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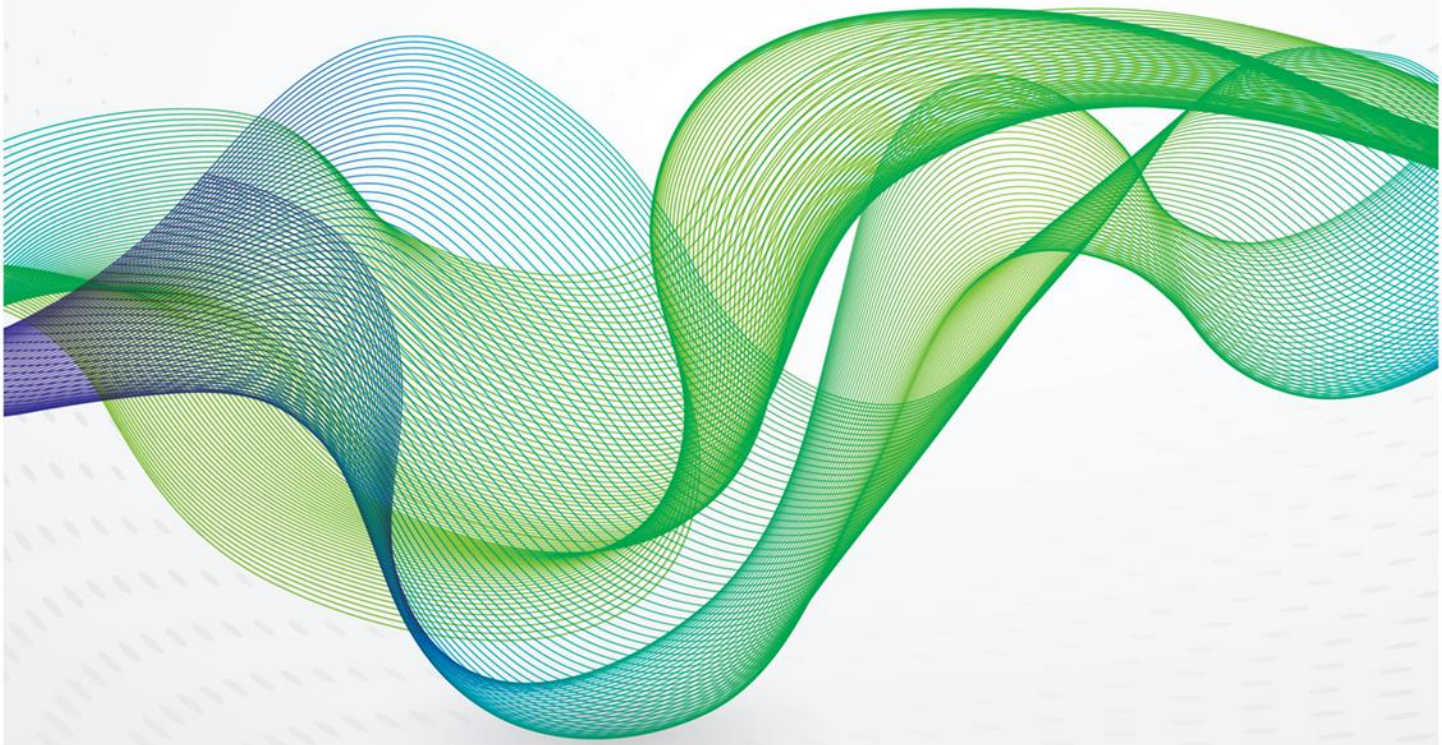
Key Themes for the Global Energy Economy in 2023



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1. Introduction – rebalancing the energy trilemma

In this latest edition of our Key Themes series we examine a number of topics which we believe will be highly relevant to the global energy economy in 2023. The past twelve months have seen a huge re-prioritisation of energy policy away from environmental issues and towards energy security and affordability. Many of the articles in this document question whether this will be a long-term trend or whether sustainability will return to the top of the policymaking agenda once the short-term need to focus on security of supply has passed. Indeed, many of our contributors argue that the short-term rebalancing of the energy trilemma towards energy security may even bring environmental benefits in the longer term given the desire of many countries to reduce their exposure to hydrocarbons in the aftermath of the war in Ukraine and its energy-related consequences.

The re-balancing of the energy trilemma

The energy trilemma has been a major plank of energy policy thinking over the past decade, focusing on the balance between achieving *sustainability* (decarbonisation of the energy system), *equity* (accessibility and affordability for consumers), and *energy security* (ensuring adequate supply). In developed economies, growing concern about the environmental impact of the energy economy meant that sustainability had increasingly become the priority, especially since the Paris Agreement at COP21 in 2015, with affordability and accessibility being related concerns of the energy transition, while energy security was seen as a lesser issue thanks to the availability of diversified supplies delivered through increasingly fungible global markets. In contrast, in many parts of the developing world, energy equity and security arguably ranked above sustainability, although the growing frequency and impact of extreme weather events has clearly placed the low carbon transition higher on policy agendas.

Russia's invasion of Ukraine has not only caused a dramatic reconsideration of this prioritisation, with energy security becoming the number one focus globally, but it has also highlighted the difference in perceptions of the trilemma around the world. In addition, a fourth dynamic – government intervention – is further highlighting the differences in perception and the difference in ability to manage the energy trilemma. The provision of finance is also a major topic of debate, especially in the Global South where countries are demanding support from the developed countries which are seen as responsible for the current environmental issues. 2023 will see further debate about the rebalancing of the energy trilemma from a global perspective, with a number of key themes set to dominate policymaking, corporate decision-making, and academic debate.

Differing regional perspectives

In Europe, and especially the EU, the drive to diversify away from imports of Russian energy will continue. However, while the need to secure adequate supply for the winter of 2023/24 will necessitate a focus on short-term access to alternative sources of natural gas, 2023 could also be a year in which EU plans for a faster energy transition start to crystallise. The REPowerEU plan that was catalysed by the Russian invasion of Ukraine is based on the thinking that a more rapid decarbonisation of the European energy system can provide more energy security over the long-term as well as helping to achieve the continent's climate ambitions. However, two key questions that will be intertwined in 2023 are firstly whether energy security issues will continue to dominate and distract politicians away from the longer-term sustainability goals, and secondly whether the longer-term goals themselves, especially the aim to reduce gas demand set out in the REPowerEU plan, could undermine efforts to secure new supplies in the short term.

The theme of short-term energy necessity merging into longer term climate strategy is also seen in other regions which are struggling to balance the energy trilemma. In many Asian countries, for example, high energy prices and the reduced availability of LNG taken by Europe have forced a reconsideration of energy strategy. Development of domestic coal resources, although clearly less environmentally friendly than many alternative energy sources, is becoming a priority again as cost and

availability trump climate impact, at least in the short term. Meanwhile in Africa, the EU's search for new gas supply has rekindled the drive to develop new gas export projects that can also supply the domestic market. In this case, a dual desire to generate export revenues and to provide energy access means that the priorities of the trilemma are being rebalanced.

Assessing technology and financing options

As the role of hydrocarbons is being reconsidered, and as the reality that they may remain important to the global energy system for longer than many would like becomes clear, so the sustainability element of the trilemma is being adjusted to cope. As evidenced at COP27 the development of carbon removal technologies, voluntary carbon markets, and carbon capture and storage business models is set to become an increasing theme in 2023 and beyond, at least with a medium-term perspective of facilitating a more orderly transition to a carbon-free energy system in the longer term.

This does not mean that the expansion of renewables as soon as possible is not critical – it clearly is and 2023 will provide more evidence of how growth is accelerating. However, another dynamic that will be a continuing focus in the coming year is the financing of the transition to a zero-carbon economy in the Global South. While rich OECD countries have the wealth to deal with a short-term energy crisis while also planning for a longer-term clean energy future, COP27 underlined that the developing world, where most of the growth in economic activity, population, and emissions will be seen over the next three decades, do not enjoy similar wealth and are demanding assistance from the Global North, which is the cause of the environmental problems in the first place. This finance dynamic that surrounds the energy trilemma in many regions of the world will be a huge focus in 2023, as the debate over the provision of funds for mitigation, adaptation and loss and damage develops ahead of COP28 at the end of the year.

Geopolitics will be critical

Beyond this issue, the rebalancing of the energy trilemma to focus on energy security has also highlighted some of the key emerging risks in the energy transition. With relations between the world's two largest emitters, China and the US, becoming ever more competitive and assertive, a race to be the technology leader of the energy transition is well underway, and has been ratcheted up by the recent US strategy to dramatically limit technology transfer to China. While this will undoubtedly have a negative impact on China's ability to develop certain technologies it also highlights the cards which China has to play regarding security of supply of critical minerals and materials. Its dominance of the mining, and especially the processing, of key inputs to energy transition technologies is becoming a major element of the energy trilemma and of geopolitical debate, which is a further destabilising factor in resolving the rebalancing question.

Two final points can be made on the impact of this rebalancing process and the uncertainties surrounding it. The first is that it increases the risk of stranded assets – a short-term focus on hydrocarbons to replace Russian imports could lead to the development of new resources that have a limited lifespan should the elements of the trilemma be rebalanced again in the near future. This leads to a second key commercial risk for companies who are the key investors in the energy system. How do they balance short-term needs for energy security with longer term demands for a low or zero carbon environment? And how do they factor ESG requirements into their investment planning? One answer is that they will aim to develop any energy resources, hydrocarbons included, with as low a carbon intensity as possible, but 2023 is likely to be another year where this assertion is severely tested by the competing interests of energy consumers, environmental NGOs, demanding shareholders, and policymakers with multiple short- and long-term objectives.

As a result, in 2023, the energy trilemma will remain critical for a number of reasons and will provoke a wide range of vital questions. First, as European countries seek new LNG supplies, will these undermine policies aimed at advancing the energy transition? Related to that, will ambitious targets to reduce emissions through lower gas consumption limit Europe's ability to secure long-term gas supplies? Next, how will European policies and commercial strategies impact the availability and affordability of energy

in developing economies? Given sustainability concerns, can new hydrocarbon projects—required for supply security—get off the ground? And how will government policies impact these choices? Already, governments (and EU institutions) have been instrumental in dictating storage trends (both oil stock releases and gas stockpiling), which have in turn impacted price signals. Government perceptions of market risks and global trends will therefore be critical in 2023 as they inform policy choices and balance the trilemma. Finally, and related to this, government choices will lead to financing priorities: will governments opt to subsidise end users to shield them from the impact of high energy prices, or will they proceed with taxing fossil fuels and imposing carbon tariffs? Will developed economies invest in new hydrocarbon projects, grids, batteries or critical materials at home or abroad and how will these investment choices be perceived in developing countries?

To help in assessing these questions and to provide some initial responses we have grouped the articles in this Key Themes paper as follows. We start within an assessment of, and outlook for, the global oil market, before continuing with a series of articles on Europe, including the outlook for gas demand, the need for significant regulatory activity in the EU, the importance of monitoring gas storage levels, and the potential impact of prices caps. We also look at whether EU member states will respond to solidarity agreements in a crisis situation. Moving to a more global perspective we then review the availability of LNG to meet European demand and what this might mean for other importing regions before assessing the impact of the re-opening of the Chinese economy, the energy implications of India taking over the G20 presidency, and the development of Africa's hydrocarbon strategy as part of the energy transition.

This takes us onto questions of a more environmental nature. We look at the issues that will likely be raised in the Global Stocktake which will take place in 2023 ahead of COP28 and also consider the critical financing issues that emerged from COP27 and need to be addressed during this year. We then review the need for further progress on Article 6 and the development of voluntary carbon markets, and related to this we consider the outlook for carbon removal technologies and the potential for further progress on the issue of accounting for greenhouse gas emissions in the energy value chain. We return to look at China, which has also pledged to issue a methane action plan this year but where a rapid rebound in energy demand could delay climate action and lead policy makers to focus on avoiding power shortages. Moving to the electricity sector, another contribution outlines why 2023 will be an important year for electricity market design in Europe. We also consider the resurgence of nuclear power across the world and ask whether 2023 will see a further acceleration of this trend. Finally, we discuss the impact of the US's Inflation Reduction Act on the development of hydrogen technology and ask whether it undermines activity elsewhere in the world.

This list of themes is long but it is clearly not exhaustive. However, it highlights many of the topics which we will be researching at OIES during 2023 and we would encourage you to access our written output at www.oxfordenergy.org. For further details about how to join the discussion at the many events which we hold for our sponsors and benefactors, where you can meet our fellows and address issues in more detail, please contact Kate Teasdale at kate.teasdale@oxfordenergy.org.

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2. Oil markets in 2023: the year of the aftershocks

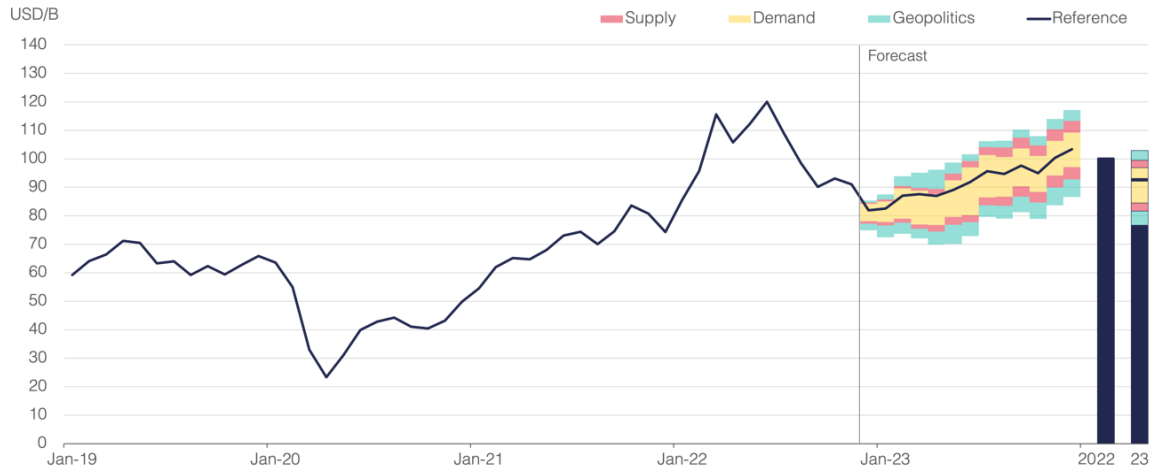
Oil markets were subject to a series of large shocks during 2022: Russia's invasion of Ukraine in late February and the ensuing sanctions, embargoes, and the price cap on Russian oil imports; a coordinated response by oil-consuming nations (led by the US) to control prices by a massive release of strategic stocks; recessionary and inflationary pressures weighing on the global economy; China's domestic demand shocks from its strict zero-COVID policy; and the massive transformations in crude and products trade flows, to name but a few.

Oil markets throughout the years have been subject to both supply and demand shocks, but 2022 also saw an increase in government intervention in global energy markets, including oil markets, as energy security and affordability concerns became key drivers of energy policy. These increased government interventions have elevated key uncertainties in the physical market, while oil futures have also witnessed a decline in liquidity and open interest, alongside rising costs of using these markets for risk management.

These shocks and elevated uncertainties shaped balances and market expectations. That said, the global oil market adapted quickly and physical supplies were little affected. In fact the market built a small surplus of around 500,000 b/d in 2022 following a -2.3 mb/d deficit in 2021. The unwinding of OPEC+ cuts, the release of SPR oil, the ability of Russia to redirect its exports away from Europe, which limited the Russian supply disruption, and weak demand growth particularly in Q3 and Q4 all contributed to a fairly balanced market in 2022.

The events that unfolded in 2022 have set the stage for another unpredictable year. Figure 1 below shows the balance of risks surrounding our reference outlook for 2023 (in our reference case, Brent averages USD92.7/bbl in 2023). Even in the bearish scenarios (e.g., deeper and prolonged recession, lower realisation of Russian supply disruptions, stronger US production growth) the oil price remains supported at around USD70/bbl as the low buffers in the system (i.e., low spare capacity and low commercial stocks) keep prices sustained. The bullish scenarios in which prices move above USD100/bbl capture a perfect storm where large supply disruptions from Russia amid heightened geopolitical risks elsewhere are confronted by a mild recession and a strong rebound in China's demand.

Figure 1: Balance of risks



Note: Brent price

Source: OIES (*Oil Monthly*)

In 2023, pressures on global oil demand are shifting from recessionary concerns to the uncertainty over the extent and duration of a global recession. And even though inflation is set to decline this year, it remains uncertain how soon central banks will feel comfortable about easing monetary policy as well

as how much policy space there is to promote growth. But it is not all gloom for global demand prospects in 2023. The consensus continues to point towards only a mild recession in the US, and to Chinese demand growth in H2. Indian demand growth - a bright spot in 2022 - is expected to soften slightly.

In terms of oil products, the focus in 2023 will remain on middle distillates with jet fuel recovery a wildcard. Although jet fuel demand at the end of 2022 was only marginally improved from a year ago, estimated at around 20 per cent below pre-pandemic levels, we expect to see the recovery accelerating in 2023 even as the airline industry continues to face bottlenecks. Europe continues to rely heavily on Russian diesel imports (which accounted for an average of 45 per cent of the total in 2022). The upcoming embargo on imports of Russian products in February 2023 will force Europe to source supplies from other regions to substitute for nearly 500,000 b/d of Russian diesel import losses. Even the economic recession is unlikely to resolve the diesel supply deficit in Europe, while commercial stocks remain well below their five-year average.

On the supply side, Russia will remain centre stage in 2023 as the EU embargo on Russian crude and oil products takes full effect. In 2022, Russia redirected sanctioned crude particularly to India, China, and Turkey, allowing its domestic oil production to remain close to pre-war levels. But with the EU embargo on crude and products exports in full force this could change. The full impact of the EU embargo and the price cap on Russia's production and exports will not be fully understood at least until the end of Q1 2023 when the embargo on Russian products comes into effect on February 5.

With its October decision to cut output, OPEC+ set the tone for 2023 and sent a clear signal that it is willing to act proactively and pre-emptively to balance the market. In the past, such moves were limited by weak cohesion within OPEC and the time it took to negotiate output cuts. As a result, OPEC responses always arrived late after market balances had weakened sharply. But OPEC+ cohesion is now stronger and the group can respond in a more timely manner. In the October meeting, OPEC+ signalled that it will take action at any time by calling an extraordinary meeting. Also, the dynamics within the group are shaped by the fact that most OPEC+ producers outside the Middle East are producing at maximum capacity and below their quotas.

US shale continues to attract focus with the emergence of private operators as a new force within the shale industry while growth from public operators remains constrained due to investor pressure and bottlenecks, with US crude production growth projected to reach 800,000 b/d year-on-year in 2023 from 600,000 b/d in 2022. The use of the SPR as a tool for market management - a key feature in 2022 - is likely to remain relevant in 2023. This includes announced buybacks but also potential releases should the market tighten. This reflects a more fundamental shift in US policy towards using the SPR to influence market balances and expectations.

Lastly, geopolitical risks outside Russia in places like Libya also remain a wildcard, with a long speculated return of Iranian production now completely off the table in 2023.

Last year also saw a massive and structural transformation in crude oil and products trade flows with US, West African, and Middle Eastern crudes finding their way into the Mediterranean and Europe, while Russian Urals crude has been competing in Asia with Middle Eastern and West African crudes, as well as other sanctioned crudes from Iran and Venezuela. In terms of products, Europe has increased its imports of non-Russian products attracting supplies from more distant places including the Middle East, India, China, and Brazil. In effect, the oil market in its various layers has been performing the key function of redirecting crude and products in the face of a massive shock, but as the trade routes have become longer, the adjustment in price differentials sharper, the tanker market more segmented, a new class of trading practices and entities is emerging. Refineries are having to change their crude slates resulting at times in sub-optimal use of crudes. These shifts in trade flows will accelerate and consolidate in 2023, with wide implications for the structure of the market, geopolitical relations, and the dominance of the dollar in oil trade.

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3. European gas demand: key factors to keep an eye on in 2023

European gas demand collapsed in 2022 on the back of mild temperatures, high gas prices, and changes in consumer behaviour (Figure). However, despite a strong decline in 2022, additional gas demand reduction will be needed in 2023 in preparation for winter 2023/2024 and even potentially for winter 2024/2025.

Gas demand drivers are complex and specific, but there are a few key factors to keep an eye on during 2023. To begin with, the industrial sector has been the main source of gas demand flexibility in 2022, and it is expected to continue playing this role through voluntary reduction and demand response. For most manufacturing production (the chemical sector being a clear exception), strong output in 2022 suggested that record prices have not had as dramatic an impact as one could have expected (yet?) with significant switching to alternative energy sources and improved operational efficiency. However, after over a year of high prices, most of the 'low hanging fruit' is likely to have been harvested by now, so it is unclear how easy it might be to further reduce gas use without reducing production. In addition, it seems likely that most of the decline has come from reduction measures (as opposed to major demand destruction), which means that when gas/electricity prices go down, be it as a result of the market rebalancing or as a result of support measures from governments, a significant proportion of gas demand in the industrial sector (which seems to have gone down by about 15-20 per cent in 2022) could come back within a few weeks, as seen in October when gas prices reached their lowest levels in months and fertilizer producers restarted production in Europe.

Secondly, warm weather at the beginning of the year and similarly at the beginning of the winter season 2022/23, limited the need for gas use in space heating in 2022. Mild temperatures and continued high gas prices seem to have also facilitated an important demand response from small residential and commercial consumers, a usually rather inelastic sector in the short term, in the form of lower production and fuel switching in small businesses and lower energy use in the buildings sector. Continued participation of consumers in demand saving measures in buildings is going to be essential throughout 2023. There are two main uncertainties: first, government intervention in subsidizing energy bills and campaigns to save energy will need to send the right signals in order to keep consumption low; and second, temperatures: cold weather may erode consumers' willingness to reduce their energy for heating (and possibly increase gas demand by up to 15-20 bcma).

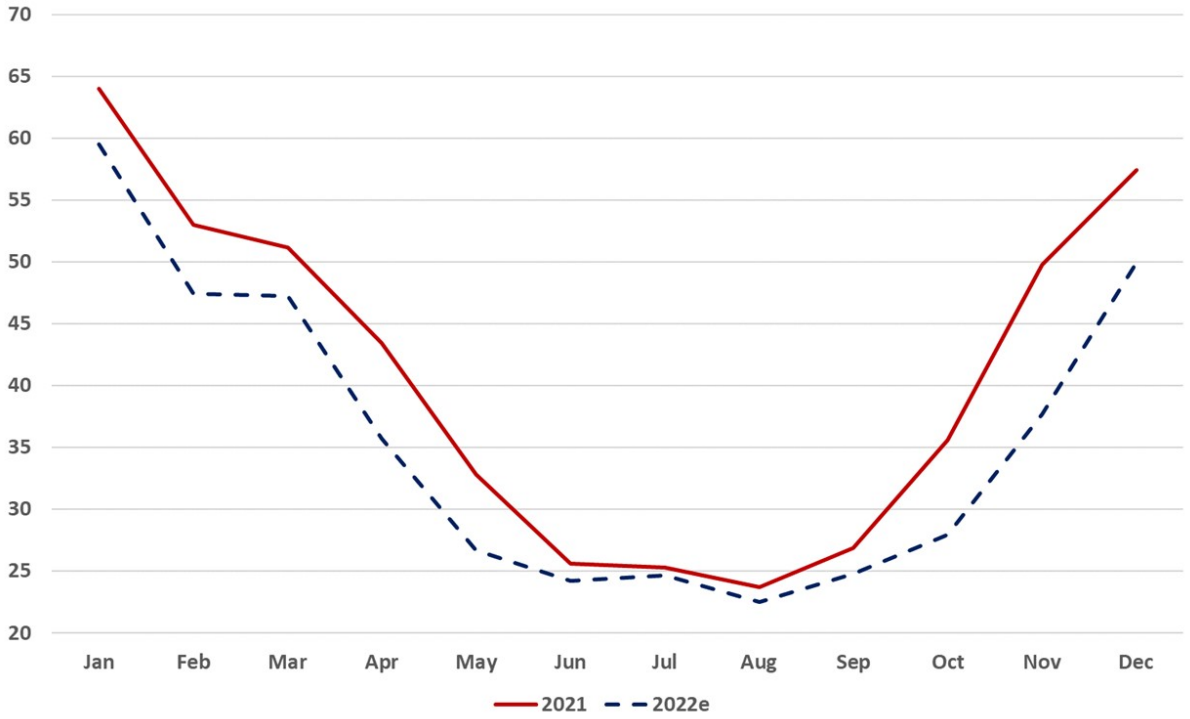
Finally, in contrast to the trends observed in the industrial and heating sectors, gas used for electricity generation increased year-on-year in 2022. Three main elements influenced the need to use more gas in the power sector (despite aims to reduce consumption): continued high electricity demand in the first eight months of the year, before energy-saving measures and economic slowdown finally started to have an impact from September onwards, and the low availability of both nuclear and hydropower.

French nuclear generation typically covers as much as 15 per cent of European electricity needs, but in 2022, the French utility EDF faced a wave of repairs following the discovery of corrosion issues and also delays to its scheduled 10-year maintenance due to the COVID pandemic (as well as strikes in France in October). This forced a record number of reactors offline for most of the year. EDF is racing against the clock to put as many reactors as possible back in service as soon as possible. By late December the company had confirmed its expectations for 300-330 TWh of nuclear generation in 2023, which would still be relatively low for the French nuclear fleet but around 18 - 19 per cent higher than 2022 levels. However, uncertainties remain as the company revised its predictions for nuclear generation downwards four times in 2022.

In conclusion, the key issues to keep an eye on in 2023 will be the pace of return of French nuclear reactors, the willingness and ability of large and small consumers to continue adapting their usual behavior in order to use less energy (especially during cold days in the winter), and last but not least, the depth of a looming economic recession. And while the main drivers are largely similar across Europe, the evolution of gas consumption will continue to be diverse, which can be explained by a number of country-specific factors including the role of gas in the energy mix, access to alternative fuels

and the levels, and extent, of support measures from governments to shield their national consumers from the worst impacts of high energy and gas prices.

Figure 2: Monthly gas demand in EU27 + UK, 2019-2022 (Bcm)



Source: Data from Eurostat, IEA, Entsog, GRTgaz, Terega, THE, SNAM, Enagas, NationalGrid and Fluxys. Calculations and graph by the author

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4. 2023: A year for the EU to deliver the legislative framework of the Green Deal

Since the Commission tabled the 'Fit for 55' packages in July/December 2021, the European Council (the Council) and the European Parliament (EP) have worked diligently to advance these initiatives. Besides the acts already agreed in November and December 2022, all the legislative acts of the two Fit for 55 packages, complemented by a new proposal regarding electricity market design and a Hydrogen Bank, need to be adopted by European legislators before the end of 2023. This timing is not only crucial in order to speed up the implementation of the Fit for 55 packages but is indispensable because the EP will not be able to exercise its role as co-legislator after Q1 2024 due to the European elections in June 2024 and the start of the election campaign in April 2024.

The following sections provide an overview of the legislative process that needs to happen in 2023 and highlights the major issues which are at stake in each area:

Legislation adopted relating to the two Fit for 55 Packages and due to come into force in 2023

The Council and the EP reached a provisional political agreement on the reform of the ETS[1] and the CBAM[2] in November/December 2022 pending formal adoption by both institutions which is due in early 2023.

The Council also formally adopted new measures on Joint Purchases of Gas and a Solidarity Mechanism in December 2022. In addition, in December 2022 the Council adopted a regulation that establishes a Market Correction Mechanism to protect citizens and the economy against excessively high prices. The regulation aims to limit episodes of excessive gas prices in the EU that do not reflect world market prices, while ensuring security of energy supply and the stability of financial markets. All three measures are due to come into force in 2023.

Ongoing legislative debate relating to the two Fit for 55 Packages

- Renewable Energy Directive: Discussions are continuing, with the key areas of debate being the headline renewables target, the obligation to replace 75 per cent of grey hydrogen in industry with renewable hydrogen by 2030, and the revision of guarantees of origin for renewable sources.
- REPowerEU Amendments: Discussions will start in January and the key issues are the renewable energy headline target, the framework for renewables permitting, and the definition of 'overriding public interests.'
- Hydrogen and Decarbonised Gas Package: Discussions can only start once the EP and the Council have respectively adopted their report and general approach, likely in Q1.
- Methane Regulation: Discussions can start once the EP has adopted its report (likely in January) with the key issues being leak detection and repair obligations, monitoring and reporting obligations for underground coal mines, and the role of the International Methane Emissions Observatory.
- Energy Efficiency Directive: Discussions are ongoing around the scope of the energy efficiency first principle and the EU-wide 2030 energy efficiency target.

[1] Emissions Trading System
[2] Carbon Border Adjustment Mechanism

- Energy Tax Directive: Discussions within the Council are continuing with the main remaining issues being to allow more flexibility for Member States' specific national circumstances, potential exemptions for aviation and maritime, and a potential transition period for the increased taxation of fossil fuels.
- In addition, EP and Council have to start and finalise the discussions on the following legal proposals: Energy Performance of Buildings Directive; Alternative Fuels Infrastructure Regulation; ReFuelEU Aviation Regulation and ReFuelEU Maritime Regulation

New legislative discussions to be started by the European Commission in 2023

- Electricity market redesign: A targeted, structural reform of the EU electricity market framework was announced by the Commission President in September 2022 as a reaction to criticism of the present system in the light of the current energy crisis. However, the Commission may well limit its proposal in Q1 to those elements that can be seen as an improvement on the Clean Energy Package, such as grandfathering the inframarginal clawback, consumer protection, notably against high energy prices, long-term contracts, and peak-shaving demand reduction. For the more controversial topics (notably the possible replacement or deeper reform of the merit order and the marginal pricing system, the introduction of a kind of nodal system, and the EU wide introduction of capacity markets), more consultations and analysis are needed. The Commission might undertake such analysis in 2023/24, leaving the tabling of the legislative proposal to the new Commission in 2025.
- Hydrogen Bank proposal: this proposal was also announced by the Commission President in September 2022. Funding of around EUR 3 billion will be proposed, to be administered via the Innovation Fund. The pilot phase of the Hydrogen Bank would start in Q3 2023 with a CfD[3] scheme allocated via a competitive bidding mechanism, with a view to covering the cost gap between renewable hydrogen and methane or hydrogen produced from natural gas in the EU.

Assessment

This work program for 2023 represents a huge challenge for the European institutions. However, the EU must deliver on all its ambitious legislative actions if it wants to live up to its climate targets. This needs to happen at a time where the energy crisis is causing economic and social challenges in the shadow of the ongoing Russian war against Ukraine. If in previous times when the EU had to go through economic or political crises there was always the expectation that it would emerge even stronger from the crisis, this expectation cannot been taken for granted this time. The negotiations will show whether or not the Member States in the Council, the different political groupings in the EP, and the Commission are capable of striking compromises that truly deliver on all three overarching energy policy objectives: fostering sustainability by agreeing on an ambitious but also realistic path toward a high level of renewable energy in the European mix; safeguarding the security of energy supply for all Member States by moving forward in solidarity and accepting hydrocarbons and technologies like CCUS as important stepping stones for reaching carbon neutrality without jeopardizing security of supply; and guaranteeing households and industries affordable energy prices by developing the necessary support instruments at EU and national levels, including targeted measures to help the most vulnerable and energy poor. Only if all actors conduct negotiations with all three objectives in mind can one expect an outcome that not only makes the European energy system more resilient and fairer but also lays the foundation for an acceleration of the decarbonisation of the European economy in future years.

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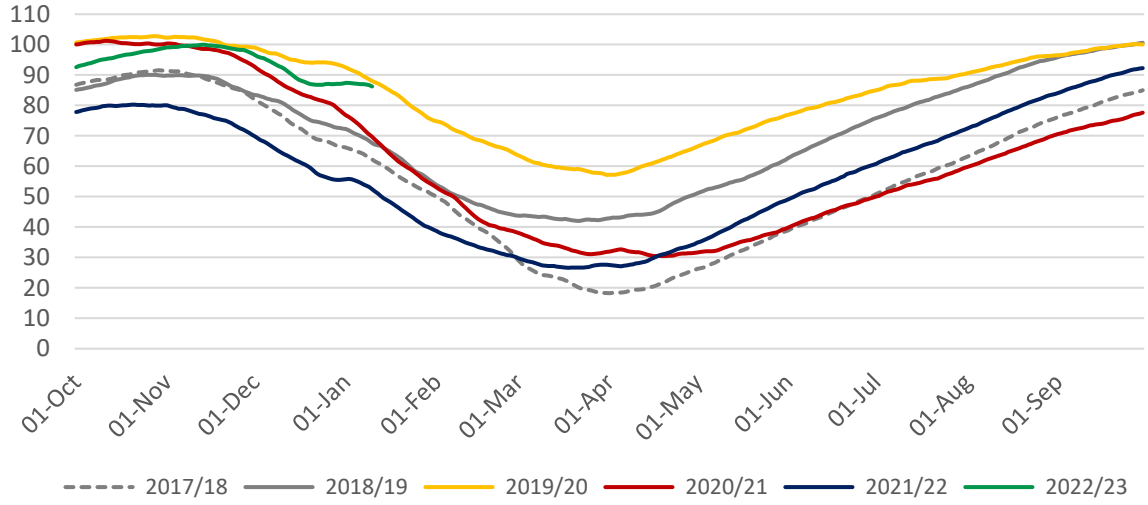
[3] Contract for Difference

5. Storage as an indicator of European market tightness

Gas storage, and its vital role in balancing the European gas market, increases in prominence during times of market imbalance. The rapid drawdown of stocks during a period of unusually cold weather in Europe ('The Beast from the East') in Q1 2018 was followed by the use of storage to absorb excess volumes from an oversupplied market in summer 2019 and summer 2020. In Q1 2021, rapid withdrawals from European storage offset the drop in European LNG imports, with cargoes being drawn away to northeast Asia by a spell of very cold weather and a related surge in regional demand. In each of these cases, the rate of storage injection or withdrawal, along with total stock level, has been an indicator of market over-supply or under-supply, with those injections and withdrawals motivated by pricing signals that themselves reflect market conditions.

2022 was different, insofar as the period between 1 April and 1 October saw record net injections despite record high prices. It was not summer oversupply, low prices, and the promise of wide sesasonal spreads that motivated those injections, but a strong concern over likely future market tightness in winter 2022/23. Such was the level of concern that net injections continued throughout October and into mid-November. This record injection through into early winter was made possible by a combination of policy-driven and price-driven demand reductions, robust pipeline supplies from non-Russian suppliers, and record LNG imports with cargoes attracted by high prices. Summer 2023 is likely to see a similar policy-driven push to replenish storage even if conditions for doing so are unfavourable.

Figure 3: European gas storage stocks (Bcm)



Source: Data from Gas Infrastructure Europe Aggregated Gas Storage Inventory. Graph by the author.

In the period between 14 November and 31 December 2022, European net storage withdrawals totalled 12.6 Bcm. This was 8.7 Bcm (41 per cent) lower year-on-year, and 5.5 Bcm (30 per cent) below the average for the same period in 2017-2021. Indeed, 2022 was the first year since 2010 that stocks actually grew between 24 and 31 December. This lower-than-average withdrawal reflects a market that remains relatively well-balanced, albeit with high prices necessary to continue attracting supply.

Looking ahead, there are several signposts to look for. Firstly, storage stock levels in mid-winter (on 1 February 2023) will provide an indicator of how much of a 'buffer' remains to balance the market in the event of a late-winter surge in demand, as happened in late February-early March 2018. Secondly, stock levels at the end of winter (on 1 April 2023) will indicate how much would need to be injected during summer 2023, in order to bring stocks back to capacity by 1 November 2023.

Thereafter, stock levels will be monitored throughout the summer, to assess progress in bringing those stocks back to full capacity by 1 November. It should be remembered that Europe benefitted from

unusually benign weather conditions in October and the first half of November 2022, and a repeat of such conditions cannot be guaranteed in 2023. Therefore, Europe needs to be as close to its storage target as possible by 1 October, with stocks as close as possible to filling the 105 Bcm storage capacity.

On 31 December 2022, European storage stocks were just over 87 Bcm, which was almost 32 Bcm higher than on 31 December 2021 and just over 14 Bcm higher than the 31 December average for 2017-2021. The average storage withdrawal in Q1 in 2018-2022 was 37.4 Bcm, peaking at 48.1 Bcm in Q1 2018 and reaching a low of 28.1 Bcm in Q1 2022. If that Q1 2018-2022 average withdrawal were to be repeated in Q1 2023, Europe would have around 50 Bcm left in storage on 1 April 2023. If the maximum or minimum storage withdrawals (in the cold and mild Q1s of 2018 and 2022, respectively) were to be replicated in Q1 2023, Europe would be left with a minimum of 39 Bcm and a maximum of 59 Bcm in storage on 1 April 2023.

'Average' withdrawals in Q1 2023 would leave net injections of 50 Bcm sufficient to bring stocks back to full capacity by the start of winter 2023/24. The 'Mild Q1' or 'Cold Q1' withdrawals would mean summer net injections of 40 Bcm or 60 Bcm would be needed to bring storage back to full capacity. For comparison, European net injections in summer 2022 were around 72 Bcm.

In Q1 2023, the supply-demand balance that will determine withdrawal volumes will be rather different to recent years. Demand looks set to be lower, Russian pipeline supplies also lower, and LNG imports higher. If pipeline supply from Russia remains at the December 2022 level (78 MMcm/d), the year-on-year decline in Russian pipeline supply to Europe in Q1 2023 will be 19.2 Bcm. In a benign scenario, continued subdued demand and robust LNG imports could offset that loss. For example, if LNG imports in Q1 2023 were maintained at the level of Q4 2022, the year-on-year increase in Q1 2023 would be 5.6 Bcm. Similarly, demand in Q4 2022 was 20 per cent lower year-on-year. Even if demand in Q1 2023 were just 10 per cent lower year-on-year, this would imply a drop of 14.9 Bcm. If non-Russian pipeline imports were to remain unchanged year-on-year, this balance - with lower demand and higher LNG supply fully offsetting lower Russian pipeline supply - would allow storage withdrawals in Q1 2023 to also remain virtually unchanged year-on-year, and the 'Mild Q1' scenario would be achieved.

In a more challenging scenario, a surge in European gas demand and Asian LNG demand, combined with the year-on-year decline in Russian pipeline supply, could make the drawdown of storage stocks more substantial. For example, if non-Russian imports (pipeline and LNG) and production remained at the level of Q1 2022 (thus reversing the gains in LNG imports in recent months), demand returned to the level of Q1 2022, and Russian pipeline supply remained at 57 MMcm/d (the average for the first half of January), a net withdrawal of 49 Bcm would be required to achieve a physical balance on the European market – a withdrawal volume similar to the 'Cold Q1' scenario noted above.

It is also possible to conceive of an extremely challenging scenario, in which cold weather across the northern hemisphere brings European demand back to the level of Q1 2018 and causes LNG imports to decline by 10 per cent year-on-year in the face of strong demand from Asia, while the other 'challenging scenario' assumptions regarding production and pipeline imports remain unchanged. This would require storage withdrawals of 72 Bcm. If Russian pipeline supplies halted in mid-January, Q1 2023 storage withdrawals in this 'extremely challenging' scenario would rise to 77 Bcm.

As a result, although prices remain of critical interest because they may rise or fall dramatically in the space of a day or several days, storage stocks are a more fundamental indicator of market balance even though they may take weeks and months to be accumulated or drawn down. If Europe were to approach mid-August with stocks well short of the 1 October target, even a concerted effort to build stocks would be hampered by constraints on daily injection capacity. Conversely, if Europe were to begin winter 2023/24 with storage relatively full, this buffer would last for several months. This slow-moving nature of storage – akin to a very large concert hall with very few, narrow entry-exit doors – means that progress towards replenishing stocks in mid-to-late summer 2023 is likely to influence market sentiment (and, by extension, forward prices) for winter 2023/24.

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6. Final agreement on wholesale gas price caps foreshadows future challenges for EU energy policy

In late 2022 the EU Council finally agreed on a wholesale gas price cap mechanism in response to the record high gas prices. However, the 'market correction mechanism' is problematic as it does not address the underlying causes of high gas prices, primarily the reduction of Russian gas supplies from 41 per cent of the EU gas market to 9 per cent, and the lack of low-cost alternatives to fill the gap. It serves as a warning that, even in the face of a serious and immediate emergency, the EU Council lacks either the will or the imagination to develop and implement policies which meet its stated objectives. This bodes ill for the decisions that the Council will need to take to transform the EU's energy systems to meet its climate goals and it raises questions about what will happen in the EU gas market when the mechanism takes effect in February 2023.

The Council was divided on the value of a price cap and its level. The Commission was against a price cap, and it tried to avoid one by creating a framework without any detail. When this was rejected by several Member States, the Commission proposed a price cap at such a high level (€275/MWh) that it would be unlikely to be triggered. This was also rejected prior to agreement on a price cap of €180/MWh at the TTF and if the TTF price was at least €35/MWh above a benchmark price for LNG for at least three working days. The mechanism applies from 15 February 2023, and will last for at least twenty working days if triggered. If the TTF price falls below the cap for at least three consecutive working days, the cap is automatically deactivated. There are also 'safeguards' so that the cap is deactivated if it causes an increase in gas demand, a reduction in LNG imports, a significant drop in TTF liquidity, or if the EU Commission declares a supply emergency. The Commission, and the European energy and financial market regulators, ACER and ESMA, are charged with monitoring the functioning of the mechanism. If the mechanism causes market problems, the Commission will suspend it.

The legislation makes grimly amusing reading. The drafters tie themselves in sophistic knots trying to justify the price cap, while at the same time explaining the need for all the safeguards to prevent it from harming the EU gas market. This is a circle which cannot be squared as the problems of a price cap are inherent to its nature.[4] For the cap to have an impact it must override the prices which result from normal market functioning. Current prices are not caused by a market malfunction, but by a fundamental change in the supply-demand balance. It is no wonder that prices have increased dramatically as the EU has lost a third of its gas supply. Moreover, the recent falls in gas prices have been driven by demand reductions as the consumers have reacted to price increases, and the EU has been blessed with mild weather. Only by rebalancing supply and demand will prices be reduced sustainably. By implying that current prices are not a reflection of market reality, the very name of the 'market correction mechanism' is disingenuous.

Some may take comfort from the safeguards in the package but in reality, the problem of the price cap has only been kicked down the road. At the lower level of €180/MWh, gas prices in 2022 would have been above the cap for a fifth of the time, compared to a fiftieth of the time with the Commission's original proposal of €275/MWh. If the price cap is triggered at any point after February 15 then the market will need to find some other way of balancing which makes it more likely the safeguards will be triggered. But if the cap is suspended and prices rise to their natural level the price cap proponents will likely cry 'foul.'

As a result, the agreement is fragile and could lead to significant political dispute during the year if prices rise about €180/MWh. Germany reluctantly agreed to the mechanism in return for more ambitious renewable targets, but Austria and the Netherlands abstained. Agreement seems to have been driven more by the need to unblock the Council's agenda than any real meeting of minds. For example, price

[4] For a detailed examination of the issues see Barnes (2022) 'EU Commission proposal for joint gas purchasing, price caps and collective allocation of gas: an assessment' Oxford Institute for Energy Studies

cap discussions have delayed progress on key elements of the ‘Fit for 55’ package put forward by the Commission in 2021, including legislation on energy efficiency, renewables, reform of the gas market, and hydrogen. Therefore, it will be vital to monitor all reactions should gas prices start to rise towards the price cap level, not only from politicians from the various member states but also from market participants who will have to deal with the consequences of their actions. As with all state-interventions in markets, the unintended consequences could be significant.

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7. The EU regulatory framework governing solidarity during a gas crisis[5]

The EU has witnessed a severe gas (and energy) crisis since late 2021 and, in certain circumstances, the crisis could become more acute next winter. In this case, sharing of limited gas supplies across the EU could become a necessity. The Security of Supply Regulation (SOS Regulation, 2017), the Gas Demand Reduction Regulation (GDR Regulation, 2022), and the (draft) Enhancing Solidarity Regulation (ES Regulation, 2022) all contain solidarity provisions, aimed at alleviating any such crisis. However, 2023 could test the effectiveness of these provisions, particularly in respect of Germany, Czechia, Slovakia, Austria, and Hungary.

SOS Regulation

The SOS Regulation, adopted in 2017, introduced a solidarity obligation, under which a Member State which is directly connected to a requesting Member State, is obliged to reduce gas supplies to its own non-solidarity protected customers to support solidarity-protected customers in the requesting Member State. Solidarity-protected customers include all household customers connected to a gas distribution network and may include district heating installations in so far as they deliver heating to households (thus excluding small or medium-sized enterprises) or essential social services (including services such as healthcare, essential social care, emergency and security services but excluding educational and public administration services), and essential social services, as long as they are protected customers. A Member State can only request the application of the solidarity mechanism when the market cannot deliver the supplies for its solidarity-protected customers and after it has declared an emergency – the highest crisis level (preceded by an early warning and an alert). Member States were required to conclude their bilateral solidarity agreements, stipulating technical, legal, and financial arrangements, by 1 December 2018 but by January 2023, only six such agreements have been concluded (between Germany and Denmark, Germany and Austria, Italy and Slovenia, Latvia and Estonia, Latvia and Lithuania, and Estonia and Finland).

Enhancing Solidarity Regulation

In December 2022, the EU adopted the ES Regulation, which alongside the joint purchasing platform and the price correction mechanism, included provisions on solidarity, complementing the SOS Regulation. In particular, the ES Regulation extended solidarity protection to critical gas volumes for security of supply of electricity. This obliges a Member State to reduce gas supplies to its own customers, except (essential) volumes to solidarity-protected customers, critical volumes for security of supply of electricity, volumes for the electricity needed for the production and transportation of gas, and volumes necessary for the operations of various critical installations and infrastructure for a requesting Member State that is unable to cover (the essential volumes of) its solidarity-protected customers and supply the critical gas volumes for electricity security of supply. It has also extended the solidarity obligation – currently applicable only to Member States directly connected to a requesting Member State – to Member States with LNG facilities, provided that the necessary infrastructure is available. Importantly, the Regulation has introduced the default rules governing the implementation of the solidarity mechanism for those Member States which failed to conclude their bilateral solidarity agreements by the time of a solidarity measure being requested.

GDR Regulation

Following an estimation by the EC that a 15 per cent reduction of gas demand would be sufficient for the EU to see through the winter of 2022/23 – even if all Russian gas supplies were to be cut off – in August 2022 the EU adopted the GDR Regulation, which stipulates a voluntary 15 per cent gas demand reduction by each Member State between 1 August 2022 – 31 March 2023 (compared to their average consumption between 1 August and 31 March in the preceedeing five year period). It becomes mandatory when the Council, acting on a proposal from the EC and supported by a qualified majority,

[5] This article is based on Yafimava (2023 forthcoming) EU solidarity at a time of a gas crisis.

declares a Union alert, obliging each Member State – although exemptions are possible – to reduce its gas consumption by 15 per cent, taking the already achieved reductions into account. EU gas demand had already declined by almost 15 per cent in 2022 compared to 2021, mostly due to very high prices (forcing industrial closures) and mild temperatures (leading to lower demand for residential heating). Should EU gas demand remain on this trajectory, an EU alert might not be triggered. The EC must propose triggering an EU alert if at least five Member States have declared a national alert, or if there is a substantial risk of a severe gas shortage or exceptionally high gas demand resulting in a supply shock but where the market is still able to manage the disruption. As the criteria is not clearly defined, the EC has significant discretion over whether to make such a proposal, and the factors capable of prompting it to do so include a complete halt in Russian gas flows to Europe, a significant deviation from the 15 per cent demand reduction trajectory, lower LNG imports, and colder weather causing an accelerated storage depletion. Once the EU alert is declared, Member States would determine whose supplies get cut off, prioritising supplies to protected customers. Industrial consumers would likely be the first to experience reductions, but difficult trade-offs would have to be made with each Member State determining which industries are considered more critical than others. There would also be measures aimed at reducing gas consumption by the electricity sector. Overall, the process of implementing the mandatory gas demand reduction provision has a significant scope for disagreements – within Member States, between Member States, and between Member States and the EC – over who is going to be cut off and who is going to be exempted, thus potentially undermining its effectiveness during an actual crisis.

Conclusions: Possible Impact of Solidarity Measures During a Gas Crisis

The solidarity measures stipulated in SOS, ES, and GDR Regulations would likely have a limited – albeit not negligible – impact on the gas supply situation for the central and east European sub-region, should Russian flows be cut off. Even if these measures are agreed and implemented – and there are significant difficulties associated with this process, some of which could be resolved by next winter – infrastructure and capacity constraints would limit the volume of ‘solidarity gas’ which would be ‘freed up’ and which could flow to these countries from the adjacent Member States. In the short term – possibly until 2025, by which time more LNG supply and more LNG terminals and interconnections are expected to be available – even with maximum assistance from the other Member States, the central and east European sub-region could have problems coping with the consequences of any further significant reduction in Russian flows. Therefore, although gas rationing appears increasingly unlikely during the current winter, there is a significant risk that rationing will be needed in the winter of 2023/24, unless a recession triggers an even more significant gas demand reduction than is currently being observed in Europe.

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8. Where will Europe get its gas from in 2023?

At the beginning of 2022, if someone had told you that European[6] pipeline gas imports from Russia would decline by 55 per cent or some 83 bcm and that not only would gas supply to buildings be maintained in the depths of winter, but there would be record gas storage injections, you would have questioned their analytical capability and probably their sanity. While that is precisely what happened, Europe was very lucky in that the weather in 2022 was extremely warm at the beginning and end of the year, significantly reducing heating demand for gas, and the region also managed to increase its LNG imports by some 63 bcm over 2021, a rise of over 60 per cent. The very high prices also significantly reduced gas demand in industry and probably also affected household behaviour to limit energy consumption as winter approached. The rise in LNG imports reflected not only a rebound in global LNG supply of some 28 bcm (6 per cent), after the issues and constraints in 2021,but also diversions of cargoes away from other markets, especially China, where LNG imports were down by some 21.5 bcm, wiping out almost all growth since 2019.

Europe's overall 2022 balance saw the decline in pipe imports from Russia by 83 bcm being more than offset by a 74 bcm demand reduction, increased LNG imports of some 63 bcm, plus a slight increase in production and net pipeline imports from other sources which were higher by some 5 bcm. This additional 'supply' of around 59 bcm enabled net storage injections of 32 bcm in 2022, compared to a net withdrawal of 22 bcm in 2021.[7]

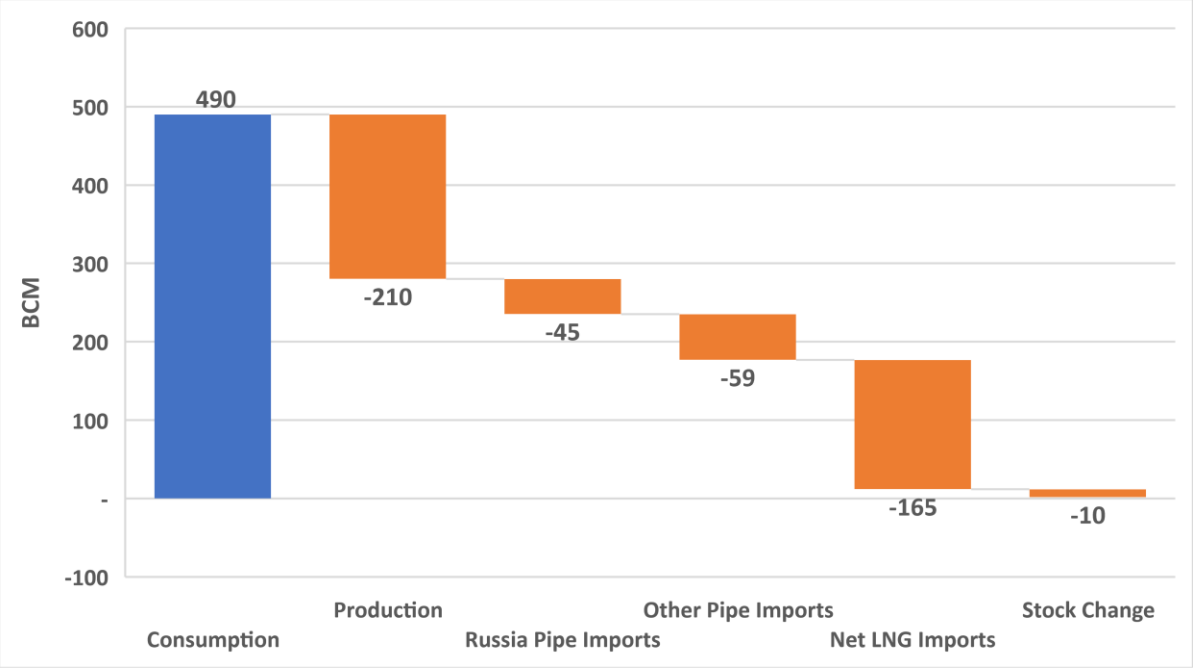
Turning to 2023, we are already looking at a year-on-year reduction in pipe imports from Russia of around 40 bcm, assuming that flows continue at current rates via Ukraine and Turkstream. Even including flows to Turkey, pipe imports from Russia will be down to roughly 45 bcm,[8] against 168 bcm in 2021. However, if gas demand were to remain at the same level in 2023 as in 2022 (although this assumes another very warm year and no rebound in industrial gas demand) and the level of production, net pipeline imports (other than from Russia), and LNG imports were unchanged, then the reduction in pipe imports from Russia could be met by net withdrawals from storage of some 10 bcm (compared to the net injection of 32 bcm in 2022, so a net change of around 40bcm), as shown below.

The net withdrawals from storage could be reduced by additional LNG imports, especially into Germany, with the new LNG import terminals coming onstream in 2023. The growth in overall LNG supply looks reasonably robust in 2023 with prospective growth of just under 30 bcm, although there are very few new export terminals coming onstream this year. The growth mostly comes from technical issues being resolved at projects in Norway, Malaysia, and the US (Freeport), additional feedgas in Trinidad and Nigeria, and the ramp up of volumes from projects which started up in 2022, such as Calcasieu Pass in the US and Coral FLNG in Mozambique.

Europe might be expected to be able to get at least half the 30 bcm rise in LNG supply, which would eliminate the need for net storage withdrawals in 2023. However, LNG imports seem likely to bounce back in the rest of the world. China is likely to see some recovery in LNG imports even as domestic production and pipeline imports are likely to meet much of the incremental demand. The emerging southeast Asian markets are also growing. Any recovery in the very price sensitive markets of India, Pakistan, and Bangladesh may depend on LNG spot price levels in 2023.

[6] Europe includes the EU27 plus the UK, Norway, Switzerland, Serbia, Bosnia-Herzegovina, North Macedonia, Albania, and Turkey.
[7] The additional supply (based on changes in flows between 2022 and 2021) is 59 bcm (74 bcm lower demand plus 63 bcm more LNG, 5 bcm more production and other pipeline imports minus 83 bcm loss of Russian pipe import) which accounts broadly for the change in the net storage injections/withdrawals of 54 bcm (32 bcm net injection in 2022 minus the 22 bcm of net withdrawals in 2021).
[8] Around 20 bcm to Turkey and 25 bcm to the EU and Balkans.

Figure 4: Europe Balance 2023
BLUE demand is met by ORANGE supply



Source: IEA, ENTSOG, KPLER data, NexantECA WGM, OIES estimates

There are, however, some dangers to this potentially benign outlook for Europe, which has assumed that the other key parameters in terms of supply and demand in Europe in 2023 remain the same as in 2022, plus a rising global LNG supply. The IEA, in a recent note,[9] suggested that European gas demand could be higher by some 20 bcm as a result of slightly colder 2023 weather and avoiding production curtailments in energy-intensive industries. In addition, there remains a strong possibility that flows of Russian pipeline gas through Ukraine could be completely cut off as the war continues and if President Putin decides to tighten the energy screw even further. At current rates – around 40 mmcmd – the full year flows of gas along the Ukraine route would be some 14.5 bcm. A shutdown for half the year would increase Europe's need by some 7 bcm. This could also lead to Ukraine and Moldova requiring more imports from the EU, adding more supply requirements.

If Europe were to need another 30 bcm in supply in 2023, compared to the initial relatively benign outlook, significant pressure would be placed on the LNG market and the level of global prices. LNG volumes to the more price sensitive Asian markets would be particularly at risk. Ultimately, Europe could be faced with an inability to refill storage during the summer and/or more curtailments of industrial gas demand, if LNG could not be diverted from other markets. As a result, although the outlook for 2023 appears more positive than many might have thought even three months ago, the risks of a supply shortage and higher prices cannot be discounted and the key parameters will need to be carefully monitored throughout the year.

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[9] How to Avoid Gas Shortage in the European Union in 2023. IEA, Paris, December 2022

9. China in 2023: A year of two halves

A seemingly mundane announcement on 7 December 2022[10] effectively signalled the end of China's strict zero-COVID policy. The policy reversal has come as a surprise to many, especially given that the government seems to have made few preparations for it, such as rolling out vaccinations for the elderly or preparing intensive care units. And with limited data, the severity of the impact remains unclear. Since early December, the virus has been spreading in China's large cities - with estimates pegging the number of infected at around 250 million in the first twenty days of December[11] - alongside anecdotal reports of a spike in deaths. But the official death toll reported on 4 January 2023 was 5,253 since the start of the pandemic.

Meanwhile, the economy continued to slow, with factory activity in December China shrinking for the third consecutive month as COVID infections sweeps through production lines. This deceleration will likely continue through early 2023 as infections continue, although China's National Health Commission reportedly expects outbreaks to peak in January.[12] What is clear, then, is that China is learning to live with COVID and that much of the economic fallout will be felt in the first quarter of 2023, with some lingering effects in the first half. Whether infections peak in January, as the government expects, or later in the winter, remains to be seen. This, in turn, will be critical for China's economic outlook as well as for its energy demand. But the longer the economic deceleration, the sharper the rebound is likely to be as the government seems to be switching to a pro-growth mind-set.

The Central Economic Work Conference (CEWC) - the most important Party-led annual economic meeting - which convened on 15-16 December, focused on the real estate sector and efforts to ensure that stalled construction projects are completed and that developers have sufficient credit to execute them. Bank funding and credit lines have since been made available to developers. The CEWC also gave a nod to a more proactive fiscal policy and indicated potential support for the tech sector. Put simply, announcements in December seem to be hinting at the unravelling of almost three years of macroeconomic policies that squeezed the real estate sector and private entrepreneurs alongside the strict COVID controls. The extent to which these are short term measures to support growth or a deeper U-turn in government priorities, will be a key question for 2023.

The steepness of the recovery, after the initial hit, is also an open question. The Chinese government did not set a GDP growth target at the CEWC (it might still issue one during the Parliamentary sessions in March), but the IMF now expects China's GDP to grow by 4.4 per cent year-on-year in 2023, after a weaker expansion of 3.2 per cent in 2022.[13] To be sure, views of China's growth potential vary widely, with estimates ranging from 3 per cent to 5 per cent for 2023. Proponents of lower growth rates highlight structural macroeconomic factors that will impede a return to the heyday of rapid growth, such as high levels of local debt and a long-term slowdown in housing demand which will hold back expansion in infrastructure that had served as a main growth lever for over a decade.

But the domestic structural issues may not manifest themselves in 2023. The reopening of the country will likely result in a rebound in consumption and travel - with travel already beginning to recover in large cities - as well as fewer supply chain disruptions. As China's supply chains return to normal, business sentiment within China as well as international confidence in China as a manufacturing base could

[10] National Health Commission, "Notice on Further Optimising and Implementing the Prevention and Control Measures of COVID-19", 7 December 2022, http://www.nhc.gov.cn/xcs/gzzcwj/202212/8278e7a7aee34e5bb378f0e0fc94e0f0.shtml

[11] Qianer Liu, Cheng Leng, Sun Yu, Ryan McMorrow, "China estimates 250mn people have caught Covid in 20 days", Financial Times, 25 December 2022, https://www.ft.com/content/1fb6044a-3050-44d8-b715-80c18ca5c9ab

[12] "Chinese Cities See Covid Peaking in January as Official Data Gets Obscured," Bloomberg, 26 December 2022, https://www.bloomberg.com/news/articles/2022-12-26/china-cities-covid-estimates-suggest-infections-may-peak-in-january?leadSource=uverify%20wall

[13] Based on Xi Jinping's New Year's speech, however, the economy grew in 2022 at over 4 per cent, Laura He, "Xi Jinping estimates China's 2022 GDP grew at least 4.4%. But Covid misery looms", CNN, 2 January 2023, https://edition.cnn.com/2023/01/02/economy/xi-jinping-china-gdp-estimate-covid-intl-hnk/index.html

improve, leading not only to a catch-up in production, but potentially to a further boost in demand for manufacturing, even though the recession in Europe could dampen appetite for exports. The low growth forecasts may prove overly pessimistic, but equally, there are headwinds buffeting a very strong economic expansion.

In light of this, energy demand is likely to remain subdued initially, and see a strong recovery in the second half of 2023. Both oil and gas demand are set to grow as economic activity rebounds. Oil product demand will see growth across the barrel: from industrial fuels for construction activity through to transport fuels as domestic and international travel resume. At the same time, crude imports and product exports depend on quotas and licences. And in a pro-growth environment, the government may issue additional allowances for independents to import crude and for the majors to export products as a means of boosting growth. Nonetheless, in the first half of the year, in the context of weak domestic demand, crude import growth could be muted even as product exports rise. What is more, it will be important to watch if environmental control policies and tax crackdowns will be softened, allowing the Shandong independents as well as new refineries to thrive. If environmental protection takes a backseat to growth, crude imports and refinery throughputs will rise strongly this year, but domestic demand increases will moderate product exports in the second half of the year.

Gas demand may only pick up later in the year, although spot LNG purchases are slowly resuming. Even though an uptick in industrial activity will support gas demand, it will only lead to more spot LNG purchases if prices do not spike. Indeed, with additional flows on the Power of Siberia and a strong policy mandate to focus on domestic production, most of the incremental gas demand will be met by pipelines and domestic supply. That said, with new LNG terminals and SPAs starting up, LNG flows will pick up from their 2022 levels, rising by 6-8 bcm, after a close to 20 bcm drop in 2022. The potential, at least for the second half of the year, is likely skewed to the upside.

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10. India's G-20 Presidency

The energy trilemma (balancing energy affordability and accessibility while maintaining security of supply and ensuring environmental protection) shifted in 2022 to an overwhelming emphasis on energy security, particularly in developed countries. This created negative consequences for developing countries, regarding energy affordability and the 3Fs: 'food, fuel, and fertilizers'. In light of these challenges, global dialogue and coordination fora have assumed added importance. The G-20 is a grouping of 19 developing and developed countries (including China), plus the EU.[14] Together these countries represent 90 per cent of global GDP, 80 per cent of global trade, and 67 per cent of the world's population.

India holds the G-20 Presidency in 2023 and will lead a nine-month global deliberation to shape the agenda for a September summit. India's priority areas include the energy transition, climate finance, clean technology-sharing instead of dominance, pursuit of the Sustainable Development Goals (SDGs)including the 3Fs, and digital public infrastructure.[15]

For the first time, all G-20 troika members are developing countries (Indonesia, India, and Brazil).[16] They will reinforce a common set of relevant priorities, address the 3Fs, and seek more balance in the energy trilemma, away from energy security alone and towards a greater emphasis on affordability and access, as well as environmental protection.

The work of the G-20 takes place on two tracks, leading up to the summit: the Finance track, and the Sherpa[17] track. The latter will set the development and energy agenda for the G-20 leaders. Sherpa will lead 13 working groups covering: energy, trade, investment, development, employment, tourism, agriculture, digital infrastructure, health, education, culture, environment, and anti-corruption. India has planned over 200 meetings across 32 workstreams in 50 cities, involving ministers, government officials, and civil society members in the lead up to the summit.

India aims to influence the global conversation in three primary areas: (i) *energy transition*, including pushing for equal treatment of all fossil fuels; (ii) *multilateral development bank (MDB) reforms to support climate finance* through new financial instruments that do not increase developing country indebtedness when borrowing for global public goods; and (iii) *digital public infrastructure* to support energy efficiency and SDG progress, through enabling adoption of emerging technology areas such as 5G, IoT, artificial intelligence, machine learning, blockchain, drones, robotics, additive manufacturing, nano-based devices, etc.

India has some experience with digital technology in SDG applications in agriculture, health, cyber security, smart cities, and automation, with special focus on solving real-life problems with information technology leading to *increased energy efficiency/carbon credits.* [18] Smart meters are another

[14] Argentina, Australia, Brazil, Canada, China, EU, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, UK, and USA.

[15] Digital infrastructure refers to physical resources necessary for the use of data, computerised devices, systems for scaling and faster impact, and monitoring and verification. India has nearly half a billion internet users and many indigenous digital services, platforms, and solutions it is willing to share with peers.

[16] The "troika" refers to the past, present, and next presidency of the G-20. Its mandated collaboration ensures continuity of initiatives underway, as well as buy-in to new areas.

[17] Sherpas are personal representatives of leaders of member countries at such international summits, with the term being derived from the Nepalese who serve as guides for mountaineers in the Himalayas.

[18] India has a large ongoing government program to reduce the use of fossil fuels (including diesel) in agricultural pumping and to incentivize farmers, through direct digital payment transfers, to shift to solar powered pumps. There are also numerous ICT-based energy efficiency applications (apps) and pilot projects being tried in various parts of the country, for intelligent water management, smart buildings, solar powered refrigerated warehouses to reduce post-harvest losses, smart transport etc, all with a view to saving energy and realizing quantifiable savings. All these technologies use the internet for real-time communication and data capture, which is essential for entering these initiatives in the carbon credits market. India has frequently offered to share its digital technologies with other developing countries at cost or as a donation, eg COWIN which is its Covid vaccine tracking portal that contains details of over 2 billion administered vaccinations.

application that can lead to better energy management, provided that the underlying digital infrastructure is in place. India will support other developing countries by offering some of these digital technologies.

Other priority areas include:

- Green Grids Initiative/OSOWOG:[19] Cross-border transmission networks for trade in solar energy during evening peaks, taking advantage of time differences e.g Oman/Qatar have afternoon sunshine when India and southeast Asia are dark; solar trade can avoid the use of fossil fuels at the evening peak.
- Global capacity building and climate resilience-building associations such as the International Solar Alliance; Global Biofuels alliance (Biogas, Ethanol); nature-based carbon sink solutions (e.g., Mangrove Alliance); the coalition for Disaster Risk Reduction etc. These will be strengthened for continuity beyond India's presidency.
- Green hydrogen and shared R&D to lower costs in pursuit of clean fuels for industrialisation and transport needs.
- Innovative low-cost cooling technologies (in the face of life-threatening temperature rises).
- Adaptation in the face of climate hazards (heat, drought, flood, fires) that jeopardize food security and SDG nutrition achievements. 2023 is the UN's international year of millets, a drought- and heat-tolerant crop.
- "Mission LiFE" which pushes climate action from the country level down to individuals, companies, and governments, with proposals for their respective roles

India believes that today's 'energy transition by only those who can afford it' must not continue to be the way forward.

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[19] One Sun-One World-One Grid, an initiative of PM Modi that is backed by several countries including the UK, currently at feasibility study.

11. Revisiting the Africa-Europe energy relationship

Last year, Europe's frantic search for alternative natural gas supplies to replace Russian gas imports led to an unexpected interest in African gas. Presently, Europe accounts for the bulk of Africa's natural gas exports, and European governments are hoping to temporarily increase Africa's share of these imports still further. Thus, an effective energy relationship between these two regions is crucial.

Until the eruption of the Russia-Ukraine war and the worsening of Europe's energy crisis, this relationship was mainly conducted in a commercial way by European or international energy companies and relevant African hydrocarbon entities (national companies and/or national/international company partnerships). This seems to be changing with the European Union (EU) taking a more interventionist role in the 'management' of Europe's gas imports.[20] Unfortunately, there has been a lack of consistency in recent EU policies which is creating some confusion among gas suppliers.

Two EU policy announcements issued in December 2022 could raise tension this year between Europe and its non-EU gas suppliers. The first is the EU climate action regarding the Carbon Border Adjustment Mechanism or CBAM[21] and the second is its gas price cap mechanism decision.[22] Although the yet-to-be fully adopted CBAM does not cover hydrocarbon imports, it does target energy-intensive products exported by African and Middle Eastern hydrocarbon producers. Nevertheless, it was the gas price cap decision, which directly relates to natural gas trade, which triggered immediate African reactions.

Algeria's energy minister was the first to respond by stating that 'Algeria does not support the idea of capping gas prices'. The Algerian minister added that, 'open, transparent, non-restricted, and non-discriminatory gas markets are more than necessary…'. [23] Interestingly, this was something the European Commission strongly pushed for a few decades ago during its gas market liberalization negotiations with gas exporters.

Incremental African gas volumes are planned to be supplied to Europe starting this year and new international gas project investments are also expected to be sanctioned in 2023 and future years (e.g., the final investment decision - FID - for the next phase(s) of Mauritania-Senegal's Grand Tortue Ahmeyim LNG project). The EU gas price cap is temporary, and it is not clear how it would be implemented, if at all. But it could unnecessarily affect FIDs of potential new or expanded African gas export schemes. Could 2023 bring the moment of truth for all the African gas supply plans and expectations announced last year? Could an increase in African gas exports to Europe and African gas project FIDs materialize this year?

All this is taking place against the background of Africa's search for an as yet elusive fair energy transition. After the mixed results of COP27, the road to COP28 this year will again be a challenging one for African policymakers. Existing and future African gas exporting countries are at different stages in the formulation of their energy transition strategies, but for all of them, natural gas is expected to play a fundamental role not only in their energy transition strategies, but in their overall economic development. It would be naïve and irresponsible to think that gas production in Africa could suddenly be stopped, significantly reduced, or avoided altogether.

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[20] As formally framed in the EU's REPowerEU plan and including the recent gas price intervention announcement (footnote 3 see below).

[21] European Council (2022). "EU climate action: provisional agreement reached on Carbon Border Adjustment Mechanism (CBAM)", 13 December. https://www.consilium.europa.eu/en/press/press-releases/2022/12/13/eu-climate-action-provisional-agreement-reached-on-carbon-border-adjustment-mechanism-cbam/

[22] European Council (2022). "Council agrees on temporary mechanism to limit excessive gas prices", 19 December. https://www.consilium.europa.eu/en/press/press-releases/2022/12/19/council-agrees-on-temporary-mechanism-to-limit-excessive-gas-prices/pdf

[23] *Algerie Presse Service* (2022). "Arkab: l'Algérie ne soutient pas l'idée de plafonnement des prix du gaz naturel", 20 December. https://www.aps.dz/economie/149037-arkab-l-algerie-ne-soutient-pas-l-idee-de-plafonnement-des-prix-du-gaz-naturel

However, the long-term uncertainties about the future of unabated gas supplies pose a problem not only for gas exports to Europe, but also for supplies to African domestic energy markets. It is highly likely that European or international companies' investments in African gas development projects will be affected by future European decarbonization measures, and therefore both African gas producers and international investors will need to focus on carbon capture, storage and utilization projects and the urgent reduction of associated gas flaring and methane emissions.

Europe could play a role in assisting African hydrocarbon-producing countries in their energy transition strategies. A series of Africa-Europe initiatives, including the Africa-EU Energy Partnership,[24] were set up, but these have had limited impact so far. Initially, there were African concerns about the EU Green Deal, specifically 'that it was imposed on them' and that it was focused on 'mitigation, circular economy, and carbon taxes'.[25] In some cases, attempts by EU governments to develop clean energy initiatives in Africa have been based on old energy trade models applied to new clean products, such as the ambitious plans to export North African green hydrogen to Europe using massive dedicated renewable energy capacity in North Africa, while levels of clean electrification in Africa remain far from satisfactory.

Therefore, the Africa-Europe energy relationship will need to be revisited to address not only Europe's short to medium term gas import needs, but also Africa's longer-term domestic energy consumption and energy transition concerns. Could 2023 be the trigger year for a more effective and sustainable Africa-Europe energy partnership or will it be a year of accentuated tensions between Europe and its African gas suppliers?

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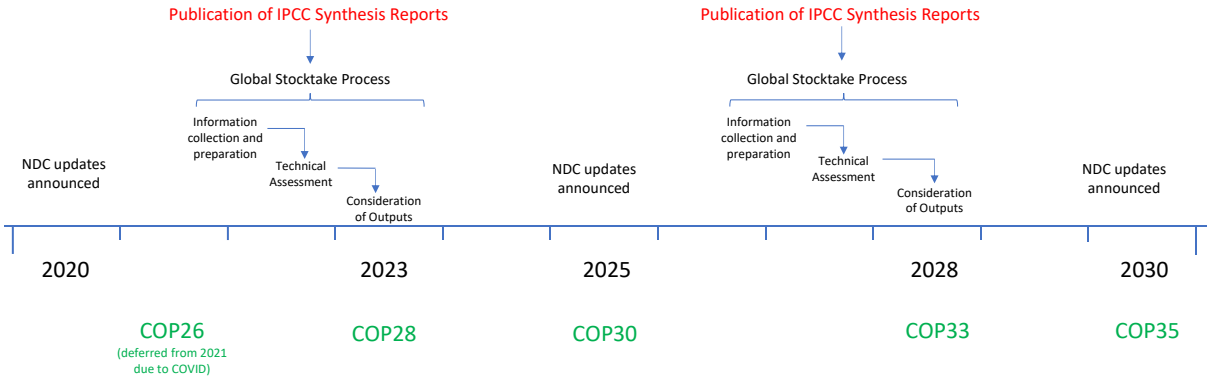
[24] https://africa-eu-energy-partnership.org/
[25] Hanne Knaepen (2020). "Barriers to Europe-Africa Cooperation on Climate Change", ISPI, 21 December. https://www.ispionline.it/it/pubblicazione/barriers-europe-africa-cooperation-climate-change-28645

12. The Global Stocktake – A critical update on climate action, or lack of it

COP27, held in Egypt in November 2022, boasted a few notable successes, in particular the establishment of a Loss and Damage Fund to compensate developing countries for the impact of climate change. However, one of the most obvious deficiencies was the lack of significant progress on setting and implementing more ambitious emissions reduction targets. Prior to the conference a series of IPCC reports had highlighted that the world is not on target to meet its 1.5º warming target and during the event itself the NGO Climate Tracker highlighted that on the basis of current policy implementation the world will warm by 2.7º by 2100.[26] To mitigate this, countries had agreed at COP26 in 2021 to update their national plans (or nationally determined contributions, NDCs) during 2022 with more ambitious targets, but only 20 of the 193 parties had done this by November.[27] As a result, UN Secretary-General Antonio Guterres felt compelled to warn, 'we are on a highway to climate hell with our foot still on the accelerator'.[28]

This situation has highlighted the importance of a process established under Article 14 of the Paris Agreement known as the Global Stocktake (GST). Its purpose is to assess progress on 'mitigation, adaptation, and the means of implementation and support, and in the light of equity and the best available science'.[29] In other words how are countries doing in their efforts to bring down emissions, how prepared are they to adapt to a changing environment, and what progress is being made to provide help to poorer countries, especially with climate finance. The GST takes place once every five years in tandem with the setting of new NDCs, as shown in the chart below. In the current cycle, progress on implementing the NDC targets set in 2020/21 (a process that was delayed by COVID 19) is being reviewed in 2022/23 ahead of the presentation of new NDCs in 2025. These will then be reviewed in 2027/28 ahead of a further set of new NDC targets in 2030, as part of the ratcheting process established in the Paris Agreement.

Figure 5: Timetable for the Global Stocktake Process



Source: Author

COP27 marked the end of the second of three phases in the current cycle. Phase 1, which began at COP26, has involved the gathering of information, while phase 2 has been the technical assessment of that data and a review process which commenced at COP27. The Sharm El Sheikh Implementation Plan, published at the end of the conference,[30] noted the importance of this periodic review and it is significant that the discussions around the GST took place at numerous roundtables that involved

[26] Bloomberg, 10 November 2022, "Climate Projections Again Point to Dangerous 2.7C Rise by 2100"
[27] See Climate Action Tracker at https://climateactiontracker.org/climate-target-update-tracker-2022/
[28] IISD Daily Report from COP27, Monday 7 November
[29] https://unfccc.int/sites/default/files/english_paris_agreement.pdf
[30] Sharm El Sheikh Implementation Plan, Section XII, UNFCCC, at https://unfccc.int/documents/624444

participants from a wide range of affiliations, underlining the intended inclusive and collaborative nature of the process.

However, although the COP27 discussions on the GST were positive, despite some complaints about the presence of oil and gas industry lobbyists,[31] the real test of the process will come in 2023 when the results are made public and the political negotiations about how to respond to them begin. One major issue will be the pledge by developed countries to provide USD 100 billion of climate finance for the developed world by 2020. This goal has already been missed, but a new promise to achieve it by 2023 will be reviewed in the GST and the outcome will no doubt be highlighted. Furthermore, although the performance of individual countries will not be a focus, in order to avoid excessive finger-pointing, it should also become abundantly clear whether the world as a whole is implementing emissions reduction plans and is on target to meet its climate objectives. As this is unlikely to be the case, controversial questions about why not and what can be done will no doubt be raised and vociferously debated.

The first sign of results from the GST process should start to emerge in February 2023 when the 193 parties in the UNFCCC process, as well as interested non-parties (such as NGOs) have been invited to offer thoughts on how the outputs should be considered. A more specific consultation process is then planned for April before an in-person workshop in October, ahead of COP28 which is due to take place in the UAE from 30 November to 12 December. To further emphasize the importance of the GST, the UN Secretary-General has invited all parties to a 'climate ambition summit' ahead of the conclusion of the GST to ensure that the outputs are fully understood and that resulting plans of action are considered. As a result, although the GST has been described as something of a 'sleeper issue' its importance is set to become very clear in 2023 as it takes centre stage in the debate about the world's progress, or lack of it, towards meeting climate goals and about the plans that need to be put in place to close any gaps. This could therefore be the moment when the reality of the climate emergency is laid bare and could act as an important catalyst for policy-makers to start to make more concrete plans to rectify the situation, with significant implications for countries and companies alike.

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[31] https://www.carbonbrief.org/cop27-key-outcomes-agreed-at-the-un-climate-talks-in-sharm-el-sheikh/#:~:text=Back%20to%20top-,Sharm%20el%2DSheikh%20implementation%20plan,last%20year's%20Glasgow%20Climate%20Pact.

13. Progress with climate finance ahead of COP28 will be vital in 2023

One of the major themes for advancing climate mitigation and adaptation in 2023 will be the status and progress of climate finance. The years following the Paris Agreement in 2015 were marked by a sustained growth of capital allocation towards climate mitigation and adaptation, [32] with major innovations also in terms of financing instruments adopted to channel capital.[33] However, 2022 marked a major break in this trend with the focus of global policy-makers moving from long-term environmental governance to short-term energy and debt affordability, while investors became less interested in pro-environmental investments and more concerned about inflation, interest rate, and currency risks. While the current energy crisis is likely to increase the longer-term motivation to develop low-carbon energy sources, it has also highlighted that the costs of the energy transition and of limiting climate change are far higher than previously thought. As a result, in 2023 the challenges of navigating the current uncertain economic environment could undermine hope for any major innovations in climate finance, despite the fact that it will become increasingly clear that more finance is needed if the world is to get back on track to meet its climate goals.

Looking back at 2022, two main themes are particularly notable and whose consequences will be particularly relevant to monitor for 2023. First are the outcomes and consequences of recent international climate negotiations. A core objective of delegates at COP27, particularly those representing developing countries, was to bring the spotlight back onto the role of climate finance. The fact that COP27 was hosted in Africa gave major impetus for the host country to ensure this topic was high on the agenda, despite the major headwinds created by the energy and geopolitical crises in 2022.[34] The main achievement was the announcement, on the final days of the conference, of the commitment to set up a fund for loss and damage arising from climate change. While the announcement has huge significance and reiterates once again the principle of 'common but differentiated responsibilities'[35], the operationalization and actual financial commitments still need to be agreed with the details expected to be part of more complex negotiations between developed and developing countries in 2023 and during future COPs.

The second key issue for 2023 is whether there will be a recovery in the scale of climate financing, following a sharp decline in global issuance volumes in 2022 as a result of the global economic headwinds. Recent developments in instruments such as green bonds (and more generally Green, Social, and Sustainability Bonds collectively referred as 'GSS' bonds) and Sustainability-Linked bonds, have marked an important milestone in facilitating the allocation of capital towards projects and assets for climate mitigation and adaptation. However, the current global economic environment, with rising interest rates in major economies, has created major challenges for the ability of emerging countries to attract investors and repay current outstanding debts due to the sharp appreciation of the US dollar against other currencies. Against this background, multilateral development banks (MDBs) can play an important role in supporting risk mitigation and promoting financing structures for developing countries. While MDBs have historically mostly focused on private blended finance transactions, 2022 marked the first transaction in which the World Bank supported the de-risking of publicly-traded green bonds issued

[32] Global investment in assets and projects directed to climate mitigation and adaptation reached USD 650 billion in 2022 alone according to IMF estimates. The International Energy Agency (IEA) estimated total investments between 2016 and 2020 averaged USD 1.5 trillion. See: "Net Zero by 2050. A Roadmap for the Global Energy Sector", 2021, https://www.iea.org/reports/net-zero-by-2050.

[33] For instance green and other thematic loans/debt market as well as carbon markets in its various forms. Green bonds grew as an important asset class in the same period reaching the milestone of USD 1 trillion of debt outstanding in 2021.

[34] Already ahead of COP27, developed countries had promised to meet their USD100 billion financing target, as agreed in COP15 in Copenhagen, by 2023 at the latest after a delay from 2020 due to the covid pandemic. Limited results have been achieved so far on that front.

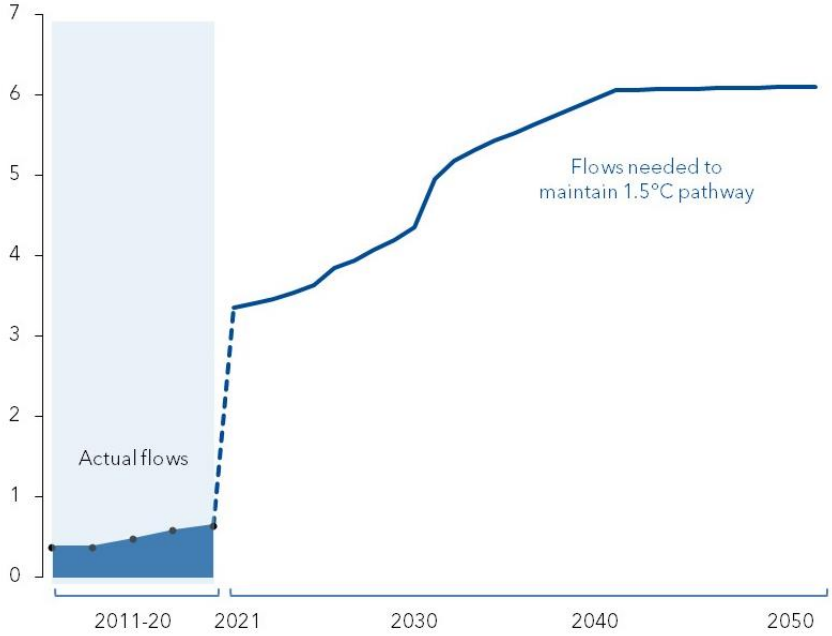
[35] The 'common but differentiated responsibilities' in the United Nations Framework Convention on Climate Change acknowledges that developed economies carry a major responsibility in addressing the current climate crisis

by developing countries.[36] The role of MDBs globally will be carefully monitored in 2023, especially as the need for change was actively discussed at COP27.

The global stocktake will also have significant implications for climate finance in 2023. It will review the performance of countries against their climate plans and will outline what is needed to achieve the 2050 climate goals, most likely highlighting the need to scale-up investments (and thus financing) towards climate mitigation and adaptation.

Current figures estimated by the IMF show a large gap between current commitments and the required scale. Only USD 630 billion were invested in 2022 compared to the need to achieve stable flows of investments of the order of USD 3 - 6 trillion between 2030 and 2050, see Figure 1.[37] With the total share of global financial assets at USD 470 trillion,[38] the main challenge that policymakers will face in 2023 and for the years ahead is how to shape incentives to direct capital towards climate mitigation and adaption assets and projects while navigating the current challenging economic and geopolitical environment.

Figure 6: Climate finance flows, actual and needed to limit warming to 1.5°C



Sources: Georgieva K., Adrian T., Global Landscape of Climate Finance 2021, Climate Policy Initiative, IMF, August 2022, https://www.imf.org/en/Blogs/Articles/2022/08/18/public-sector-must-play-major-role-in-catalyzing-private-climate-finance

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[36] https://pressroom.ifc.org/all/pages/PressDetail.aspx?ID=26688

[37] The International Energy Agency (IEA) estimates that in a net-zero scenario (NZE), investments in the global energy system need to increase from the current level of USD 1.5 trillion a year to USD 4.5–5.0 trillion a year between 2030 and 2050. Total investments range between USD 100 trillion and USD 150 trillion between 2020 and 2050. See: "Net Zero by 2050. A Roadmap for the Global Energy Sector", 2021, https://www.iea.org/reports/net-zero-by-2050.

[38] In 2020 total global financial assets exhibited strong growth in 2020, increasing by 11 per cent with the global non-banking financial Intermediation (NBFI) sector, constituting mainly pension funds, insurance corporations, and other financial intermediaries experiencing asset growth of 8 per cent, reaching USD 230 trillion. See: https://www.fsb.org/2021/12/global-monitoring-report-on-non-bank-financial-intermediation-2021/

14. Article 6 post-COP27

At COP26 in 2021 the rulebook for Article 6 of the Paris Agreement (which covered the creation of a market for carbon credits) was finally established, and the focus then shifted towards putting the crediting mechanisms and frameworks included in it into operation. However, despite the optimism in the lead-up to COP27, market participants were left with a bittersweet feeling, with the resolution of many key issues pertaining to Article 6 being pushed back to COP28 in 2023. Negotiations in the lead-up to and during COP28, alongside the recommendations of various initiatives such as the Integrity Council for the Voluntary Carbon Market (IC-VCM) and the Voluntary Carbon Markets Integrity Initiative (VCMI), will have important implications for the development of wider carbon markets, including voluntary carbon markets (VCMs), and more generally, for the spectrum of policies that countries can implement to attract climate finance via carbon markets.

In terms of advancing the operationalization of Article 6 in COP27, the Parties agreed on key reporting templates, particularly the 'Initial Report' and the 'Annex to the Bilateral Transparency Report'. Some observers believe the finalization of these templates should enable countries to start developing cooperative approaches and signing bilateral and multilateral agreements under Article 6.2. Under Article 6.2, a host country has the right to authorise the transfer of Internationally Traded Mitigation Outcomes (ITMOs) which can be used either by credit-buying countries towards achieving their nationally determined contributions (NDCs), in market-based schemes such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) or by companies to offset their emissions.

Perhaps the most contentious issue which remains unresolved is the optionality of host countries to revoke the authorisation for corresponding adjustments (CAs) of credits issued under Article 6.2 (but also under Article 6.4). This is particularly important for investors, project developers, and the wider market which need predictability to be able to attract the necessary finance for scalability and for carbon projects to be bankable. This issue also relates to host countries' concerns of over-selling cheaper credits at the risk of increasing the cost of achieving their climate targets. This has led a few countries such as India to rethink their strategies and limit the export of carbon credits to ensure that the credits are first used towards meeting their own NDCs, with the surplus allowed to be transferred abroad. What is also becoming increasingly clear is the importance of capacity building in host countries to enable the set-up of proper registries and accounting infrastructure. Particularly with regards to capacity building, multilateral development banks are expected to play a major role going forward with several initiatives and pilot schemes already under way. Another issue relates to the confidentiality of reporting, where the agreed text provides a participating party the right to 'designate information provided to the Article 6 technical expert review team during the review as confidential', which does not help the transparency of the verification process. Despite these outstanding issues, some countries are already inking bilateral agreements under Article 6.2, led so far by Switzerland, Singapore, and Sweden.

Other unresolved issues include the definition of the role of carbon removal, both engineered and nature-based, under Article 6. Particularly, Parties are yet to agree on appropriate accounting methods, monitoring, and reporting standards for carbon removal, including in relation to reversal and leakage issues and the need to avoid negative environmental and social side effects. Another unresolved issue is whether credits generated from emissions avoidance projects should be included within the framework of Article 6 at all. On the upside, more clarity has been provided on the process to follow for transitioning legacy credits under the Clean Development Mechanism (CDM) to the Article 6.4 crediting mechanism, with a template for transition requests for project developers expected to be published in June 2023.

Another development concerning Article 6.4 was the clarification of the role of ITMOs which are not authorized and hence not correspondingly adjusted. Article 6.4 effectively establishes a new type of carbon credits, called 'mitigation contributions', which cannot be used to make offset claims at the national level (i.e. towards meeting countries' NDCs). These mitigation contributions 'may be used, inter alia, for results-based climate finance, domestic mitigation pricing schemes, or domestic price-based

measures, for the purpose of contributing to the reduction of emission levels in the host country'. It does indirectly reduce their scope by implying that these credits cannot be used for offsetting, even though the issue of regulating corporate claims in the VCM does not fall under the jurisdiction of the COP. However, there have been calls for national governments to play a more active role in providing a regulatory environment and clarifying the rules around the VCM.

The term 'inter alia' in reference to the usage of 'mitigation contributions' is of significance and has created debate among observers. The legal term, meaning 'among other things', suggests that carbon credits with no CA can be used in the VCM. This may create a two-tier system and rather than convergence, may lead to divergence, with buyers preferring to purchase 'authorized' and 'adjusted' credits, although these credits may not necessarily be of higher quality but may be perceived to be so. Also, the type of claims which can be made using these mitigation contributions will affect buyers' demand as their prime motivation in using these credits is to offset part of their emissions rather than using them for results-based climate finance. Therefore, the ultimate decisions stemming from Article 6.4 will have indirect implications for the VCM both on the supply and demand for carbon credits though these will not be fully understood until the operationalization of Article 6.4 by the Supervisory Body (SB), which is not likely to occur before 2024.

In parallel, a number of new initiatives were announced at COP27. Of note are John Kerry's Energy Transition Accelerator, which has the aim of developing a VCM to unlock private sources of finance to help developing countries phase out fossil fuels and accelerate investment in renewables; the creation of the Global Carbon Trust (GCT) as a platform that enhances transparency and liquidity in the market by ensuring defined credit standards are met and performance is delivered; and the Africa Carbon Markets Initiative which aims to produce 300 million carbon credits annually by 2030. It is important that the myriad of growing initiatives is complementary in nature and ensures additionality, and that the funded projects generate high quality credits. Additionally it is key that frameworks and guidance on how corporations can use these credits under these schemes is consistent with the existing standards, current initiatives, and Article 6.

2023 promises to be the year where further clarity is provided on how different mechanisms under Article 6 would be effectively put into practice. Participants in carbon markets will be closely examining the policy frameworks governing transactions under Article 6.2 and the next negotiations surrounding Articles 6.4, as well as further clarification by the major standardisation bodies and the various initiatives, such as the IC-VCM and the VCMI. Until some of the key uncertainties are resolved and some of the rules are clarified, carbon markets are unlikely to fulfil their maximum potential. In the short term, the prices of standardized carbon contracts traded on exchanges are expected to continue to experience high volatility, like that seen in December 2022, on the back of thin liquidity, higher interest rates, a very uncertain macroeconomic picture, and also a broader disappointment about COP27 which did not provide market participants with more clarity and did not fully capitalize on the momentum built in COP26. It is to be hoped that 2023 and COP28 can provide a more positive outcome and momentum towards the full operationalization of Article 6.

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15. Outlook for Carbon Removals Post-COP27

With over 70 side-events focused on carbon removals at COP27, the Conference would go on to be aptly dubbed the 'Removals COP' by its conclusion. This, however, should have come as no surprise. The market for carbon removal credits had attained record growth and delivery rates in 2022, with around 600,000 tonnes of purchases made in the market, a figure that was over five times higher than purchases made the previous year. This trend is set to continue into 2023 and beyond, especially as many new removal credit suppliers enter the market.

Nevertheless, it is imperative to note that many of these deals were bilateral 'pre-purchase' agreements, where suppliers and buyers enter into long-term contracts to remove CO_2 in the future. Additionally, the bulk of this figure was due to one mega-deal (400,000 tonnes) involving the aviation company Airbus and 1PointFive, who are developing projects using Carbon Engineering's Direct Air Capture (DAC) technology. 2022 also saw the emergence and/or expansion of a number of marketplaces dedicated to selling removal credits, notably Puro.Earth, Carbonfuture, Patch, Watershed, and Supercritical. This is both good and bad news.

The good news is that a market for removals, whether tech- or nature-based, has finally picked up and that DAC, a climate solution once thought too expensive to pursue, is seeing an unprecedented surge in demand. In part, this is due to its high permanence of removal but also to its effectiveness in addressing legacy emissions, which has made it a necessary inclusion in the IPCC's 1.5°C climate scenario. The emergence of different marketplaces is also a clear signal that a market for removal-based credits exists.

The bad news is that at least half of the pre-purchase orders (involving DAC and concrete mineralization) will take four to five years to fulfil and so they will not contribute to immediate climate action. Also, the market is still limited to a very select number of suppliers and large corporate buyers with voluntary climate targets, such as Shopify, Microsoft, Swiss Re, Stripe, and JPMorgan Chase. The development of different standards and removal methodologies also risks creating fragmentation and confusion in the market, if they are not properly aligned across different verification bodies.

Indeed, it was this latter verification and certification point that took centre stage in the lead-up to the discussions at COP27. Not only have different initiatives and standards emerged for removal methodologies in carbon markets, including by Verra, Gold Standard, CCS+ Initiative, and Puro.Earth, but governments are also exploring how to best incorporate removals into their climate policies. Earlier in 2022, the Biden administration passed the historic Inflation Reduction Act (IRA) which increased the level of tax credits for carbon removals and carbon capture and storage technologies relative to its 45Q predecessor, a move considered as a game changer for the entire industry as it expands the range of market adoption and renders more projects financeable in the US.

In November 2022, the EU put forth a proposal for a carbon removal certification framework (CRCF) that would reliably certify high-quality carbon removals and harmonise action across Europe. The CRCF is based on four key principles that ensure: accuracy of quantification of removal benefits; additionality; long-term storage; and environmental sustainability. Throughout 2023, the European Commission will consult an expert group to develop tailored certification methodologies for the different types of removal activities. It is also worth noting that, as of yet, certified carbon removals are not included in the scope of the EU-ETS which was set up with emission reductions in mind. Introducing removals into the European compliance market can help the EU reach a net-negative target but may require fundamental changes to its structure.

COP27 was also a stage for the inauguration of other removal-focused, cross-border agreements. The Carbon Dioxide Removal (CDR) Mission launched the 'CDR Launchpad', a coalition of governments committed to advancing development of removal technologies by investing in demonstration projects and encouraging knowledge exchange across parties. First-wave participants include the EU, UK, Norway, US, Canada, and Japan and the initiative is aimed at driving costs of CDR down to less than

USD 100/tonne and enabling the scale- up to the level needed for meaningful results, defined as gigatonnes removed per year globally within two decades.

The Conference also saw a number of leaders from the Global South voice their support for deploying carbon removal solutions in their respective countries, along with the passage of local legislative acts to support CDR investments in Massachusetts and California. Perhaps most critically, COP27 aimed to address key issues for the inclusion of removal solutions within the framework of Article 6, including what counts as 'removal' activities, but unfortunately fell short of addressing them in time. Some of the outstanding issues to be addressed this year at COP28 include how to monitor removals and over what timeframes, how to account for leakage and liability in case of reversals and how to ensure human and indigenous people's rights are not violated. The Article 6.4 Supervisory Board has called for more input from parties by March 2023 and will take its recommendations into COP28.

In short and on an optimistic note, 2022 and COP27 represented a major milestone for carbon removals; the ground is now set for necessary next steps to take place throughout 2023, including adopting appropriate and unified methodologies and effective supporting policies. However, it is worth noting that while action should be taken to ensure CO_2 stocks in the air are urgently and swiftly reduced, this should be done fairly and equitably, not at the expense of other emissions reduction and mitigation efforts. This starts with ensuring corporations and governments invest in removal activities as a complementary solution to neutralising hard-to-abate sectors and towards achieving net-zero, and even net-negative, targets. This will be an important focus of policymaking in the run up to COP28.

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16. Methane emissions: the increasing importance of measurement, reporting, and verification

The pressure on companies and governments to reduce greenhouse gas (GHG) emissions is increasing. Declarations to meet carbon neutral or net zero emissions targets for years or decades ahead remain important, but demonstrating that these are more than aspirations on paper will require substantially more detail of ongoing progress. This requires measurement, reporting, and verification (MRV) of all GHG emissions, with the emphasis switching to methane. The past two years have seen a broad recognition by governments that methane accounts for nearly 20 per cent of global GHG emissions (the second most important gas after carbon dioxide) and reduction of these emissions from the energy sector can be achieved more rapidly and at a lower cost than from any other source, resulting in significant temperature reduction by mid-century. The signing of the Global Methane Pledge at COP26 marked a key turning point in national and corporate recognition of the problem, and discussions at COP27 continued the momentum. 2023 will be another key year as plans to accurately account for, and reduce, emissions are further matured ahead of COP28.

EU and US Legislation and Regulation

In 2021, the European Commission published its proposed regulation on methane emissions reduction in the energy sector. The obligation to provide emissions information will be on EU importers who are required to verify the extent to which their contractual counterparts are undertaking measurement consistent with UNFCCC and OGMP standards.[39] The inference (but not a clear statement) is that if importers are unable to obtain this information, the Commission will designate a standard for such imports. Oil and gas (and eventually also coal) imports which fail to meet this standard would be subject to a tax or fee.

In 2022, the US Inflation Reduction Act included a specific methane fee rising from USD 900/tonne to USD 1500/tonne from 2024-26, applied to domestic petroleum and natural gas supply chain functions (compression, transmission and storage, processing, LNG (export, import, and storage), gathering and boosting) in excess of a specified percentage of emissions. The Act requires reporting of emissions to move from engineering-based estimates to empirical measurements from 2026.

International Initiatives

The past decade has seen a plethora of intergovernmental and industry initiatives but it is unclear how they help to monitor progress in relation to national and corporate commitments.[40] The high profile Global Methane Pledge (GMP), signed at COP26 in 2021 is `a collective effort to reduce global methane emissions by at least 30 per cent from 2020 levels by 2030 which could eliminate over 0.2 degrees C warming by 2050'.[41] A year later at COP27 a US/EU press release stated:[42]

> 'Country endorsements of the GMP have grown from just over 100 last year to 150, more than 50 countries have developed national methane action plans or are in the process of doing so, substantial new financial resources are being directed to methane action, and partners have launched "pathways" of policies and initiatives to drive methane reductions in key methane-emitting sectors – a GMP Energy Pathway launched at the June 2022

[39] United National Framework Convention on Climate Change and Oil and Gas Methane Partnership Version 2.0
[40] The Global Methane Pledge, the International Methane Emissions Observatory, the Methane Guiding Principles, Oil and Gas Climate Initiative, Global Methane Initiative, One Future, Collaboratory to Advance Methane Science, Oil and Gas Methane Partnership, and most recently the US National Petroleum Council study on natural gas Greenhouse Gases, and the Joint Declaration from Energy Importers and Exporters on Reducing Greenhouse Gas Emissions from Fossil Fuels.
[41] For more details of the Pledge see: Jonathan Stern, `The Global Methane Pledge: An Urgent Need For Progress At Cop 27', *Oxford Energy Forum*, Issue 133, October 2022, pp.63-65.
[42] *Global Methane Pledge: From Moment to Momentum*, https://www.state.gov/global-methane-pledge-from-moment-to-momentum/

Major Economies Forum on Energy and Climate and a GMP Food and Agriculture Pathway and GMP Waste Pathway both launched today at COP27.'

But despite the significant increase in endorsements, Azerbaijan, China, India, Iran, Kazakhstan, Russia, South Africa, Turkmenistan and Venezuela – extremely important fossil fuel producing, consuming, and exporting countries – remain absent from the Pledge. Perhaps even more important is the absence of detailed commitments as to how signatories plan to achieve the 30 per cent goal. Work on these issues will be a priority in 2023, and will be reviewed again at COP28 as part of the Global Stocktake.

Table 1: Canadian Methane Emissions Reduction Plan (megatonnes of CO2e)

Sector/Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Agriculture	27.37	27.36	27.38	27.40	27.41	27.39	27.37	27.34	27.33	27.29	27.22
Buildings	1.30	1.28	1.24	1.20	1.16	1.12	1.08	1.05	1.01	0.97	0.94
Electricity & Steam	0.17	0.19	0.24	0.23	0.25	0.24	0.26	0.23	0.20	0.19	0.18
Heavy industry	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.20
Oil and Gas	34.06	33.10	30.67	26.61	25.87	23.87	23.43	21.99	18.64	15.30	11.94
Others	1.34	1.26	0.47	0.46	0.42	0.40	0.40	0.39	0.40	0.40	0.41
Transportation	0.59	0.61	0.62	0.63	0.66	0.66	0.66	0.66	0.67	0.68	0.68
Waste	26.98	26.95	25.76	24.39	22.92	21.54	20.10	18.82	17.49	16.22	14.90
Grand Total	**91.99**	**90.93**	**86.57**	**81.11**	**78.89**	**75.41**	**73.50**	**70.68**	**65.93**	**61.26**	**56.46**

Source: Environment and Climate Change Canada, *Faster and Further: Canada's Methane Strategy*, September 2022, Table 1, p.13.

A notable exception is the Canadian methane emissions reduction plan (above) which has the virtue of providing detailed targets by year and by sector so that progress can be tracked. It also shows that more than 60 per cent of the reductions will come from the oil and gas sector with almost all the rest from waste. There will be a slight decline in buildings and agriculture (the latter peaking in mid-decade) while electricity, heavy industry, and transportation emissions are expected to increase slightly. This author has not been able to locate any similarly detailed official statement of how other governments intend to meet their pledge,[43] but it is to be hoped that 2023 will see the publication of similar documents that will help to crystallise the implementation of the Global Methane Pledge.

Challenges for 2023

Overall, encouraging governments and companies to improve the transparency of measurement, reporting, and verification of emissions to demonstrate progress towards reduction commitments will be one major challenge for 2023. Another will be to persuade more non-OECD governments and their energy companies to join what are not yet, but need to become, `global' initiatives. COP28 in the UAE in November will be the next formal gathering where progress is reviewed but before then it is hoped that John Kerry, the US climate envoy, will continue the lobbying work that he undertook at COP27 to bring more countries on board.

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[43] An NGO proposal for the UK involves significant emission reductions in agriculture and waste as well as energy. Green Alliance, *The Global Methane Pledge: how the UK can meet its commitment*, November 2022, p.19.

17. As China reopens, expect volatility

In 2023, China is heading into a period of especially high uncertainty, which will be reflected in overall energy consumption growth. This has, in fact, been the case since the beginning of the pandemic: in 1Q 2020, electricity consumption fell 6.5 per cent year-on-year and GDP dropped 6.8 per cent year-on-year. Then, in 2021 electricity consumption shot up by 10.1 per cent year-on-year, contributing to power shortages.[44] Following China's sudden loosening of Covid restrictions in early December 2022, infections are likely to weigh heavily on economic activity and power demand in the first few months of the year, followed by a recovery in the second half. While the timing and strength of the rebound remain an open question, the economic expansion is likely to spur energy demand from both the consumer sector and, perhaps more significantly, from infrastructure sectors that the government typically turns to for economic stimulus.

This could lead to a return of the power shortages that have plagued China over the past two years. While price controls and administrative mandates for production and restocking have boosted physical coal supplies, China's recent shortage of hydro could become a constraint in 2023.

Beijing has been emphasising supplies in policy documents,[45] including in the National Energy Administration's (NEA) 2023 guidance.[46] The first item on the NEA's agenda for 2023 is, 'improving the ability to guarantee energy production.'[47] Already in 2022, coal production capacity increased by a staggering 8 per cent year-on-year even though demand growth was slower. Coal-fired power capacity additions have also accelerated, reaching 8.9 GW in 1H 2021, and a reported 165 GW are in the pipeline currently, a huge number even if only a fraction of that gets built.[48] The guidance for 2023 includes promoting the construction of intelligent coal mines as well as enhancing safe and resilient increases in coal production. The government is also reportedly mulling lifting its informal ban on Australian coal imports.[49]

While coal is clearly a means of ensuring supply security, renewable installations have been rising strongly. In that vein, solar and wind additions in the first 11 months of the year reached 65.7 GW and 22.5 GW, respectively, out of a planned 120 GW in 2022. The NEA aims to add 160 GW of wind and solar in 2023.[50] Meanwhile, the government continues to emphasize market reforms in principle, while in practice limiting the potential for any volatility by setting a new standard of locking in 90 per cent of industrial power demand via monthly and annual contracts, limiting the role of any spot markets.[51]

The NEA guidance also echoes the government's broader stimulus efforts with a focus on physical infrastructure, specifically more pipelines, long distance transmission lines, and electric vehicles. China's electric vehicle market and battery manufacturing sectors are poised for more growth. In 2022,

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[44] Electricity demand growth is loosely correlated with GDP growth; the two sometimes diverge during periods of economic downturns and recoveries. See Boqiang Lin, Yao Wang, "Inconsistency of economic growth and electricity consumption in China: A panel VAR approach" 2019, https://www.sciencedirect.com/science/article/abs/pii/S0959652619314970

[45] Michal Meidan, Anders Hove, "China's 20th Party Congress and energy: The good, the bad and the unknown", OIES Comment, November 2022, https://www.oxfordenergy.org/publications/chinas-20th-party-congress-and-energy-the-good-the-bad-and-the-unknown/

[46] National Energy Administration "Study and Implement the Spirit of the 20th CCP Congress; Provide Strong Energy Guarantees for the Construction of a Socialism Modern Country; the 2023 National Energy Work Conference was help in Beijing"; 30 December 2023, http://www.nea.gov.cn/2022-12/30/c_1310687421.htm

[47] 2023 年能源工作安排来了，风光累计装机将达 9.2 亿千瓦 https://m.jiemian.com/article/8669261.html

[48] "China is doubling down on coal despite its green ambitions", Japan Times, 31 October 2022, https://www.japantimes.co.jp/news/2022/10/31/business/china-doubles-down-coal/

[49] "China considers lifting ban on Australian coal imports." Argus, 4 January 2023

[50] 风光新增装机规模将达 1.6 亿千瓦！明年能源工作划重点, https://news.cnstock.com/news,bwkx-202212-5000072.htm

[51] NDRC, 国家发展改革委 国家能源局关于做好 2023 年电力中长期合同签订履约工作的通知, https://www.ndrc.gov.cn/xxgk/zcfb/tz/202212/t20221222_1343756.html

China's new energy vehicle (NEV[52]) market reached nearly 7 million sales, the second consecutive year that China's EV market has doubled. Even as Covid lockdowns chilled consumer activity, NEVs captured over 35 per cent of the passenger vehicle market in November 2022, up from just over 5 per cent only 24 months ago. China is on track to vastly exceed its official 2025 NEV market share target of 20 per cent, potentially reaching 10 million EV sales in 2023, nearly half of the passenger vehicle market. In 2023, the government could raise the outdated NEV target, set targets for fleet electrification, and introduce new EV incentives into the heavy-duty trucking field.

On climate, China is poised to take action on methane., A joint working group on methane emissions was part of the US-China joint declaration at COP26 in Glasgow, while at COP27, China announced new strategic plan on controlling methane. Action on methane is important because of the impact on climate - the UNFCCC estimates implementing the global pledge on methane would prevent 0.3 degrees C of warming by 2050 - but also due to its impact on the energy sector.

The IEA estimates China is responsible for 16 per cent of global methane emissions, and 48 per cent of global methane emissions from energy.[53] China's energy-related emissions stand at 28 million tonnes per year, according to the IEA, and the majority of China's methane emissions come from coal, including both vented gases and fugitive gas emissions. Methane emissions from the oil and gas industry account for 3 million tonnes annually. China's national oil companies have pledged significant reductions as part of their carbon neutrality commitments. It will be important to see if the national methane reduction plan is indeed issued, and if companies and provinces issue additional action plans. The extent to which provincial officials and coal mining companies will ramp up monitoring and regulating methane emissions is also an open question. Policies may focus on shutting down or consolidating smaller mining operations with bigger players which have the resources to deal with methane. Both the issuing and implementation of plans in 2023 will be important to watch as an indicator of how China thinks about the compatibility of economic growth and the low carbon transition.

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[52] The NEV category includes mainly pure EVs but also plug-in hybrids and a small number of fuel cell vehicles, the latter mainly buses and trucks

[53] https://www.iea.org/reports/global-methane-tracker-2022/methane-and-climate-change

18. Electricity wholesale market design in Europe

One of the key energy policy issues in 2023 is the future design of the European electricity market. This is already an important topic in Europe, with countries taking quite different positions on whether and how to reform the current 'marginalist' market design, and on whether these reforms are designed solely to confront the current emergency or should be permanent. The debate could lead either to a strengthening of competitive markets, or to growing reliance on governments and the demise of liberalisation.

The recovery from Covid during 2021 and then in particular the Russia-Ukraine war have led to unprecedented increases in European prices of natural gas and electricity. Other factors, including unexpectedly low wind, hydro, and nuclear generation, have also contributed to the high electricity prices. In response to these, before the Russian invasion of Ukraine, most European governments followed European Commission advice, which was to reduce taxes and levies and to make financial transfers to consumers. This was considered sufficient because, in most European countries, retail prices were fixed for long periods and the expectation (or hope) was that wholesale prices would return to normal before too long.

However, there was an important exception. In September 2021, Spain was the first to take measures to control wholesale electricity prices, introducing the equivalent of a windfall profit tax related to rising gas prices. Although this measure was later watered down to reflect the fact that most energy was sold by contracts that were well below wholesale prices, Spain had set a precedent. The Spanish government had acted quickly because 10 million consumers were on a regulated default tariff that was directly indexed to wholesale spot prices; and because that tariff was the electricity component used to define the national inflation index.

After the Russian invasion of Ukraine, the pressure to intervene in European wholesale markets grew. The EU formally approved what was called the Iberian Exception, the aim of which was to decouple rising wholesale gas prices from electricity prices in Spain and Portugal. Other countries, notably France, Italy, Greece, and Romania also decided to intervene.

As the crisis has continued, two key questions still face European policy makers and require some answers in 2023. They are: 1) whether and how governments should intervene in wholesale electricity markets during the crisis; and 2) whether a new market design is required for the longer term to deliver net zero emissions. Whereas the first of these questions reflects alarm over very high gas and electricity prices, the second responds to a realistic concern that future wholesale electricity prices will be too low and uncertain to justify the needed investment in renewables and flexibility.

The two questions overlap. A central issue for both is that the current 'marginalist' market design is 'pay as clear', so all electricity is traded in day-ahead markets at a single wholesale price that reflects the short-run marginal cost (SRMC) of the resource needed to clear the market in any hour. For many European countries that resource is frequently natural gas, or hydro, whose opportunity cost is usually the cost of gas. However, as intermittent renewables penetrate deeply and start to set wholesale market electricity prices, these prices are expected to be zero or near zero with increasing frequency, potentially undermining investment in further renewables and more flexible resources. There are many other problems with the current market design, including poor locational signals, lack of long-term investment signals, and inadequate participation of demand-side resources. The question faced by policy makers to address the longer-term challenge is whether to introduce gradual reforms or make significant structural changes to the design of the market.

The political debate in the EU has so far concentrated on short-term decoupling of gas from electricity to lower prices, and on proposals for gradual reform to the existing market design. However, just before Christmas 2022, the European Commission leaked a 'non-paper' on electricity market design. It mentions explicitly the idea of paying each generation technology by reference to its costs. This leaves

open many design options, but essentially implies a move away from the marginalist market design. It remains to be seen whether this idea will prosper. In the non-paper, the Commission says it will launch a public consultation on market design and will publish the findings as well as a staff working document assessing options 'early in 2023'. Any structural reform along these lines will be very difficult to agree because the supporters of the current system include key players such as Germany, the Netherlands, Austria, and the Nordic countries. However, failure to reach an agreement on the future market design will undermine investor confidence, which is already dented due to the multiple interventions of the past eighteen months.

By contrast, the UK has already initiated a serious debate about the need for long term structural change. The Review of Electricity Market Arrangements (REMA) was published in July 2022, launching a public consultation on the design of wholesale electricity markets required to deliver net zero emissions by 2035. REMA is also influencing the debate about crisis management, especially with respect to decoupling of gas from electricity prices. The UK has moved faster than the EU on this critical structural issue probably because of the deeper decarbonization occurring in the country but also because of its limited interconnection with other systems.

In the UK and the EU, the market reform debate will focus on the future roles of government and markets. Some governments, notably in southern Europe, view the debate as an opportunity to strengthen government control over consumer prices, resource mix, supply security, and electricity company profitability. Others, notably in northern Europe, seek to maintain the marginalist market design and to rely on markets rather than governments to drive investment, pricing and other key decisions. The writer of this piece and OIES colleague Malcolm Keay have argued for a third way, The Decarbonised Electricity System of the Future: The Two Market Approach, which relies on a new version of competitive markets designed for 21st century economics and technologies, and which reflects consumer preferences. In 2023 we will start to see the direction that EU and UK governments are minded to adopt for the future design of electricity markets.

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19. Nuclear power in 2023: the 'nuclear renaissance' resurrected?

Twenty years ago, there was a lot of talk among supporters of civil nuclear power of a 'nuclear renaissance'. Their argument was that nuclear power provided energy security combined with low carbon dioxide emissions. The strength of nuclear's case steadily declined as the costs of new plants rose and their commercial viability in competitive markets declined. The 2011 Fukushima Daiichi nuclear accident in Japan appeared, at the time, to then provide the death knell for civil nuclear power.

However, the last few years have seen this form of energy gradually return to favour as the challenge of climate change mitigation increases in severity. Emblematic of this was the vote in the European Parliament in July 2022 to support the Commission's proposal to classify nuclear power as green energy. Finally, the conflict in Ukraine and its effect on international energy markets has highlighted the importance of energy security. Thus, in 2022 we saw a number of countries reversing or at least postponing decisions to phase out nuclear power and, in some cases, to construct new reactors. Meanwhile, several nations have been embarking on their first nuclear power programmes, mostly to address energy supply shortages. The years 2022 and 2023 may be viewed in later years as marking a critical turning point in the history of nuclear power.

The effect of the war in Ukraine has been particularly striking. In Europe, both Germany and Belgium have postponed the phase-out of their nuclear fleet, so these plants will still be operating in 2023. Of greater consequence have been the decisions of countries that are heavily reliant on nuclear power. France's President Macron has announced an ambition to build 6 (possibly 14) new reactors in the coming years. The UK continues to seek investors in reactors at two sites and is supporting the development of small modular reactors (SMRs).

In northeast Asia, the Japanese government decided in December 2022 that nuclear energy should remain at the heart of its power supply for the foreseeable future through a combination of life extensions and new reactors. Likewise, the new government in Korea has reversed the decision of its predecessor to phase out nuclear power. Instead, work will continue on those reactors currently under construction, others will start construction in 2023, and 4 new reactors are planned. Both Japan and Korea hope to deploy new types of reactor, both SMRs and those using advanced technologies, so-called Generation IV reactors. With 11 reactors under construction, India's government gave financial sanction for 10 new reactors in December 2022. Meanwhile, China with the world's third largest fleet of reactors continues with its ambitious programme, having 22 reactors under construction and another 47 planned. Russia is also expanding its large fleet.

Aside from these larger actors, numerous countries are adding, planning to add or considering adding to their existing small fleets of reactors (see **Error! Reference source not found.**).

Table 2: Nuclear reactor plans, by country

Country	Recently completed reactors	Reactors under construction	Plans for reactors	New reactors under consideration
Europe				
Finland	Olkiluoto 3			
Slovakia		1		
Czechia			Yes	
Bulgaria			Yes	
Hungary			Yes	
Romania			Yes	
Netherlands				2

Latin America				
Brazil		1	Yes	
Argentina		1	Yes	
South Asia				
Pakistan	2		1	

Behind these established nuclear power nations is a long queue of so-called 'newcomers'. These are countries in which the governments are at various stages of considering, planning or building their first commercial nuclear reactors. Five of these newcomers have reactors recently completed or under construction. The UAE has three reactors of Korean design in commercial operation and a fourth under construction. The four other countries are reliant on Russian design and support, namely Belarus, Turkey, Bangladesh, and Egypt. Poland and the Philippines, in 2021 and 2022 respectively, declared firm decisions to embark on a nuclear power programme, while most of the remaining newcomers are still to make a firm decision. Southeast Asia is a region where nuclear power is under serious consideration. Indonesia, Malaysia, Vietnam, and Thailand have built expertise in the field over many years and could launch a nuclear power programme at any time. Vietnam is the country most likely to make a firm commitment in the near future as political conditions in the three other countries are less favourable for such a far-reaching decision. In 2022 Singapore stated publicly, for the first time, that nuclear power was an option for the city state, depending on technological developments.

A key unknown is the future of new technologies. Two types can be distinguished: SMRs based on conventional technologies, and those based on advanced technologies. Several long-established nuclear power countries are pursuing both options. Russia was the first to put SMRs into commercial operation, the barge transportable Akademik Lomonosov 1 and 2 reactors in 2022. In China, two high-temperature, gas-cooled reactors have undergone tests and will be ready for commercial operation in 2023. The next year or so will start to reveal which, if any, of the many designs becoming available will be attractive to buyers.

Regardless of which technologies, conventional or new, are deployed, these ambitions and plans will face two main hurdles. The first is the longstanding challenge of cost. Russia has been generous in its financial support to those purchasing its reactors. The extent to which this can continue is unclear. Most other vendors are less generous. SMRs are intended to provide the solution to the cost problem, but this has yet to be demonstrated. One thing to watch for is the approval of SMR designs by national nuclear regulators. In 2022, the US Nuclear Regulatory Commission (NRC) formally certified the design of NuScale's SMR for use in the country, the first SMR to receive NRC certification. Also last year, Rolls Royce submitted its SMR design for approval by the UK's Office for Nuclear Regulation. In addition, companies in Canada, Japan, South Korea, India, China, and Russia are all working on SMR designs. A second challenge may arise from supply chain failures. Recent years have demonstrated the vulnerabilities of supply chains for technologies and raw materials. The nuclear power sector has a particular problem with a shortage of skilled manpower.

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20. How will the US Inflation Reduction Act affect hydrogen developments in 2023?

Hydrogen (H_2) will make an important contribution to the energy transition, although, as OIES has been arguing for some years, it is not the 'silver bullet' that some would advocate.[54] To be relevant to a decarbonised energy system, hydrogen will need to transition from its current high carbon production methods, mainly using natural gas, to lower carbon alternatives, either by capturing most of the CO_2 or by electrolysis using renewable power generation. Since 2020, many governments around the world have set increasingly ambitious targets for production of clean hydrogen[55] but it has been proving difficult to translate these bold ambitions into significant projects on the ground.

Indeed, in the OIES Key Themes for 2022, published a year ago, we highlighted, based on data in the IEA Hydrogen Database,[56] those significant (>100MW) hydrogen production projects which were claiming an onstream date in 2023/4, making the assumption that if such an onstream date were to be realised, the vast majority would need to take a final investment decision (FID) in 2022. We noted (based on electrical input capacity) projects totalling 5000 MW in Europe, 2000 MW in Australia, and around 1500 MW each in the Americas and China. Reviewing the list of projects in the latest update to the IEA database, we find that only one 200 MW project (Holland Hydrogen 1 electrolyser in the Netherlands) actually took FID and started construction in 2022 and is now showing an onstream date of 2025. 200 MW is a significant step up from previous electrolyser projects in Europe (and there is just one comparable sized project under construction in China), but is clearly far short of the 10,000 MW globally envisaged just one year previously.

That said, there were some significant policy developments both in Europe and the USA in 2022, leading to our key theme for 2023 to track whether there will be a shift in focus for clean hydrogen developments towards the USA. The key policy developments to consider are:

- The USA's Inflation Reduction Act (IRA) signed into law in August 2022, which, despite its somewhat misleading name has been billed as the 'largest climate legislation in US history'[57]
- The European Union's REPowerEU documents, primarily intended to reduce European reliance on Russian natural gas following Russia's invasion of Ukraine in February 2022, which significantly increased the European ambition for low-carbon hydrogen by 2030.[58]

The IRA contains some very specific and potentially very attractive incentives for production of low carbon hydrogen, both using electrolysis and with carbon capture and storage. The key 45V[59] Production Tax Credits (PTC) and Investment Tax Credits (ITC) are shown in **Error! Reference source not found.**. The precise mechanism for calculating carbon intensity is still to be determined, but is envisaged to use the well-established US GREET model and will also include upstream emissions (including methane emissions in the natural gas chain). It is therefore likely that the highest USD 3.00/kg PTC will only apply to electrolytic hydrogen produced using purely renewable electricity, since grid-based electricity would have too high a carbon intensity. At very low capacity factors, it may be more attractive to use the ITC, but it is generally assumed that most projects will choose to use the PTC. The IRA also contained a '45Q' tax credit for carbon capture and storage of USD 85/tonne CO_2 stored.

[54] https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2020/03/Insight-66-Hydrogen-and-Decarbonisation-of-Gas.pdf

[55] We use 'clean hydrogen' as a collective way to describe both hydrogen from fossil fuels with CCS (sometimes called 'blue' hydrogen") and hydrogen from electrolysis with renewable power (sometimes called 'electrolytic' or 'green' hydrogen).

[56] https://www.iea.org/data-and-statistics/data-product/hydrogen-projects-database

[57] https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/#:~:text=On%20August%2016%2C%202022%2C%20President,change%20in%20the%20nation%27s%20history.

[58] For a more detailed analysis of the hydrogen provisions of REPowerEU see https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2022/07/RePowerEU-Can-Renewable-Gas-help-reduce-Russian-gas-imports-by-2030.pdf

[59] '45V' and '45Q' refer to the relevant sections of the US tax legislation, the internal revenue code

Assuming 10kg CO_2/kg H_2 (as is typical for production from natural gas), this is approximately equivalent to USD 0.85/kg H_2, so may be more attractive than 45V for a blue hydrogen project developer.

Table 3: US Inflation Reduction Act hydrogen tax credits

Carbon Intensity (kg CO2/kg H2)	**Hydrogen Production Tax Credit** ($/kg H2)	**Hydrogen Investment Tax Credit** (%)
0 - 0.45	$3.00	30
0.45 - 1.5	$1.00	10
1.5 - 2.5	$0.75	7.5
2.5 – 4	$0.60	6

The USD 3/kg PTC appears very attractive, and by some analyses could reduce the effective cost of green hydrogen to around zero,[60] providing a strong incentive for existing hydrogen producers (e.g. in refineries and petrochemical plants) to switch to green hydrogen.

By contrast, while REPowerEU included a significant step up in the target for hydrogen production by 2030 to 10 million tonnes per year within the EU and 10 million tonnes of imports, it was much less clear on how producers would be incentivised to deliver this. Some initiatives have been announced, including the German H2Global tender for imports of ammonia, EUR3bn to be made available via the European Hydrogen Bank and inclusion of hydrogen within 'Important Projects of Common European Interest' (IPCEI), but these do not yet form a robust basis for a project to take FID. In the UK, progress is being made on developing Contracts for Difference as part of the UK Hydrogen Business model, and this may prove a concept which the EU could build on.

At this stage, therefore, while there are always many steps for a specific project to reach FID, it appears that the framework in the USA provides much stronger incentives to promote investment than the more complex and less developed framework in Europe. Anecdotal evidence from various conversations, and some press releases[61] indicates that demand for electrolysers is being drawn to the USA. It will be instructive through 2023 to track whether this trend continues, the extent and location of actual FIDs and whether Europe, as well as other parts of the world, including China, respond to the strong hydrogen incentives in the Inflation Reduction Act.

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[60] See for example: https://www.rff.org/publications/reports/incentives-for-clean-hydrogen-production-in-the-inflation-reduction-act/

[61] See for example: https://www.hydrogeninsight.com/electrolysers/nel-wins-56m-electrolyser-order-for-290mw-us-green-hydrogen-project-helped-along-by-new-h2-tax-credits/2-1-1335821