date). '*UAE Forms Council for Climate Change and the Environment*', Available at https://www.uaecabinet.ae/en/details/news/uae-forms-council-for-climate-change-and-environment

United Arab Emirates-CO2 Emissions Per Capita, *Knoema*. Available at https://knoema.com/atlas/United-Arab-Emirates/CO2-emissions-per-capita

United Nations Climate Change, (2021). NDC Synthesis Report, Available at https://unfccc.int/documents/306848

United Nations Development Programme. (2014). '*Promoting Low Carbon Development in Dubai*'.

United Nations Framework Convention on Climate Change and Implementation of a "New" Climate Policy Instrument," in *Intereconomics* (May/June 2004).

United Nations Framework Convention on Climate Change website, http://unfccc.int/essential_background/convention/items/6036.php

United Nations Framework of Convention on Climate Change (UNFCCC) of the Earth Summit in Rio de Janeiro, 1992.

United Nations Issue Second Carbon Credits to SABIC. (2018). *SABIC*. Available at https://www.sabic.com/en/news/12753-united- nations-issue-second-carbon-credits-to-sabic

Van Der Linde, C. (2013). '*Dynamic International Oil Markets: Oil Market Developments and Structure 1860-1990*. Vol. 15. Springer Science & Business Media.

Vat in the Gulf: Oman Becomes the 4th State to Introduce a VAT Systems. (2020). Taxamo.

Vatn, A. (2005) '*Institutions and the Environment',* Edward Elgar, Cheltenham.

Vause, A. (2019). 'The UAE's Fight Against Bribery and Corruption', *DLA Piper*.

Victor, D.G. *et al*, (2006). '*Natural Gas and Geopolitics: From 1970 to 2040',* Cambridge University Press.

View of Saudi Arabia With Regards to Climate Change Negotiations, Saudi Arabia Permanent Mission to the United Nations (2009). Available at http://www.saudimission.org/attachments/043_climate%20change.pdf

Vision 2030 Kingdom of Saudi Arabia website, available at http://vision2030.gov.sa/en

Wael, M. and Roca, M. (2012). 'Saudi Arabia Plans $109 Billion Boost for Solar Power', *Bloomberg News*. https://www.bloomberg.com/news/articles/2012-05-10/saudi-arabia-plans-109-billion-boost-for-solar-power.

Wael, Mahdi, N. and Vivian, 'Saudi Arabia Scales Back Renewable Energy Goal to Favor Gas', *World Oil*.

Walter W., Paul, P and DiMaggio, J. (1991). '*The New Institutionalism in Organizational Analysis*', University of Chicago Press.

Warsaw International Mechanism for Loss and Damage Associated with Climate Change Impacts. (2017). *United Nations Framework Convention on Climate Change Webpage*. Accessed December 12, 2017, Available at http://unfccc.int/adaptation/workstreams/loss_and_damage/items/8134.php

Wasmi, N.A. (2015). 'UAE's Environment Goals Set Out Ahead of Crucial Paris Conference', *The National*.

Waterbury, J. (2013). '*The Political Economy of Climate Change in the Arab Region*', Arab Human Development Report: United Nations Development Programme.

Weatherby, C., Eyler, B. and Burchill, R. (2018). *'UAE Energy Diplomacy: Exporting Renewable Energy to the Global South',* Trends Report, Trends Research and Advisory & the Stimson Centre.

Website of the International Renewable Energy Agency, available at http://www.irena.org/

Weissman, S. *et al.*, (2016). '*Natural Gas as a Bridge Fuel*', Center for Sustainable Energy.

What Drives Crude Oil Prices?, U.S. Energy Information Administration. Available at https://www.eia.gov/finance/markets/crudeoil/spot_prices.php#:~:text=The%20volatility%20of%20oil%20prices,fixed%20in%20the%20near%2Dterm.

Williamson, N. and Garcia, M.M. (2011). *'Gas Shortages in the Middle East: An Unlikely Paradox',* An International Comparative Legal Guide to Gas Regulation.

Willuhn, M. (2018). 'EU and China to Cooperate on Clean Energy Technology and

Emissions Trading', *PV Magazine*

Winter, R.K. Jr. (1973). 'Economic Regulation vs Competition: Ralph Nader and Creeping Capitalism', *The Yale Law Journal,* 82(5), pp. 890-902

Woerdman, E. (2004). 'The Institutional Economics of Market-Based Climate Policy, Developments', *Environmental Economics*.

Wogan, D. *et al*, (2019). '*Policy Pathways to Meet Saudi Arabia's Contributions to the Paris Agreement*', KS--2019-DP49. KAPSARC, p. 9.

Wójcik, D. (2007). 'Geography and the Future of Stock Exchanges: Between Virtual and Real Spaces', *Growth and Change*, 38(2): 200-223.

World Weather and Climate Conditions, available at https://weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine, doha, Qatar

Xiong, L., Shen, B., Qi, S. and Price, L. (2015). Assessment of allowance mechanismin China's carbon trading pilots', *Energy Procedia*, *75*, pp.2510-2515.

Xi's Huzhou Trip: *The Birth of "Two Mountains" Theory*, The State Council Information Office: People's Republic

Zafar, S. (2016). 'A Primer on Landfill Gas Recovery', *EcoMENA*.

Zhang, Y. *et al*, (2018). *'China's Carbon Market: Accelerating a Green Economy in China and Reducing Global Emissions',* Global Development and Environment Institute Working Paper No. 18-01.

Zhang, Y. *et al*, (2020). 'Quantifying Methane Emissions From the Largest Oil Producing Basin in the United States From Space', *Scientific Advances*, 6(17).

Zhu, T., Bian, W., Zhang, S., Di, P. and Nie, B. (2017). 'An improved approach to estimate methane emissions from coal mining in China', *Environmental science & technology*, *51*(21), pp.12072-12080.

Appendix A: Detailed Additions to Chapter Seven

Table 7.1: Gulf Hydrocarbon Producers' Core Positions During Climate Negotiations (From Kyoto to Glasgow)

• Hydrocarbon-producing countries feared that the global implementation of either a carbon trading or a carbon taxation regime would cause a marked decline in global oil demand, raising the price of oil to consumers.
• A decline in hydrocarbon-based revenue to producing countries would negatively affect their ability to implement sustainable economic development and expand social welfare. An unstated concern is that decreasing foreign revenue would stimulate socio-political discord in many producing countries.
• Carbon taxation is one of the most prevalent methods of carbon emissions reduction. This abatement method would cause a growth in the 'rent' that various (principally developed) consuming countries acquire in the global energy market. Thereby increasing the transfer of wealth from producers to consumers.
• An increase in renewable energy subsidies would likely be at the expense of hydrocarbons. And, according to hydrocarbon producers, would be unfair trade discrimination.
• Significant technological innovation would be required to refashion hydrocarbons into a less carbon-intensive fuel.
• Developed countries should create a viable framework for transferring carbon abatement/renewable energy technology to developing (including producer) countries.
• Carbon capture and storage is a viable technology that can ensure hydrocarbons will continue to meet energy demand in a decarbonized world for the future.
• Developed countries bear the historical cost of global carbon emissions. And, therefore, should establish adequate compensation mechanisms for producing countries that would experience foreign revenue decline.
• The science of anthropogenic climate change is largely unproven and needs to be researched in depth. Some Gulf policymakers believed climate change to be a hoax perpetrated by Western countries to impede their economic development.
• Hydrocarbons still constitute the majority of the global energy mix. Any rapid steps to reduce its demand would cause severe economic disruption for the producing countries and cause price shocks for the consumers in the developed and developing countries.
Sources: Suraje Dessai, 'An Analysis of the Role of OPEC as a G77 Member at the UNFCCC' (2004) <https://wwfint.awsas-sets.panda.org/downloads/opecfullreportpublic.pdf>

Table 7.2*: Equity Principles and Burden Sharing Rules*

Equity principle	Interpretation	General operational rule
Egalitarian	Every Individual has an equal right to pollute or to be protected from pollution	Allow or reduce emissions in proportion to population
Sovereignty	All nations have an equal right to pollute or to be protected from pollution; current state of emissions constitutes a status quo ("grand-fathering")	Proportional reduction of emissions to given or existing emission levels or equal percentage of emission reduction
Polluter pays	Welfare losses corresponding to gains by emissions	Share abatement costs across countries in proportion to (eventually including historical emissions) emission levels
Ability to pay	Mitigation costs vary directly with national economic well-being	Equalize abatement costs across nations (costs as proportion of GDP equal for each nation)
Horizontal	All countries with similar features have similar emissions rights and burden-sharing responsibilities	Equalize net welfare change across nations-net cost of abatement as a proportion of GDP
Vertical	Welfare losses vary positively with national economic well-being; welfare gains vary inversely with GDP	Progressively share net welfare change across nations, net gains inversely and net losses positively correlated with per capita GDP
Utilitarian	Achieving the greatest good (happiness) for the greatest number	Maximize net present value of the sum on individuals' utility (maximize social welfare)
Compensation	No nation should be made worse off	Compensate net losing nations
Rawls' maximin	The welfare of the worst-off nations should be maximized	Maximize the net benefit to the poorest nations
Market justice	Market justice	Allocate emissions permits to the highest bidder
Consensus equity	The negotiation process is fair	Seek a political solution to emissions reduction
Convergence	Equalize per capita emissions	Converge to an upper boundary of emissions
Environmental	The environment receives preferential treatment	Maximize environmental values and cut back emissions accordingly

Source: Decision Making Frameworks: Working Group III, Intergovernmental Panel on Climate Change Website

Table 7.3: Foundation for an NDC

Elements of a Holistic NDC	Key Considerations
Ambition	Whether the NDC seeks to implement GHG emissions reductions through a viable and clearly defined framework? Is the country able to implement more reductions without significant economic disruption? Is the political will adequately telegraphed for decarbonization implementation? Will the NDC assist in meeting the collective goal of maintaining global warming below 1.5 degrees Celsius?
Transparency	Does the NDC have an efficient mechanism for monitoring progress toward the pledged targets?
Equitableness	Is each party undertaking a fair share of climate mitigation and adaptation to achieve the target of a global temperature increase below 1.5 degrees Celsius?

Table 7.4: Main Elements of Saudi Arabia's First NDC (2016)

Saudi Arabia seeks to diversify its economy from a singular dependence upon hydrocarbon-generated income. The principal impetus for Saudi Arabia's NDC is to accelerate economic diversification. Saudi Arabia's NDC is designed so that the following policies and actions will generate mitigation co-benefits and contribute to economic diversification that allows Saudi Arabia to meet its greenhouse gas reduction pledges.
Copenhagen Pledge 2020 Target: None
Paris Agreement Target: Yes
Ratification: Yes (Dec. 3, 2016)
2030 Target: Economy-Wide Annual Abatement of 130 MtCO2e after 2030 (ex. Land Use and Land Use Change and Forestry)
Alternative Energy Deployment: Invest and deploy ambitious programs for alternative energy to increase its role in the domestic energy mix. This includes nuclear power, solar PV and Solar CSP, wind energy, geothermal energy, and waste-to-energy technologies. Towards the goal of expanding renewable energy use in the Kingdom in 2017, Saudi Arabia announced a renewable energy investment plan of between $30-50 billion comprising approximately 60 projects with 9.5 gigawatts of renewable energy (capacity) to be produced annually by 2023. In August 2017, the Saudi government announced that it planned to exceed its target of 9.5 gigawatts. However, further details were not forthcoming at the time of its announcement.
Energy Efficiency: Saudi Arabia seeks to promote, stimulate and support policies to implement carbon mitigation co-benefits in energy efficiency. The Saudi energy efficiency program currently focuses on three main sectors, construction, industry, and transportation, accounting for over ninety percent of the Kingdom's energy consumption. Saudi Arabia intends to derive most of the mitigation co-benefits from the introduction of efficiency standards in the transportation and construction sectors and the implementation of energy efficiency measures in the industrial sector. Additionally, this program seeks to convert single-cycle power plants to combined cycle power plants rapidly. As part of its energy efficiency program, Saudi Arabia plans to reduce power and water subsidies by $53 billion and reduce non-oil subsidies by twenty percent by 2020.
Carbon Capture and Utilization/Storage: Saudi Arabia intends to construct the world's largest carbon capture and storage plant. The Saudi Aramco CCS plant aims to capture and purify approximately 1,500 tons of CO2 a day for use in various petrochemical plants across the country. Forty million standard cubic feet a day of CO2 will be captured, processed, and injected into the 'Uthmaniya oil reservoir to enhance oil recovery.
Gas Utilization: Saudi Arabia seeks to stimulate and funnel investments into the natural gas sector to transition away from the domestic consumption of oil. As natural gas is less carbon-intensive than oil, the displacement of oil consumption would lead to lower carbon emissions, thus realizing a large part of Saudi Arabia's mitigation co-benefit goals. As part of the National Transformation Program, Saudi Arabia intends to increase gas production from 12 Bcf/d to 17.8 Bcf/d by 2020 and deploy more combined cycle power plants to transition from open cycle power generation.
Methane recovery and flare minimization: Saudi Arabia is currently taking action to conserve, recover and reuse methane and promote the reduction of flaring and fugitive emissions. Saudi Arabia joined the Global Methane Initiative in 2014. Saudi Arabia has made strides in natural gas flaring reductions. In 1974, gas flaring accounted for nearly seventy-five percent of its hydrocarbon emissions. Due to better hydrocarbon management practices, the government reduced flaring to less than one percent of total emissions. However, based on the most recent data, Saudi Arabia still ranks at eleventh globally for gas flaring.
Sources: Saudi Arabia INDC (2016) and Climate Action Tracker <http://climateactiontracker.org/countries/saudiarabia.html>

Table 7.5: Main Elements of Saudi Arabia's Updated NDC (2021)

Saudi Arabia submitted its updated NDC on October 23, 2021. It reaffirmed its commitment to the Paris Agreement goals through mitigation co-benefits through economic diversification and adaptation. It increased its ambition by raising its 2030 emissions reductions target from 130 MtCO2e in its first NDC (2016) to 278 MtCO2e. However, Saudi Arabia states that its aspirations are contingent on long-term economic growth and diversification that will still rely upon a large contribution from its hydrocarbon export revenues to the national economy. The Saudi NDC also predicates its GHG reduction policies on the assumption that the socio-economic consequences of international decarbonization actions will not pose a disproportionate or abnormal burden on the Saudi economy, as per Paragraph 2 of Article 3 of the UNFCCC. The updated 2030 targets utilize the Circular Carbon Economy Approach.
Paris Agreement Target: Yes
Ratification: Yes (Oct. 23, 2021)
2030 Target: Economy-Wide: Increased its 2030 emissions reductions target from an annual abatement of 130 MtCO2e in its first NDC (2016) to 278 MtCO2e after 2030 (ex. Land Use and Land Use Change and Forestry).
Alternative Energy Deployment (Power Sector): Renewable energy projects will diversify the energy mix used in electricity production. The renewable energy ambition aims to reach around 50% of the energy mix by 2030. Through the National Renewable Energy Program, the Kingdom will implement a set of comprehensive reforms, regulations, and policies to stimulate private sector investment, research, and development, employment in renewables. The program sets a roadmap to diversify local energy sources, encourage economic growth, and establish the local renewable energy supply chain and industry. The Kingdom will seek to localize a significant portion of the renewable energy value chain in the Saudi economy, including research & development and manufacturing. Specific technologies for deployment include solar PV, concentrated solar power, wind, geothermal energy, waste to energy, and green hydrogen.
Energy Efficiency: Numerous initiatives will be implemented to improve and raise the efficiency of energy consumption in the targeted sectors, including improving the efficiency of home appliances and air conditioning units, improving the efficiency of feedstock utilization in key strategic industries such as petrochemicals, improving transportation fleet fuel economy, phasing out inefficient used light-duty vehicles, implementing aerodynamic regulation for heavy-duty vehicles, and improving the thermal efficiency of power generation, transmission, and distribution. The National Energy Services Company (Tarshid) incentivized energy efficiency in government buildings and private sector investment in energy efficiency services. It plans to retrofit the entire pool of public and governmental assets and facilities, including 2 million streetlights, 110,000 government buildings, 35,000 public schools, 100,000 mosques, and 2,500 hospitals and clinics.
Blue Hydrogen: The Kingdom is developing a National Hydrogen Strategy to chart pathways to become a global leader in the hydrogen industry. With associated carbon emissions captured, utilized, and/or stored in geological formations, blue hydrogen can be utilized domestically in various industrial sectors. Pilots, research, and demonstrations will be prioritized to improve technology maturity and lower costs in the aviation, shipping, petrochemicals, and steel industries.
Carbon Capture and Utilization/Storage (CCUS): To advance the uptake of CCUS technologies and scale up its deployment, the Kingdom plans to transform Jubail and Yanbu into global hubs for carbon capture, utilization, and storage. The hubs will leverage the concentration of the manufacturing industry, proximity to sinks, and transport infrastructures. Jubail and Yanbu are homes to the regional petrochemicals, steel, and other heavy industries. Both cities represent the economy of scale opportunity to reduce, reuse, recycle, and remove GHG

emissions.
Gas Utilization: As part of reforms of its domestic energy sector, the Kingdom aims to increase the utilization of natural gas in its energy mix. By 2030, the Kingdom aims that up to 50% of its electricity generation is expected to be met by natural gas, significantly lowering the carbon intensity of domestic energy generation.
Methane recovery and flare minimization: The methane management measures include zero flaring in the oil and gas industry, recovery, and subsequent utilization for power generation and petrochemicals production. The Kingdom as a member of the Global Methane Pledge initiative, will collaborate with other members to reduce global methane emissions by 30% by 2030 relative to 2020 levels.
Sources: Saudi Arabia NDC (2021) and Climate Action Tracker <http://climateactiontracker.org/countries/saudiarabia.html>

Table 7.6: Main Elements of UAE's First NDC (2015)

The UAE is attempting to ambitiously diversify away from domestic hydrocarbon consumption and radically increase renewable energy production. The climate pledges of the UAE have already implemented policy as outlined within its economic blueprint for development, entitled, *Green Growth Strategy*. The Emirati NDC is intended to generate substantial mitigation co-benefits through its macro-economic diversification strategy.
Copenhagen Pledge 2020 Target: None
Paris Agreement Target: Yes
Ratification: Yes (Sept. 21, 2016)
Mitigation Target: Various Non-Quantified measures, alternative energy generation by 24% in 2021.
Land Use, Land Use Change, and Forestry: Not Mentioned
Long-Term Goals: None (However, other official government announcements indicate a plan for 75% alternative energy generation by 2050 by installed capacity). Each Emirate is responsible for creating its carbon emissions reduction strategy. The Emirati INDC did not list any firm and quantifiable carbon reduction targets, but it did outline the below actions to be undertaken. Most of the recorded measures are already implemented policies.
Reduction of Gas Flaring: To reduce gas flaring in the hydrocarbon sector and develop and deploy carbon capture and storage across the country.
Alternative Energy Development: Investment in nuclear, solar, carbon capture, and storage to increase alternative energy in the domestic energy mix to 24% by 2021 by installed capacity.
Electricity Pricing Reconfiguration: Broad power tariffs increase to reduce domestic energy demand.
Energy Pricing Deregulation: Increases in gasoline and natural gas prices to eventually meet international levels.
Energy Efficiency Standards: The creation of energy efficiency standards for residential appliances and the building sector (Abu Dhabi established in 2014) (Dubai established in 2011).
Country-wide Rail System: A planned national railroad network to reduce the use of personal automobiles.
Transport Sector: Significant investments in light rail and local metro systems (already in place in Dubai).

Table 7.7: Main Elements of UAE's Second NDC (2020)

When the UAE submitted its first NDC, it did not pledge an emissions reduction target; it only had a clean energy target set for 2021. The UAE progressed significantly with a 2030 emissions reduction target in this NDC.
Emissions Reduction: Reduction of 23.5% in GHG emissions for the year 2030, relative to business-as-usual (BAU). The BAU scenario emissions in 2030 stand at about 310 million tons, assuming a moderate annual economic growth based on historical growth trends.
Type: Absolute, economy-wide emission reduction target relative to BAU.
Scope and Coverage, Consistent with IPCC Guidelines: Key sectors covered: Energy, Industry Processes and Product Use, Waste, Agriculture, Land Use Change & Forestry Greenhouse gases covered: Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O), Perfluorocarbons (PFCs).
Timeframe and Period of Implementation: From the start of 2021 to the end of 2030
BAU and NDC Target Scenarios: BAU scenario starts in 2016 and takes into account mitigation measures implemented by the UAE by the end of 2016. NDC Target scenario represents a deviation from the BAU, accounting for implemented and planned mitigation measures for the period 2017-2030.
If applicable, the Intention to Use Voluntary Cooperation under Article 6 of the Paris Agreement: While the UAE intends to primarily rely on domestic efforts to fulfil its NDC objectives, it may consider using voluntary cooperation under Article 6 of the Paris Agreement partially achieve these objectives.
Sources: UAE NDC (2020) <https://www4.unfccc.int/>

Table 7.8: Comparison of UAE NDC Targets

		2016 NDC	2020 NDC	Change
2030 unconditional target(s)	**Country's formulation of the target**	Increasing the contribution of clean energy in the total energy mix from 0.2% in 2014 to 24% by 2021	Reduction of 23 5% in GHG emissions in 2030 relative to a BAU of 310 MtC02e*	+
	Absoluter emissions level [excl. LULUCF]	[238 MtCO2e in 2021** according to CAT calculations]	246 MtCO2e in 2030**	
	Emissions compared to 1990 and 2010 [excl. LULUCF]	[485% above 1990 levels in 2021] [24% above 2010 levels in 20211	505% above 1990 levels in 2030 28% above 2010 levels in 2030	
	CAT rating	Highly insufficient	Highly insufficient	
	Net zero-emissions target	No	No	
	Alignment of NDC to long term target	No long-term emissions reduction target available	No long-term emissions reduction target available	
	Sector coverage	Energy	Economy-wide (Energy, Industry Processes and Product Use, Waste, Agriculture, LULUCF)	+
	Separate target for LULUCF	No	No	+
	Gas coverage	Not relevant	Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide(N20), Perfluorocarbons (PFCs)	+
	Target type	Clean energy target only, no emissions reduction target	Emissions reduction below business-as-usual scenario	+
	Clarity of implementation plan	The first NDC includes a list of economic diversification measures "with mitigation co-benefits" in key sectors. These measures are implemented at the sub-national, emirate level (mostly in Dubai and Abu Dhabi).	The second NDC includes a somewhat more comprehensive list of mitigation strategies and policies in key (sub-)sectors. It also mentions the new inter emirate and federal governance structures for implementing climate policy. All seven emirates participate in these processes.	
	Explanation of why the target is a fair contribution towards the global goal	No	There is a section justifying the fairness and ambition of the target in the second NDC, but it does not provide a clear explanation as to how this target is a fair contribution with regards to the long-term temperature goal of the Paris Agreement.	
	Followed guidance on information to facilitate clarity, transparency and understanding of NDCs in Decision 4/CMS.1	Not applicable	No. While reference to the guidance is made, some elements are missing, including transparency on the sources used to calculate the BAU scenario, the GWP values and assumptions around LULUCF.	

Table 7.9: Main Elements of First Qatar's NDC (2015)

Qatar is attempting to increase the proportion of solar energy in the domestic energy mix and decrease the amount of natural gas consumed for water desalination projects and power generation. The NDC is also focused on the environmental risk that Qatar suffers from in the event of significant global temperature increases. The Qatari NDC is intended to generate mitigation co-benefits through its macro-economic diversification strategy.
Copenhagen Pledge 2020 Target: None
Paris Agreement Target: Yes
Ratification: Yes (June 23, 2017).
Mitigation Target: Focus on Economic diversification with mitigation co-benefits.
Land Use, Land Use Change, and Forestry: Not Mentioned
Long-Term Goals: None (however, other official government announcements indicate a plan for 1,800 MW of solar energy production by 2020 with 10 GW produced by 2030).
Energy Efficiency: References Qatar's various energy efficiency projects but indicates that the existing capacity is not enough to support upgrades.
Clean Energy and Renewables: Focus upon investments in LNG, which has a lower carbon intensity than oil and coal, and current or proposed investments in wind and solar energy with a view of exporting solar-generated electricity throughout the region at a future date. Stresses that technology transfer is required to increase deployment.
Research and Development: Investment in research and development in renewable energy technology and climate change adaptation.
Education: Focus on increasing human resources and capacity building in the youth demographic to promote environmental awareness.
Tourism: Promotion of sustainable tourism to reduce reliance on hydrocarbon resources.
Water Management: Initiation of policies to increase water conservation and renewable energy-powered desalination plants.
Infrastructure and Transportation: Significant investment in public transportation and the domestic road network.
Source: Qatar INDC (2016)

Table 7. 10: Main Elements of Qatar's Second NDC (2021)

Reference base year: 2019
Target year: 2030
Sector coverage: Economic diversification & Adaptation Measures with Mitigation Co-Benefits: Energy including transport & downstream industries; building & construction industry, water management, waste, and infrastructure.
Emission reduction ambition: The reduction of 25% in GHG emissions for the year 2030, relative to the BAU scenario, is consistent with provisions stipulated in Articles 4.3, 4.4, and 4.7 of PA. Also, Article 6 is considered in the implementation.
BAU and NDC target scenarios: The BAU scenario starts in 2019 and considers mitigation measures implemented by the State of Qatar until the end of 2019. The NDC target scenario represents a deviation from the BAU, accounting for implemented and planned measures for the period 2020-2030.
Consistency with IPCC guidelines and methodologies Greenhouse gases covered: Carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O). Nationally Determined Contribution (NDC) 3 Methodologies to be followed are based on the 2006 IPCC Guidelines.
Fairness and ambition of NDC based on national circumstances: Qatar is a low GHG emitting country. Historically it has been actively participating in the global efforts to address climate change by providing cleaner natural gas fuels to the global energy market, thereby reducing the global consumption of carbon-intensive alternatives. The Qatari economy is highly dependent on natural gas export revenues. This makes Qatar vulnerable to the negative impacts of response measures and the effects of climate change and its adverse impact (Art. 4.8 of the Convention).
Contribution to the accomplishment of the objective of Article 2 of the convention: Through the mitigation measures by 2030 and considering the socio-economic development objectives, Qatar will contribute on an equitable basis to achieving the objective of Article 2 of the convention.
Source: Qatar NDC (2021)

Appendix B: Total Listing of GHG Regional and Global Accounting

SCOPE 1, 2, and 3 Emissions for Adnoc, Aramco, and QatarEnergy

Company	Scope 1 Emissions	Scope 2 Emissions	Scope 3 Emissions
Saudi Aramco	49.1 million metric tons of CO2e	17.9 million metric tons of CO2e	10.5 million metric tons of CO2e
Adnoc	20,045 tons of CO2e	110,105 tons of CO2e	N/A
QatarEnergy	33.87 million metric tons of CO2e	860,000 metric tons of CO2e	N/A

Sources: www.aramco.com/-/media/publications/corporate-reports/saudi-aramco-ara-2020-english.pdf; www.adnocdistribution.ae/media/3800/adnoc-distribution-esg-report-2020-english.pdf; www.qatargas.com/english/sustainability/Sustainability%20Reports/Sustainability%20Report%202020_English.pdf

CO2 Per Capita 1971-2018

CO2 PER CAPITA

Year	UAE	Saudi Arabia	Qatar	United States	United Kingdom	China	World
1971	75.98	9.8	76.64	21	11.82	1	4.2
1975	56.05	11.22	66.64	20.4	10.74	1.3	4.3
1980	35.4	17.39	58.53	18.9	10.29	1.5	4.6
1985	35.89	13.09	33.43	19.4	9.9	1.9	4.4
1990	27.96	11.38	24.71	19.4	9.71	1.9	3.9
1995	28.85	12.55	61.91	19.3	9.28	2.6	3.8
2000	35.68	14.3	58.64	20.5	9.2	2.6	3.8
2005	25.36	16.63	58.92	19.5	8.98	4.5	4.2
2010	19.44	18.91	40.74	17.4	7.86	6.3	4.5
2014	23.3	19.53	45.42	16	6.5	7.2	4.6
2016	22.04	17.37	38.9	15.1	5.78	7.1	4.4
2018	20.8	15.3	32.4	15.2	5.4	7.4	4.5

Sources: https://link.springer.com/content/pdf/10.1007/s10098-021-02184-y.pdf, databank.worldbank.org

Total GHG Emissions Comparison 1990-2018

TOTAL (MtCO2e)						
Year	**UAE**	**Saudi Arabia**	**Qatar**	**United States**	**United Kingdom**	**China**
1990	69.71	190.64	14.08	5543.47	746.4	2873.71
1995	90.78	255.07	19.1	5843.9	702.55	3918.3
2000	113.34	291.54	24.23	6446.2	673.87	4249.7
2005	156.7	366.49	44.81	6401.12	663.91	6862.81
2010	208.58	514.56	68.84	6041.59	583.6	9872.37
2014	240.02	629.39	88.94	5711.15	502.84	11155.76
2016	259.65	664.17	94.7	5676.92	464.28	11207.66
2018	263.24	638.12	99.83	5794.35	441.13	11705.81

Source: https://www.climatewatchdata.org/ghg-emissions?end_year=2018&start_year=1990

Total GHG Emissions Rankings 1990-2018

Ranking for GHG Emissions						
Year	**UAE**	**Saudi Arabia**	**Qatar**	**United States**	**United Kingdom**	**China**
1990	63	32	125	1	10	3
1995	52	25	113	1	9	2
2000	45	24	108	1	10	2
2005	37	22	86	2	10	1
2010	36	15	70	2	14	1
2014	32	13	60	2	17	1
2016	34	13	57	2	17	1
2018	33	14	58	2	18	1

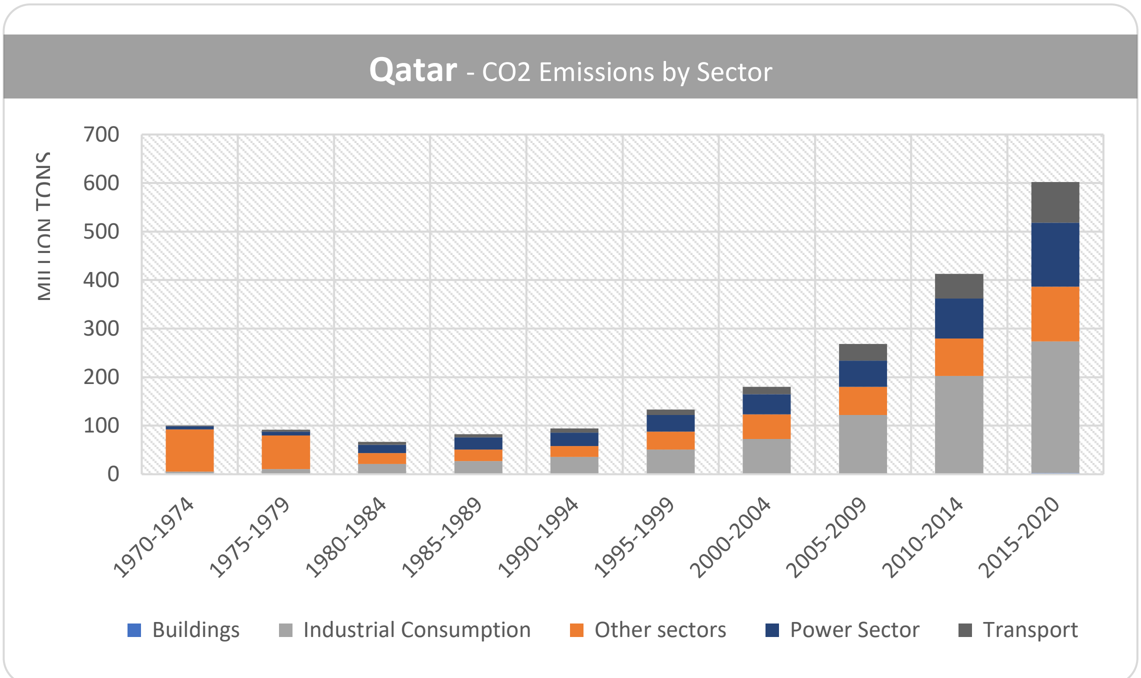
Source: https://www.climatewatchdata.org/ghg-emissions?end_year=2018&start_year=1990

Ranking for GHG Emissions Per Capita 1990-2018

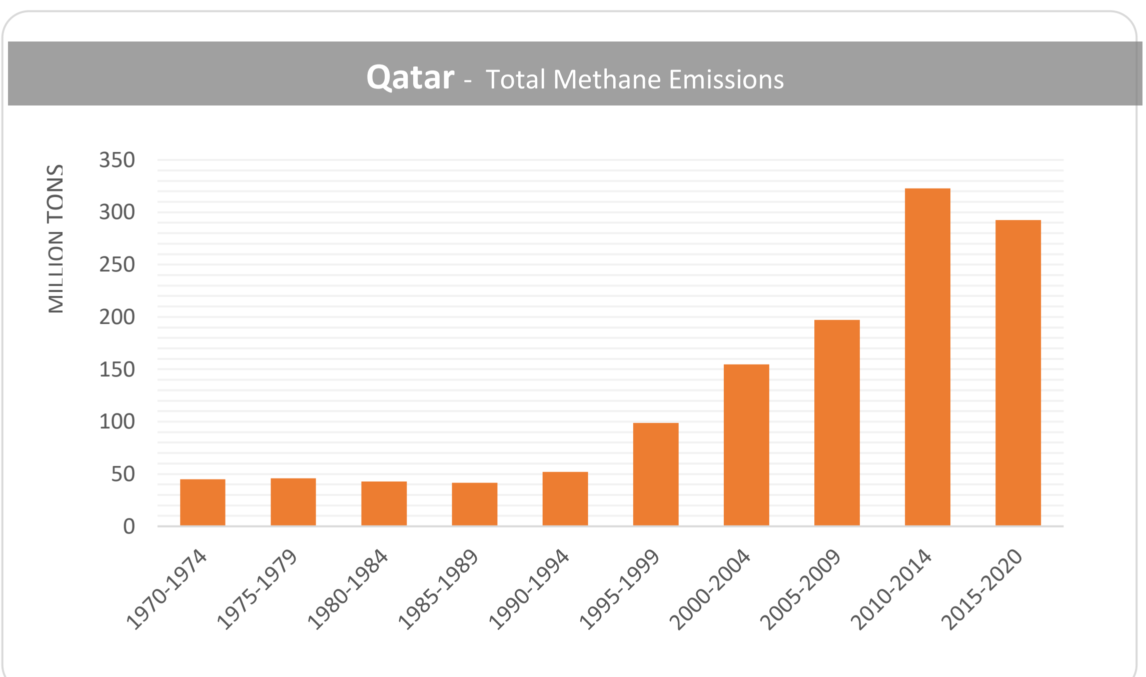
Ranking for GHG Emissions Per Capita						
Year	UAE	Saudi Arabia	Qatar	United States	United Kingdom	China
1990	4	42	7	13	34	146
1995	4	27	5	10	36	127
2000	3	21	2	11	39	126
2005	5	20	1	12	40	94
2010	9	15	2	13	49	61
2014	7	14	2	18	55	51
2016	6	13	3	18	65	57
2018	5	14	3	18	74	54

Source: https://www.climatewatchdata.org/ghg-emissions?calculation=PER_CAPITA&end_year=2018&start_year=1990

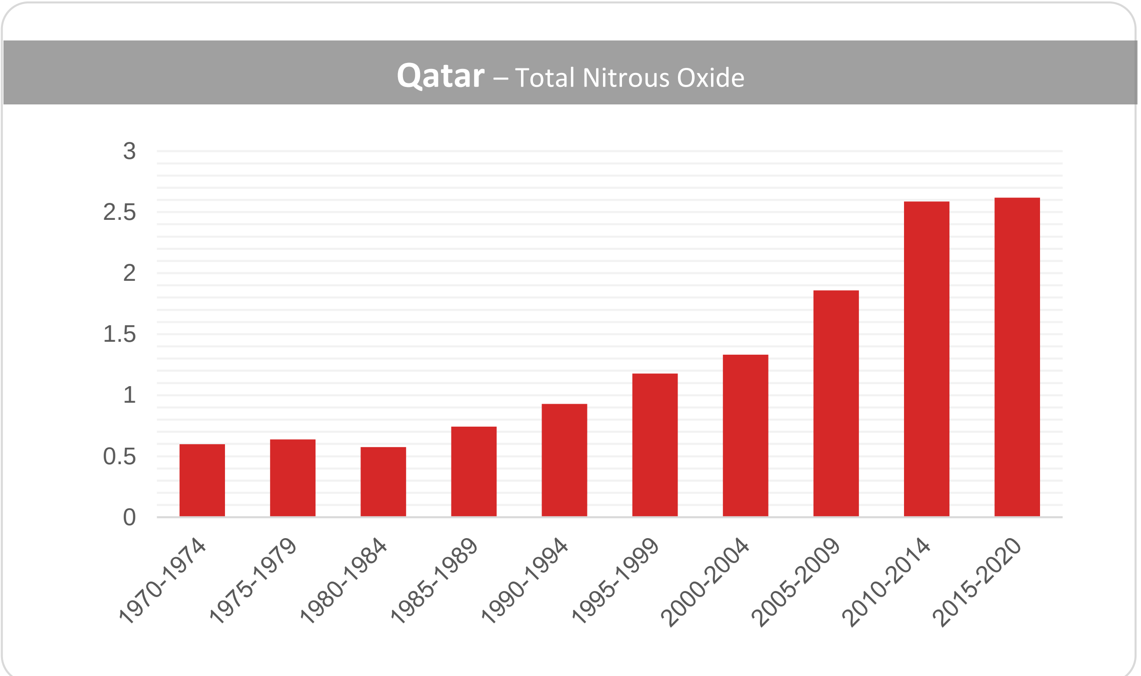
Section 1: Graphs: Qatar GHG Emissions



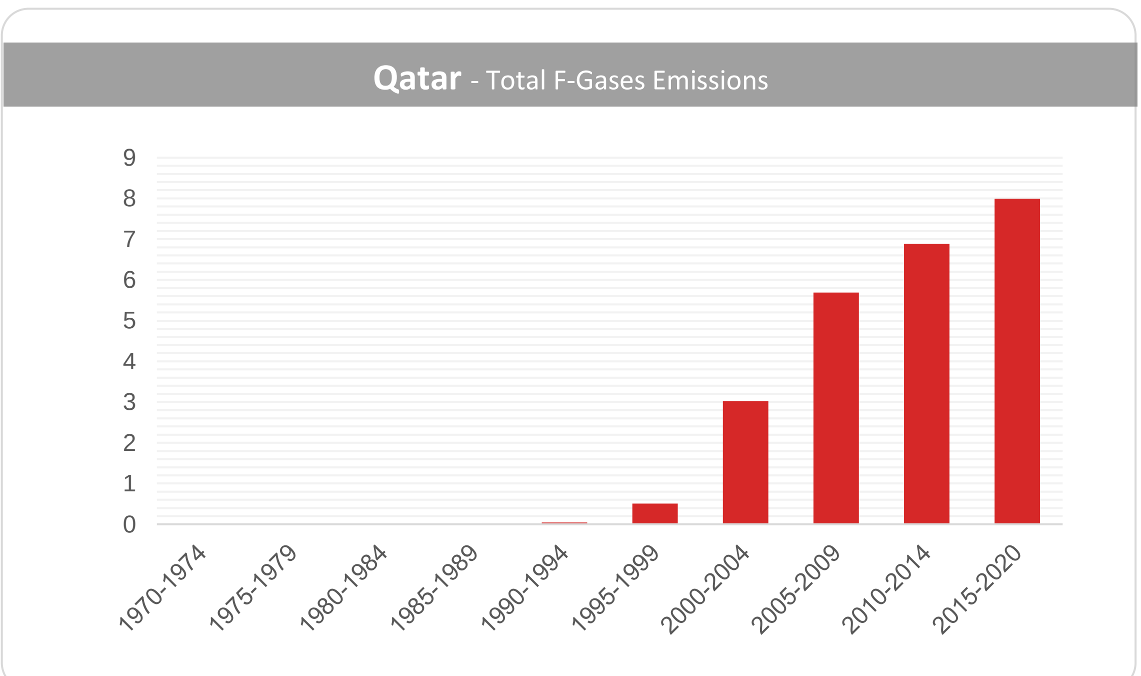
Source: https://edgar.jrc.ec.europa.eu/country_profile/



Source: https://edgar.jrc.ec.europa.eu/country_profile/QAT



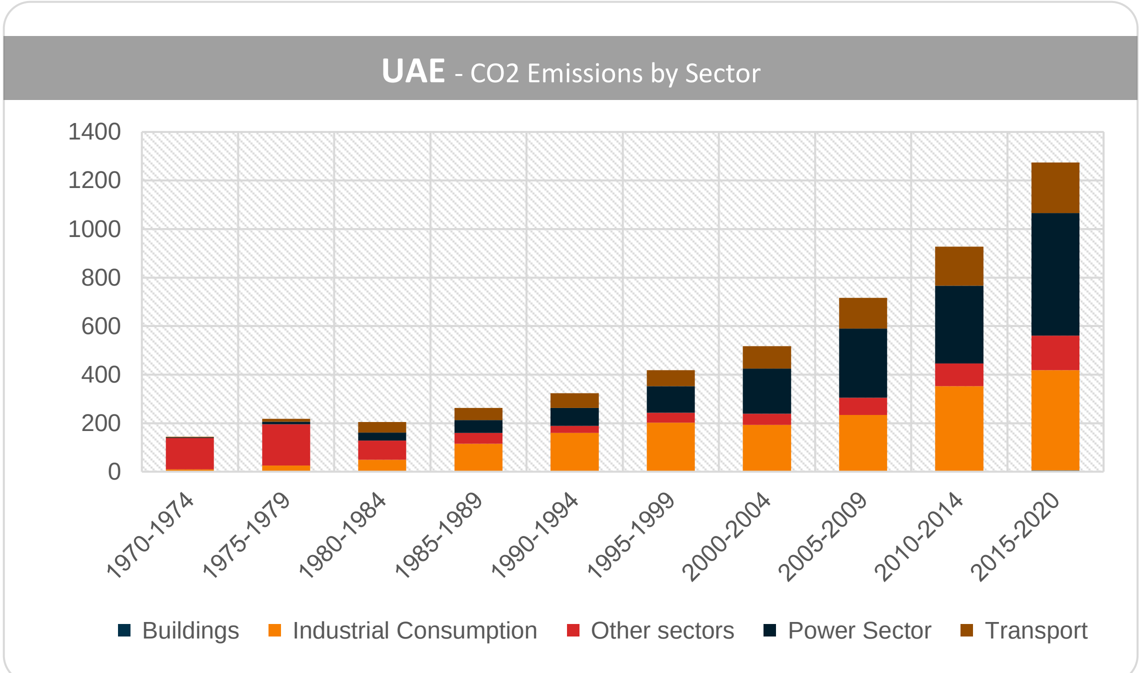
Source: https://edgar.jrc.ec.europa.eu/country_profile/QAT



Source: https://edgar.jrc.ec.europa.eu/country_profile/QAT

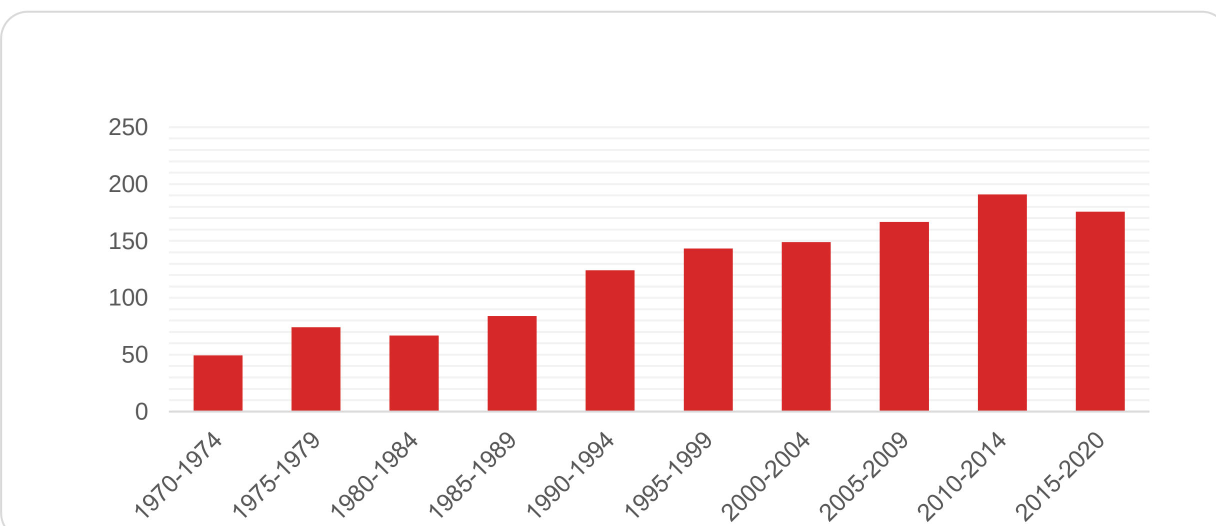
For F-Gases: The principal Industries accounted for are (1) as a substitution for ozone-depleting substances, such as refrigerants, fire retardants and coolants. This makes up over 90% of F-gas emissions. (2) transportation (mainly through air-condition for vehicles and (3) in the transmission and distribution of electricity.

Section 2: Graphs: UAE GHG Emissions

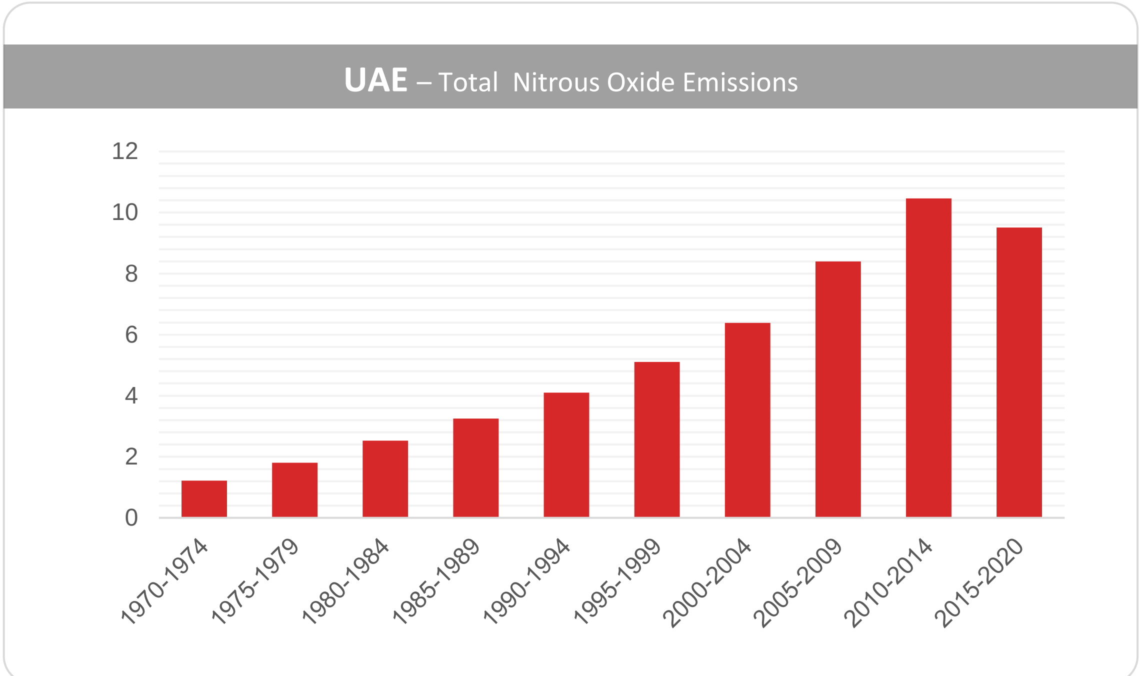


Source: https://edgar.jrc.ec.europa.eu/country_profile/ARE

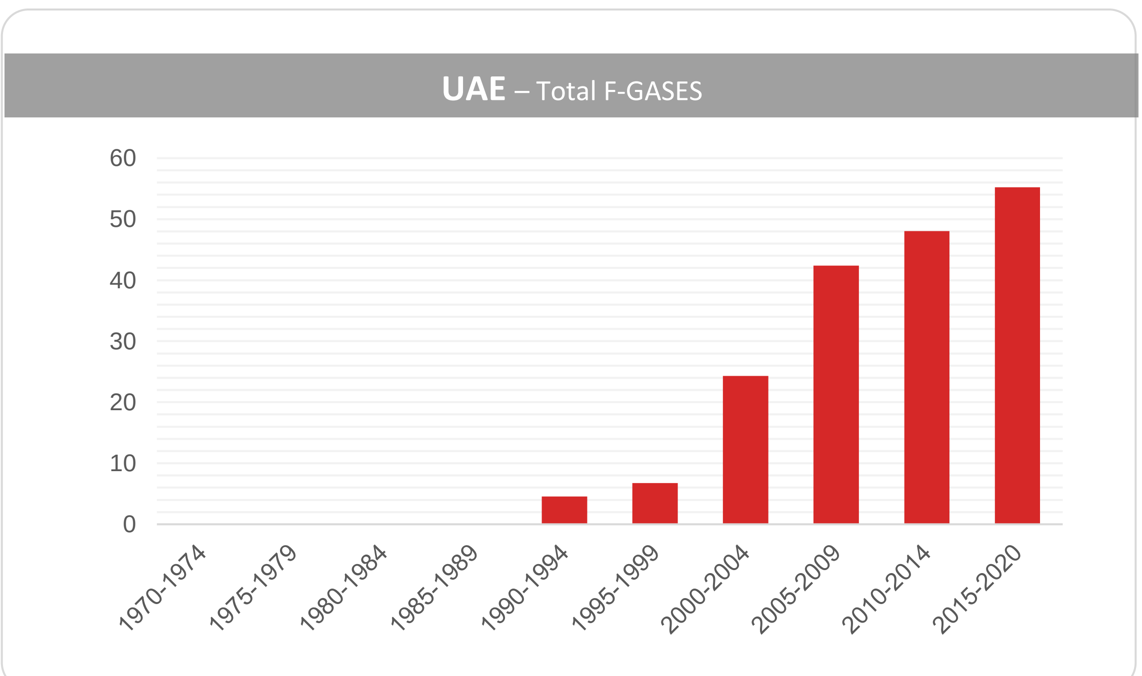
UAE – Total Methane Emissions



Source: https://edgar.jrc.ec.europa.eu/country_profile/AR



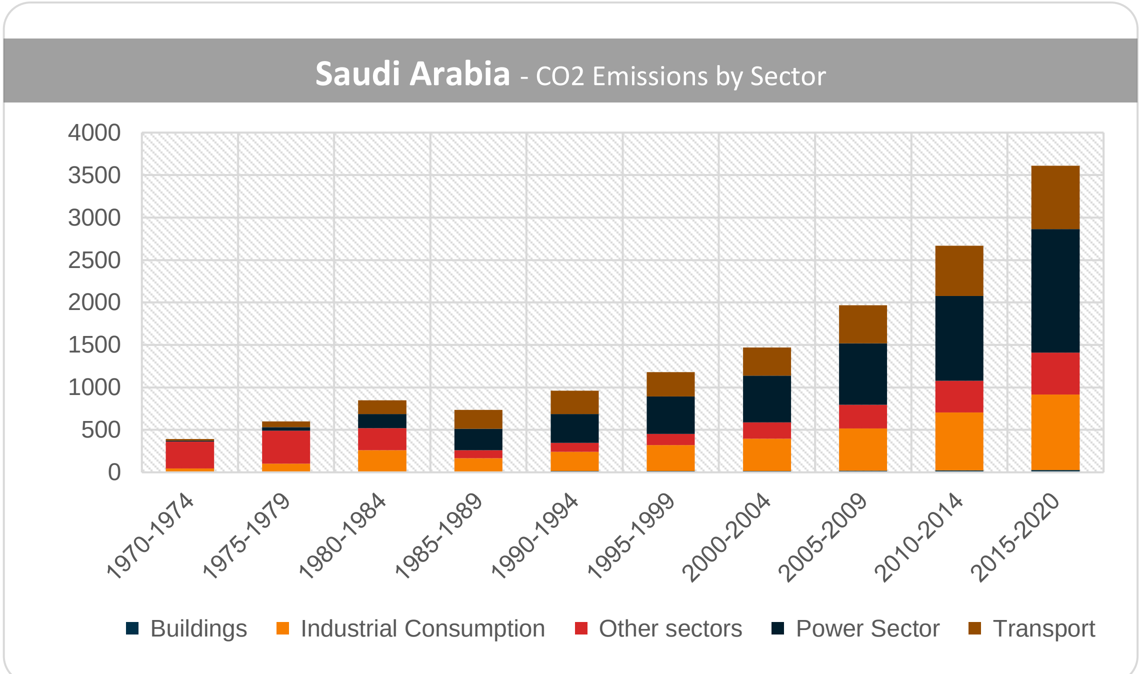
Source: https://edgar.jrc.ec.europa.eu/country_profile/ARE



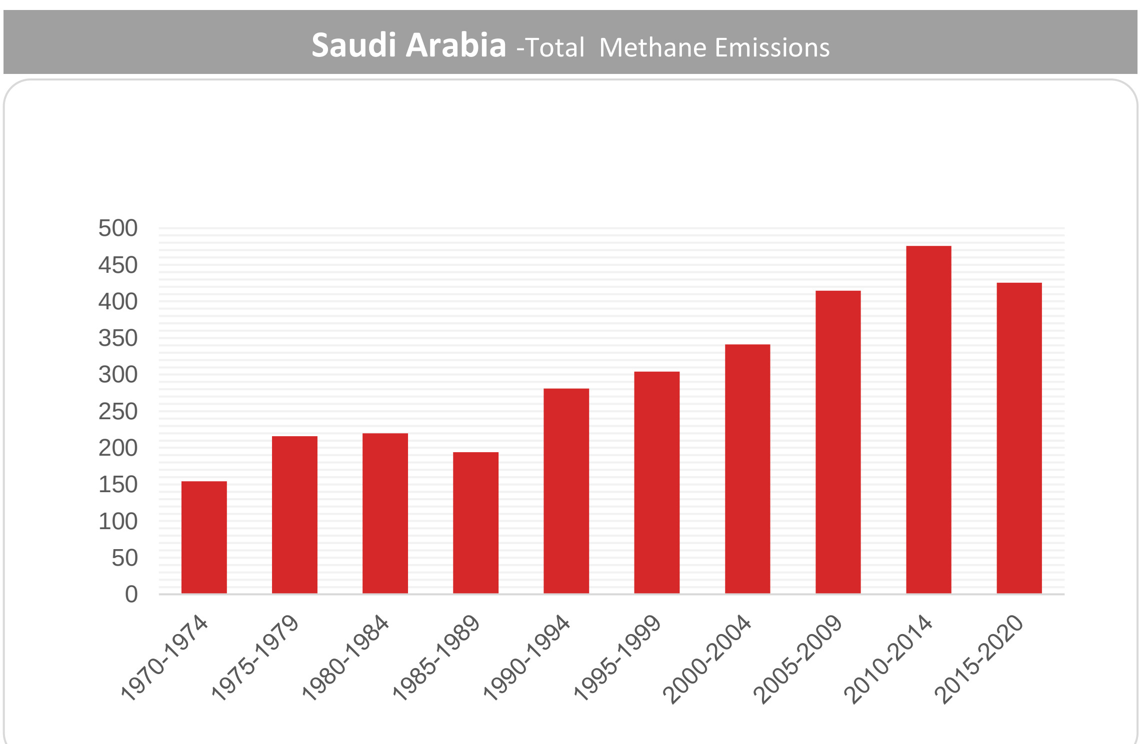
Source: https://edgar.jrc.ec.europa.eu/country_profile/ARE

For F-Gases: The principal Industries accounted for are (1) as a substitution for ozone-depleting substances, such as refrigerants, fire retardants and coolants. This makes up over 90% of F-gas emissions. (2) transportation (mainly through air-condition for vehicles and (3) in the transmission and distribution of electricity.

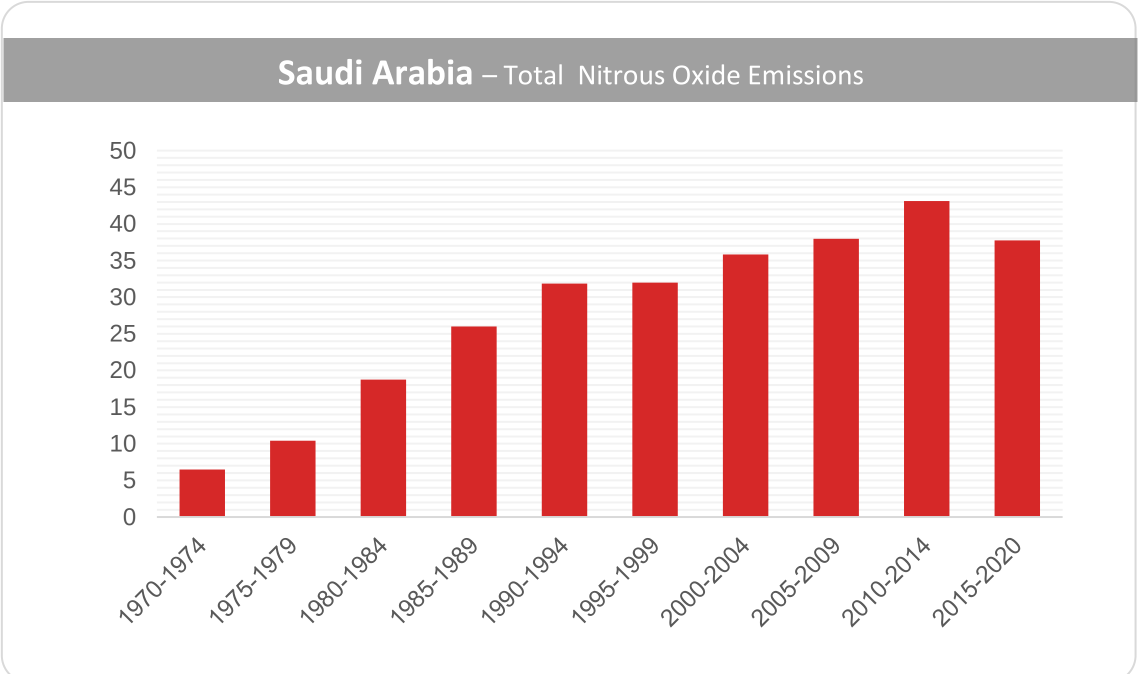
Section 3: Table and Graphs: Saudi Arabia GHG Emissions



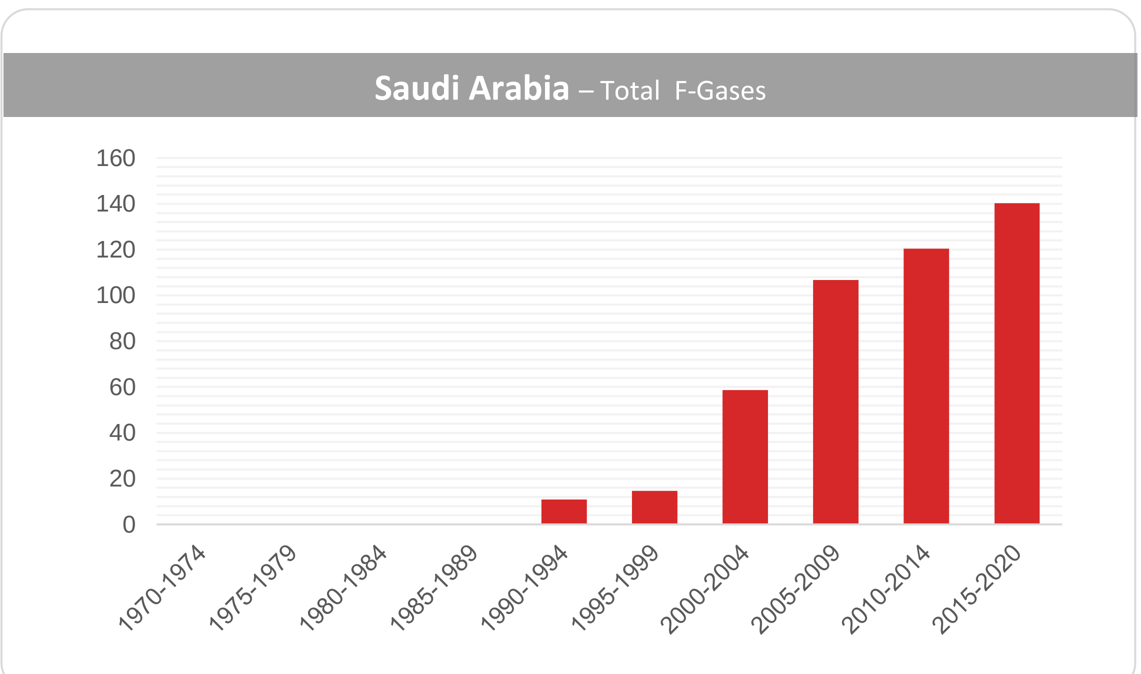
Source: https://edgar.jrc.ec.europa.eu/country_profile/SAU



Source: https://edgar.jrc.ec.europa.eu/country_profile/SAU



Source: https://edgar.jrc.ec.europa.eu/country_profile/SAU



Source: https://edgar.jrc.ec.europa.eu/country_profile/SAU

For F-Gases: The principal Industries accounted for are (1) as a substitution for ozone-depleting substances, such as refrigerants, fire retardants and coolants. This makes up over 90% of F-gas emissions. (2) transportation (mainly through air-condition for vehicles and (3) in the transmission and distribution of electricity.

Appendix C: Interviews, Conferences, Consultations and Lectures

Covid and Carbon: An Outlook for the Gulf Energy Sector National and International Security Leadership Seminar Washington DC (November 16, 2020)

Lead Consultant *UAE Energy Infrastructure*, ERGO (March 5, 2020)

UAE Global Scenarios, UAE Prime Minister's Office, Future Map (September17, 2020)

Renewable Energy Investment in the GCC, Role of IRENA (June 20, 2017)

Qatar LNG Strategy, QatarEnergy *(June 9, 2017)*

History of GCC Climate Change Negotiations, Interview with Mhamed Biygautane, Lecturer in Public Policy, The University of Melbourne (June 6, 2018, January 15, 2019, and December 4, 2020)

Saudi Carbon Reduction Plans, Aramco (February 19, 2018)

Lead Consultant: *UAE Natural Gas Investment Strategy,* ERGO (May 15, 2017)

The Impact of Shifting Geopolitics on MENA Energy, The Middle East Institute Washington DC (March 2, 2017)

A National Security and Economic Strategy from Transatlantic to Asia-Pacific American-Legion and Harriet Fulbright Institute Washington DC (March 1, 2017)

8th Gulf Intelligence UAE Energy Forum (2017) UAE Ministry of Energy Abu Dhabi, UAE (January 11, 2017).

The Water, Energy, Food Nexus: An Integrated Approach to the Middle East Water Challenge, Prince Mohammad Bin Fahd Program for Strategic Research and Studies Abu Dhabi, UAE (May 18-22, 2016).

Energy Subsidy Reform in the GCC State of the Region Forum-Government Leaders Program Under the Omani Ministry of Civil Service Muscat, Oman (November 2, 2015) Arabic Language

Power Struggle: The Geopolitics of Energy The Spectator *London, UK* (December 1, 2014).

MENA Knowledge Sharing and How-To Subsidy Reform Regional Workshop World Bank Amman, Jordan (September 7-9, 2014)

The Political Economy of Subsidy Reforms in MENA: Progress and Challenges, The International Monetary Fund and Atlantic Council, Washington DC (July 10, 2014)

Economic Challenges and Opportunities for Egypt's New Leadership, Tahrir Institute for Middle East Policy Washington DC (June 13, 2014)

Meeting with the Dubai Supreme Council of Energy to Advise about Decarbonization Opportunities in the UAE, Dubai, UAE (November 15, 2013).

Carbon Trading: Global Development and Impacts on Fossil Fuels, Chatham House, London, UK (April 13, 2013).

Energy and Oil Industry Dynamics in the Middle East Invensys: Operations and Business Solutions Forum Abu Dhabi, UAE (November 13, 2012).

Natural Gas Geopolitics 2nd Middle East Gas Forum Abu Dhabi, UAE (September 25, 2012)

Case Study: Qatar's Role in the LNG Trade LNG Shipping Forum, Royal Overseas League London, UK (September 19, 2012)

The Iranian Nuclear Issue and the Way Ahead MEC International London, UK (September 20, 2012)

The Race to Reduce Energy Intensity in the GCC Chatham House Workshop London, UK (September 18, 2012)

Lead Consultant *MENA Energy Sustainability* Financial Times-Shell Energy Dialogue Dubai, UAE (September 16, 2012)

The GCC and Asian Collaboration in the Energy Sector Zayed University Dubai, UAE (May 24, 2012)

LNG Demand Forecasts for Pacific and Atlantic Basin Markets and Opportunities for MENA Region Producers LNG Outlook 2012 Forum Dubai, UAE (May 22, 2012)

The Gulf Looking East: The Rise of an Asian Posture in Gulf Strategic Energy Policy Dubai School of Government Dubai, UAE (May 21, 2012)

Moderator: *Dealing with the Unexpected: BP's Black Swan Experience* (Given by VP of BP Dev Sanyal) 42nd St. Gallen Symposium, St. Gallen, Switzerland (May 2, 2012).

Competition or Cooperation? Energy Strategies in North East Asia European Institute of Asian Studies Brussels, Belgium (April 26, 2012).

The Coming Storm: The New Era of Unconventional Gas Production in the Gulf, Fleming Gulf Oil and Gas Conference Abu Dhabi, UAE (April 11, 2012).

Chairman "Global Gas Field Development Summit 2012" Doha, Qatar (March 28, 2012).

Chairman "Enhanced Oil Recovery Summit" Abu Dhabi, UAE (March 27, 2012).

Energy Geopolitics in the MENA Region American University in the Emirates Dubai, UAE (March 24, 2012)

"Emergent Energy Cooperation In Asia: Pathways for the Future" at the *International Conference of Emerging Regionalism: Paradigm Shift of International Relations in East Asia*? Chinese University of Hong Kong Hong Kong, China (March 9, 2012).

Chairman "3rd Annual Middle East and Africa Gas Distribution Summit" Abu Dhabi, UAE (March 5-7, 2012).

At the Energy Fault Line (The Changing Nature of Global Energy Markets Working Group Session) The Brookings Doha Energy Forum 2012 Doha, Qatar (February 20-12).

Carbon Emissions and Energy Consumption in the GCC Harvard Kennedy School (December 21, 2011).

Chairman "LNG and World Technology Summit 2011" Doha, Qatar (November 29-30, 2011).

Energy Export Scheme? Contractual and Commercial Elements of Hydrocarbon Exports-What Can Be Taken Over to a Renewable Energy Export Scheme? Renewable Energy Workshop, The Friedrich Naumann Foundation-The German Chamber of Commerce Casablanca, Morocco and Tunis, Tunisia (November 23-26, 2011).

Moderated: "Changing Energy Picture for the Middle East" Given by Rex Tillerson (CEO of Exxon Mobil) in his presentation of at the King Abdullah Petroleum Studies and Research Center-Energy Dialogue (KAPSARC) Conference, Riyadh, Saudi Arabia (November 20-23, 2011).

Gas Consumption in the Gulf and Increasing Shortages 15th Annual Megas Summit-Istanbul, Turkey (October 25, 2011).

The Role of the Gulf in Turkey's Energy Diversification Economic Policy Research Foundation of Turkey (October 21, 2011).

Economical Development of UAE's Energy Resources towards Sustainability" Zayed University, Dubai, UAE (October 19, 2011).

Moderated: "Addressing the Global Energy Challenge and the Looming Zone of Uncertainty" Given by Mark Carne Vice President of Shell, Dubai School of Government (October 18, 2011).

Moderated: "CEE in 2020: The Long Road to Energy Diversification" 21th Economic Forum Krynica, Poland (September 2011).

Presented: *The Shale Gas Market and Europe* in the panel "Gas Bridge to Low Carbon Future for the EU and Neighbors" 21th Economic Forum Krynica, Poland (September 8, 2011).

Taught Course (Assistant Professor): *The Role of Global Climate Treaties on the MENA Energy Sector* Seton Hall Law School-Middle East Summer Program Amman, Jordan (May-June 2011).

Energy Security: The Price We Have to Pay 41st St.Gallen Symposium, St. Gallen Switzerland (May 14, 2011).

The MENA Gas Sector and Fostering Growth in a Dynamic Market 2nd Annual Middle East and Africa Gas Distribution Summit Cairo, Egypt (May 1-3, 2011).

Resource Nationalism: From Spanish Roots to an Arab Tree Harvard Kennedy School (April 19, 2011).

A Strategy Beyond Oil in the Middle East: The Arab Global Forum: The Arab World: Capitalizing on Global Opportunities Washington D.C. (April 13, 2011).

Moderator: *Energy: The Key to Economic Modernization in the MENA Region* 2011 Dubai Initiative Conference Cambridge, USA (Apr. 7-8, 2011).

Moderator: *Energy Poverty: Challenges and Opportunities*: 17th Annual International Development Conference: Harvard Kennedy School (April 2-3, 2011).

Energy, Industrialization and GCC Economic Growth Conference: The Economic Transformation of the Gulf: Kuwait Programme Biennial Conference Kuwait City (Mar. 29-30, 2011).

The European Union and the Gulf Cooperation: A New Strategic Relationship Dubai School of Government, Dubai, UAE (March 21, 2011).

Making Carbon Trading Work in Saudi Arabia: A Fresh Look at Energy Consumption and Carbon Emissions in the Kingdom, King Abdullah Petroleum Studies and Research Center, Dhahran, Saudi Arabia (March 15, 2011).

The GCC and EU: Oil, Gas and FTAs, Special Lecture Series, the Brussels School of International Studies (January 19, 2011).

Appendix D: Arabic Language Documents and Resources

الإعلام البترولي لدول التعاون: دور العوائد النفطية. الكويتي. مج. 52، ع. 1356 (2014/2). ص. 6-9.
"The Petroleum Media of the Cooperation Countries: The Role of Oil Revenues." *Kuwaiti Magazine*. 52, p. 1356 (2/2014): 6-9.

العرب والصين مستقبل العلاقة مع قوة صاعدة 2019. المركز العربي للأبحاث ودراسة السياسات
"Arabs and China The future of the relationship with a rising power." Arab Center for Research and Policy Studies. 2019.

مكي، عماد. تطور صناعة تكرير النفط في الدول العربية: الحاضر والمستقبل. النفط والتعاون العربي. مج. 39، ع. 147 (2013). ص. 9-87.
Makki, Imad. "The development of the oil refining industry in the Arab countries: present and future." *Oil and Arab Cooperation*. Mg. 39, p. 147 (2013): 9-87.

مصفاة نغي سون للتكرير والبتروكيماويات خطوة بناء نحو التعاون المشترك في شرق آسيا. عالم المؤسسة. ع. 67 (2014/1). ص. 8-11.
"The Nghi Son Refinery and Petrochemicals is a constructive step towards joint cooperation in East Asia." *Enterprise world*. p. 67 (1/2014). s. 8-11.

منظمة الأقطار العربية المصدرة للبترول تقرير حول مؤتمر تكنولوجيا التكرير والبتروكيماويات في الدول الأعضاء في مجلس التعاون لدول الخليج العربية. Vol. 57, no. 4 (24/1/2014). p. 18-19.
Organization of Arab Petroleum Exporting Countries. "Report on the Conference on Refining and Petrochemical Technology in the Member States of the Cooperation Council for the Arab States of the Gulf." Vol. 57, no. 4 (24/1/2014): 18-19.

الغمري، سامي صلاح. الصناعات الغذائية بالمملكة العربية السعودية. المجلة الجغرافية العربية. مج. 45، ع 61 (2013). ص. 51-75.
Al-Ghamry, Sami Salah. "Food industries in the Kingdom of Saudi Arabia." *Arab Geographical Journal*. Mg. 45, p. 61 (2013): 51-75.

الزيتوني، الطاهر. الدور المتنامي لشركات البترول الوطنية وانعكاساته على صناعة البترول في الدول الأعضاء.النفط والتعاون العربي. مج. 39، ع. 147 (2013). ص. 89-183.
Al-Zaytouni, Al-Taher. "The growing role of national oil companies and its implications for the petroleum industry in the member states." *Oil and Arab cooperation*. Mg. 39, p. 147 (2013): 89-183.

توتال تعاني ارتفاع تكاليف الاستكشاف وتراجع الأرباح. المركز الدبلوماسي للدراسات الإستراتيجية: تقرير الاقتصاد والأعمال. ع. 10 (9/ 2014/3). ص. 46-47.
"Total suffers from rising exploration costs and declining profits." In the Diplomatic Center for Strategic Studies: Economics and Business Report. p. 10 (9/3/2014): 46-47.

حمش، تركي. الاستكشاف والإنتاج في المغمورة ودوره في تطوير احتياطي النفط والغاز. النفط والتعاون العربي. مج. 39، ع. 147 (2013). ص. 185-294.
Hamish, Turkish. "Offshore exploration and production and its role in the development of oil and gas reserves." *Oil and Arab Cooperation*. Mg. 39, p. 147 (2013). s. 185-294.

قاسم، أمجد. هل ينجح العالم في إعادة ثاني أكسيد الكربون إلى المكان الذي أتى منه؟. القافلة. مج. 62، ع. 6 (11-12/2013).-- ص. 20-25.
Qassem, Amjad. “Can the world return carbon dioxide to the place it came from?” *The caravan*. Mg. 62, p. 6 (11-12/2013): 20-25.

السياسات الاقتصادية المتبعة في دول مجلس التعاون الخليجي لاستدامة النمو خلال عام 2014. المركز الدبلوماسي للدراسات الإستراتيجية: تقرير الخليج الاستراتيجي. ع. 4 (26/1/2014). ص. 81-99.
The Diplomatic Center for Strategic Studies. “The economic policies pursued in the countries of the Gulf Cooperation Council to sustain growth during 2014.” In *The Gulf Strategic Report*. no. 4 (26/1/2014): 81-99.

رؤية تحليلية لأداء التجارة البينية كأحد ضروريات الوصول للاتحاد الاقتصادي الخليجي. المركز الدبلوماسي للدراسات الإستراتيجية: تقرير الاقتصاد والأعمال. ع. 6 (9/2/2014). ص. 6-15.
The Diplomatic Center for Strategic Studies. “Analytical vision for the performance of intra-regional trade as one of the necessities of reaching the Gulf Economic Union.” In *Economics and Business Report*, p. 6 (9/2/2014): 6-15.

الإعفاء الضريبي وتأثيرة على الاقتصاد القطري: رؤية تحليلية. المركز الدبلوماسي للدراسات الإستراتيجية: تقرير الاقتصاد والأعمال. ع. 9 (2/3/2014). ص. 5-16.
The Diplomatic Center for Strategic Studies. “Tax exemption and its impact on the Qatari economy: an analytical view.” In *Economics and Business Report*. p. 9 (2/3/2014): 5-16.

الخويطر، أحمد. كفاءة الطاقة وتحديات المستقبل. البيئة والتنمية. مج. 19، ع. 192-193 (3-4/2014). ص. 11-12.
Al-Khuwaiter, Ahmed. “Energy efficiency and future challenges.” *Environment and development*. Mg. 19, p. 192-193 (3-4/2014): 11-12.

الحربش، سليمان جاسر. الطاقة في خدمة التنمية المستدامة. البيئة والتنمية. مج. 18، ع. 190 و 191 (1-2/2014).— ص. 8-9.
Harbash, Suleiman Jacir. “Energy in the service of sustainable development.” *Environment and development*. vol. 18, p. 190 and 191 (1-2/2014): 8-9.

العشري، محمد. طاقة مستدامة للمنطقة العربية. البيئة والتنمية. مج. 18، ع. 190 و191 (1-2/2014). ص. 73-74
Al-Ashry, Muhammad. “Sustainable energy for the Arab region.” *Environment and development*. Mg. 18, p. 190 and 191 (1-2/2014): 73-74

من يعمل في الطاقة المتجددة؟. البيئة والتنمية. مج. 19،ع. 192-193 (3-4/2014). ص. 38-41.
“Who works in renewable energy?” *Environment and development*. Mg. 19, p. 192-193 (3-4/2014): 38-41.

آفاق تطور صناعة الغاز الطبيعي: الواقع والتحديات والفرص المتاحة. النفط والتعاون العربي. مج. 39، ع. 147 (2013). ص. 295-339.
“Prospects for the development of the natural gas industry: reality, challenges and opportunities.” *Oil and Arab Cooperation*. vol. 39, p. 147 (2013): 295-339.

الغاز الصخري ومستقبل الكويت النفطي. عالم المؤسسة. ع.67 (1/2014). ص. 24-27.

“Shale gas and Kuwait's oil future.” *Enterprise world*. P. 67 (1/2014): 24-27.

منظمة الأقطار العربية المصدرة للبترول. تطور أسعار الغاز الطبيعي في الأسواق العالمية وعلاقتها بأسعار النفط. الكويت: منظمة الأقطار العربية المصدرة للبترول، 2014. 106 ص.
Organization of Arab Petroleum Exporting Countries. “Evolution of natural gas prices in global markets and their relationship to oil prices.” Organization of Arab Petroleum Exporting Countries, 2014. P.106.

قطر ستنتج 23 مليون طن سنويا من البتروكيماويات بحلول 2020. المركز الدبلوماسي للدراسات الإستراتيجية: تقرير الخليج الاستراتيجي. ع. 4 (2014/1/26). ص. 39-41.
“Qatar will produce 23 million tons per year of petrochemicals by 2020.” Diplomatic Center for Strategic Studies: Gulf Strategic Report. p. 4 (26/1/2014). s. 39-41.

قراءة في سبل مواجهة التحديات التي تواجه صناعة البتروكيماويات الخليجية. المركز الدبلوماسي للدراسات الإستراتيجية: تقرير الخليج الاستراتيجي. ع. 6 (9/ 2 /2014). ص. 85- 98.
The Diplomatic Center for Strategic Studies. “A reading of ways to confront the challenges facing the Gulf petrochemical industry.” *The Gulf Strategic Report*. p. 6 (9/2/2014): 85-98.

توقعات بزيادة صادرات البتروكيماويات الخليجية. المركز الدبلوماسي للدراسات الإستراتيجية: تقرير الخليج الاستراتيجي.. ع. 6 (2014). ص. 31-32.
The Diplomatic Center for Strategic Studies. “Expectations of an increase in Gulf petrochemical exports.” *The Gulf Strategic Report*, p. 6 (2014): 31-32.

تنمية الموارد البشرية في الصناعة البترولية العربية: اضاءات مشرقة وتحديات مستمرة. نشرة أوابك. مج. 40، ع. 3 (2014/3). ص. 4-5.
“Human Resource Development in the Arab Petroleum Industry: Bright Lights and Continuous Challenges.” *OAPEC Bulletin*. vol. 40, p. 3 (3/2014): 4-5.

التمامي، أيمن عبدالملك . الصادرات البترولية لدول مجلس التعاون الخليجي إلى الولايات المتحدة الأمريكية. المجلة الجغرافية العربية. (2013) مج. 45، ع.. 61. ص. 1-25.
Al-Tamami, Ayman Abdul-Malik. “Petroleum exports of the Gulf Cooperation Council countries to the United States of America.” *Arab Geographical Journal*. (2013) vol. 45, p. 1-25.

توتال تعاني ارتفاع تكاليف الاستكشاف وتراجع الأرباح. المركز الدبلوماسي للدراسات الإستراتيجية: تقرير الاقتصاد والأعمال. ع. 10 (9/ 2014/3). ص. 46-47.
The Diplomatic Center for Strategic Studies. “Total suffers from rising exploration costs and declining profits.” *Economics and Business Report*. p. 10 (9/3/2014): 46-47.

الأسباب البيئية للنزاع : سورية الجفاف والسنوات العجاف. البيئة والتنمية. مج. 19، ع. 192-193 (3-2014/4). ص. 20-29.

إستراتيجية لسنة 2030: إدارة المياه في أبوظبي. البيئة والتنمية. مج. 19، ع. 192-193 (3-2014/4). ص. 36-37
Water Management in Abu Dhabi. Environment and development. “Strategy for 2030” vol. 19, p. 192-193 (3-4/2014): 36-37.

آل شيخ، شهيدة بنت عبدالرحمن بن عبدالله. مصادر التلوث البيئي جنوبي مدينة الرياض. المجلة الجغرافية العربية. مج. 45، ع. 62 (2013). ص. 427-468.
Al Sheikh, Shahida bint Abdul Rahman bin Abdullah. “Sources of environmental pollution south of Riyadh.” *Arab Geographical Journal*. Mg. 45, p. 62 (2013): 427-468.

إبراهيم، محمد، “العالم العربي يصحو على ثروة الطاقة المتجددة”، موقع DW، تاريخ الدخول 20 أكتوبر/تشرين الأول 2019، https://2u.pw/DFNtB
Ibrahim, Muhammad, “The Arab World Awakens to Renewable Energy Wealth,” DW: https://2u.pw/DFNtB

مصدر “مصدر للطاقة النظيفة – نشر الطاقة المتجددة النظيفة في العالم” تاريخ الدخول 22 أكتوبر/تشرين الأول 2019، www.masdar.ae.
Masdar “Masdar Clean Energy – Spreading Clean Renewable Energy in the World.” www.masdar.ae.

قاسم السمارة، امؤيد، “استثمارات دولة قطر الخارجية في مجال الطاقة: الواقع والتحديات”، مركز الجزيرة للدراسات، مايو/ أيار 2019، ، https://2u.pw/jc6wk
Qassem Al-Samara, Amoayed, “Qatar’s Foreign Investments in the Energy Field: Reality and Challenges,” Al Jazeera Center for Studies, May 2019, https://2u.pw/jc6wk

موقع الشرق، “20 مليار دولار حجم سوق الطاقة المتجددة في قطر 2022"،https://2u.pw/HN1Ja.
Al Sharq website, “20 Billion Dollars Renewable Energy Market Size in Qatar 2022”, https://2u.pw/HN1Ja.

البزيم رشيد، “استشراف مستقبل الانتقال الطاقي في العالم العربي.. دراسة حالة النموذج المغربي”، مجلة استشراف، العدد الثالث، 2018، قطر، ص 170.
Al-Bazim Rasheed, “Foreseeing the future of the energy transition in the Arab world. A case study of the Moroccan model,” *Istishraf magazine*, vol. 3, 2018, Qatar, p. 170.

عمارة, هاني عبد القادر. الطاقة وعصر القوة. عمان: عايدة للنشر والتوزيع 2012 .
Emara, Hani Abdelkader. *Energy and the age of power*. Amman: Aidah for publication and distribution. 2012.

أحمد عمار .ماذا تعرف عن مشروعات احتجاز الكربون وطرق استخدامه في السعودية والإمارات؟ الطاقة .2021
Ahmad, Amar. “What do you know about carbon sequestration projects and ways to use it in Saudi Arabia and the UAE?” Attaqa, Oct. 19, 2021. https://attaqa.net/2021/10/19/

بلال صغير .التغير المناخي في المملكة العربية السعودية: إعادة نظر في دور الإدارة المحلّية 2021 .
Bilal, Saghir. “Climate Change in Saudi Arabia: Rethinking the Role of Local Administration.” King Salman Center for Local Governance. 2021. http://www.ksclg.org/publication-project/climate-change-in-saudi-arabia-rethinking-the-role-of-local-government/

رسائل واضحة من السعودية في قمة المناخ بشأن النفط: أمن الطاقة العالمي أولوية. العين الإخبارية
“Clear messages from Saudi Arabia at the Climate Summit on oil: Global energy security is a priority.” Al-Ain News, Nov. 10, 2021. https://al-ain.com/article/saudi-global-energy-security-climate-change

دعوة سعودية لتوازن جهود مكافحة التغيّر المناخي وأمن الطاقة .2021
“A Saudi call for balancing efforts to combat climate change and energy security.” Al-Sharq Al-Awsat. Oct. 25, 2021.
https://aawsat.com/home/article/3297056

السعودية والعراق بين أكثر الدول المعرضة للمخاطر.. تغير المناخ يهدد منتجي الخام. 2021
“Saudi Arabia and Iraq are among the most vulnerable countries. Climate change threatens crude producers.” Al-hurra, Dec. 16, 2021. https://www.alhurra.com/business/2021/12/16

فيصل الفايق .واقعية السعودية تقود العالم بأطروحات ناجعة لتغير المناخ .2021
“Saudi realism leads the world with effective climate change proposals.” Al-Arabiya, Oct. 25, 2021.
https://www.alarabiya.net/aswaq/opinions/2021/10/25

تقرير: السعودية ودول الخليج الأخرى تواجه سيناريوهين مروعين يهددان سبل العيش .2021
“Saudi Arabia and other Gulf states face two horrific scenarios that threaten livelihoods due to the world's drive to transition to clean energy and climate change.” Arabic RT. Oct. 27, 2021. https://arabic.rt.com/business/1287726

السعودية أكبر مصدر نفط في العالم ستعلن عن تفاصيل خططها لمواجهة تغير المناخ .2021
“Saudi Arabia, the world's largest oil exporter, will announce details of its plans to tackle climate change.” CNBC Arabia. Oct. 23, 2021.
https://www.cnbcarabia.com/news/view/90103

السعودية تتعهد باستثمار أكثر من مليار دولار في مبادرات بيئية جديدة. 2021
“Saudi Arabia pledges to invest more than $1 billion in new environmental initiatives.” France 24. Oct. 24, 2021. https://www.france24.com/ar

المبادرة الخضراء: السعودية تعتزم تخفيض انبعاثات الكربون إلى مستوى صفر بحلول عام 2060
“The Green Initiative: Saudi Arabia intends to reduce carbon emissions to zero by 2060.” BBC. Oct. 23, 2021. https://www.bbc.com/arabic/science-and-tech-59023499

تقليل الانبعاثات الكربونية بأكثر من 278 مليون طن سنوياً بحلول عام 2030
Saudi Green Initiative. “Reduction of carbon emissions by more than 278 million tons per year by 2030.”
https://www.saudigreeninitiative.org/ar/targets/reducing-emissions/

هل تتحول السعودية إلى الطاقة الصديقة للبيئة بتدوير ثاني أكسيد الكربون؟2021
“Will Saudi Arabia turn to environmentally friendly energy by recycling carbon dioxide?” Independent Arabia. Oct. 24, 2021. https://www.independentarabia.com/

بهذه الطريقة توفر السعودية 50% من إنتاج الكهرباء عبر مشاريع الطاقة المتجددة2021 .

“In this way, Saudi Arabia saves 50% of electricity production through renewable energy projects.” Al-Arabiya. Oct. 22, 2021.
https://www.alarabiya.net/saudi-today/2021/10/22

تجميد الكربون.. السعودية تختبر تقنية جديدة لمواجهة تغير المناخ.2021 .
“Carbon freezing .. Saudi Arabia is testing a new technology to confront climate change.” Attaqa. June 30, 2021.
https://attaqa.net/2021/06/30/

أحمد بن سميط .الطاقة المتجددة في دول الخليج العربي .2019.
Ahmed bin Sumait. “Renewable Energy in the Arab Gulf Countries.” Dec. 22, 2019.
https://www.albayan.ae/opinions/articles/2019-12-22-1.3732730

بشار حميض. ضرورات مواكبة دول الخليج لثورة الطاقة البديلة. 2014.
Bashar Humaid. “The necessities of the Gulf countries to keep pace with the alternative energy revolution.” Aug. 01, 2014.
https://futureuae.com/ar-AE/Mainpage/Item/880/

دول الخليج العربي مؤهلة لتحقيق الريادة العالمية في إزالة الكربون من قطاع الطاقة .2021
“The Arab Gulf countries are qualified to achieve global leadership in decarbonizing the energy sector.” Nov. 07, 2021.
https://www.zawya.com/mena/ar/press-releases/story

دولة الإمارات تقود الجهود العالمية في قطاع الطاقة المتجددة. 2020 . زارة-الخارجية-والتعاون-الدولي. امارات
“The UAE leads global efforts in the renewable energy sector. 2020. Ministry of Foreign Affairs and International Cooperation.” UAE 2020.
https://www.mofaic.gov.ae/ar-ae/mediahub/news/2020/11/2/02-11-2020-uae-global

وليد خدوري .دور الإمارات في قطاع الطاقة المتجدد العالمي. مركز الإمارات للدراسات والبحوث الاستراتيجية
Walid Khadduri. “The UAE's role in the global renewable energy sector.” The Emirates Center for Strategic Studies and Research. Apr. 24, 2014.
https://www.ecssr.ae/reports_analysis

عدنان ز. أمين .كيف يمكن أن تصبح الطاقة المتجدِّدة متنافسة من حيث التكاليف. الأمم المتحدة.
Adnan Z. Amin. “How can renewable energy become cost-competitive.” United nations.
https://www.un.org/ar/chronicle/article/20309

الشرق. خطة قطرية طموحة للحد من انبعاثات الكربون بحلول 2025.
“Ambitious plans to reduce country codes that appear in emails by 2025.” Al-Sharq.

أحمد شوقي.تجارة الكربون :هل تستفيد الأسواق الناشئة من قواعد خفض الانبعاثات؟2021
Ahmed Shawky. “Carbon trading: Do emerging markets benefit from the rules for reducing emissions?” Dec.7, 2021.

قطر للطاقة تحضّر لسندات "خضراء"... وخطة لخفض الانبعاثات 25% بحلول 2030 .
“Qatar Energy is preparing "green" bonds... and a plan to reduce emissions by 25% by 2030.” Al-Arabi, 28 Oct. 2021.

قطر تدشن مشروعا ضخما لتخزين الكربون.. وتتوسع بإنتاج الغاز .العربي.
"Qatar launches a huge carbon storage project and is expanding gas production." Al-Arabi, 08 Oct. 2019.