Egypt's Domestic Natural Gas Industry

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PREFACE

The past 15 years have witnessed a remarkable expansion of the Egyptian gas market to the point where gas accounts for nearly half of the country's energy needs. Thus Egypt has achieved a transformation of its energy balance at the same time as developing substantial gas exports of both LNG and pipeline gas. While published literature and consultancy studies have focussed on the export dimension of this story, the domestic story has at least as much – and arguably more – applicability to a range of countries around the world attempting to develop gas reserves for the direct benefit of their population.

This paper demonstrates the enormous progress that Egypt has made in developing gas for industrial and power generation, as well as compressed natural gas for vehicles. Although the country has some way to go in the gasification of the residential sector, the connection of nearly 20% of households in such a short time is no mean feat. While the study concludes that the Egyptian gas industry should be considered very much a "work in progress" it is a work of which others in similar situations should take serious note.

We are very grateful to Randa Alami for taking on this project and seeing it through after she left the Institute. Lack of literature in the public domain made this a difficult task and the result is thus even more to her credit.

Jonathan Stern April 2006

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ABBREVIATIONS

APICORP	Arab Petroleum Investment Corporation
BP	British Petroleum
CCGTs	combined cycle gas turbine(s)
CNG	compressed natural gas
EGAS	Egyptian Natural Gas Holding Company
EGPC	Egyptian General Petroleum Corporation
EIB	European Investment Bank
ENI	Enti Nazionale Idrocarburi
ERSAP	Economic Reform and Structural Adjustment Programme
EU	European Union
FDI	foreign direct investment
GASCO	Egyptian Natural Gas Company
GDP	gross domestic product
IMF	International Monetary Fund
IEOC	International Egyptian Oil Company
IOC	international oil company
JV	joint venture
LDC	local distribution company
LNG	liquified natural gas
LPG	liquified petroleum gas
MEDA	Mediterranean Association Agreement
MEES	*Middle East Economic Survey*
NGL	natural gas liquids
NVGC	Nile Valley Gas Company
OAPEC	Organisation of Arab Petroleum Exporting Countries
OECD	Organisation for Economic Co-operation and Development
OIES	Oxford Institute for Energy Studies
PSA	production sharing agreement
SOE(s)	state-owned company(ies)
Bcm or bcf	billion cubic metre or billion cubic feet
b/d	barrels per day
cf/d	cubic feet per day
km	kilometre
mcm or mcf	million cubic metre or million cubic feet
mt/year	million tonnes per year
tcf	trillion cubic feet
£E	Egyptian pound
€	Euro
cts	cents (in US currency)

ABSTRACT

In just 15 years, Egypt moved from a dependency on oil to using gas for meeting almost half of its energy needs. This paper follows the development of this domestic gas market. It finds that demand creation was linked to upward revisions in reserve availability, but was also driven by domestic concerns about pollution and international finance which supported conversion to gas. Today, gas penetration in power generation is almost complete, and is substantive in heavy and large industries. Despite tripling over the last 10 years, the number of households connected to the gas grid is still only at 18% of households. Private distribution companies, established as part of on-going macro-economic reforms, have been key to delivering this success. Lastly, Egypt is now the world's eighth largest CNG user, with 50 stations currently operational.

The development of this market was effectively financed by sustained and substantial public investments. Related costs have still not been fully amortised, featuring as outstanding debts to the public bodies involved. While these investments have given Egypt a relatively developed gas chain from well head to delivery point, this chain is at best an emerging market. Prices are still centrally controlled, fuel delivery is still a bundled service, and private participation remains limited to a few private distribution companies. Establishing the regulatory and legislative bases of the natural gas market, including a regulator, is very much work in progress.

1. INTRODUCTION

In just over a decade, Egypt has become one of the largest domestic markets in Africa and amongst developing countries. Over the last 15-20 years, gas production and consumption have been moving upwards in tandem. Both stood at 6.8 billion cubic metres (bcm) in 1990, and both quadrupled respectively to 26.8 bcm and 25.7 bcm in 2004 (*BP Statistical Review of World Energy 2005*). Egyptian ministerial sources claim that domestic consumption rose from 22.1 bcm in 2000/01 to 30.1 bcm in 2003/04 (Ministry of Petroleum 2005), with another source claiming a higher figure of 31 bcm for 2004 (Abubakr 2005). Data discrepancies aside, Egypt has achieved a remarkable degree of gas penetration from rather modest beginnings. By comparison, older and more mature markets in Indonesia, Argentina and neighbouring Algeria consumed in 2004 33.7 bcm, 37.4 bcm and 21.2 bcm respectively (*BP Statistical Review of World Energy 2005*).

Egypt's natural gas industry moved from being a by-product of oil production efforts in the 1980s, to being a linchpin of its energy policy in the early to mid-1990s. In 2005, it acquired an export revenue-generating role as two LNG projects came on stream. These exports were made possible by substantive discoveries throughout the 1990s, with reserves quintupling from 379 (bcm) (13.38 trillion cubic feet (tcf)) in 1990 to 1,850 bcm (65.3 tcf) in 2004 (*BP Statistical Review of World Energy 2005)*. Consequently, the share of natural gas in Egyptian hydrocarbons reserves doubled from 38 per cent of the total in 1993 to 76 per cent in 2003 (Korkor and El-Behairy 2005). Similarly, the share of gas in total primary energy consumption rose from 20.4 per cent in 1990 to 46.9 per cent in 2003 (OAPEC 2004).

The shift towards exports is well documented, partly because projects have been assessed by project sponsors. The development of the domestic gas market is relatively less well understood. Likewise, while there is a great deal of information on foreign companies producing gas, and on the contracts defining their operation, there has been little consideration of the delivery infrastructure, capital investments or market development. This study seeks to understand the way the Egyptian gas industry evolved and how gas markets were created.

Despite a long tradition in central planning, managing this expansion has been quite a challenge for the Egyptian government, which repeatedly had to go back to the drawing board as more gas reserves were discovered. Similarly, the organisational and operational basis of the industry were being developed at a time of fundamental macroeconomic change aimed at liberalising the Egyptian economy. The associated economic reform programs strengthened market forces and the

private sector, but have not done away with the pervasive subsidisation and interventions in most markets, including controlled energy prices. Therefore, the government did lead gas market creation, but it did so while both engaging private operators and continuing to manage a complex web of prices.

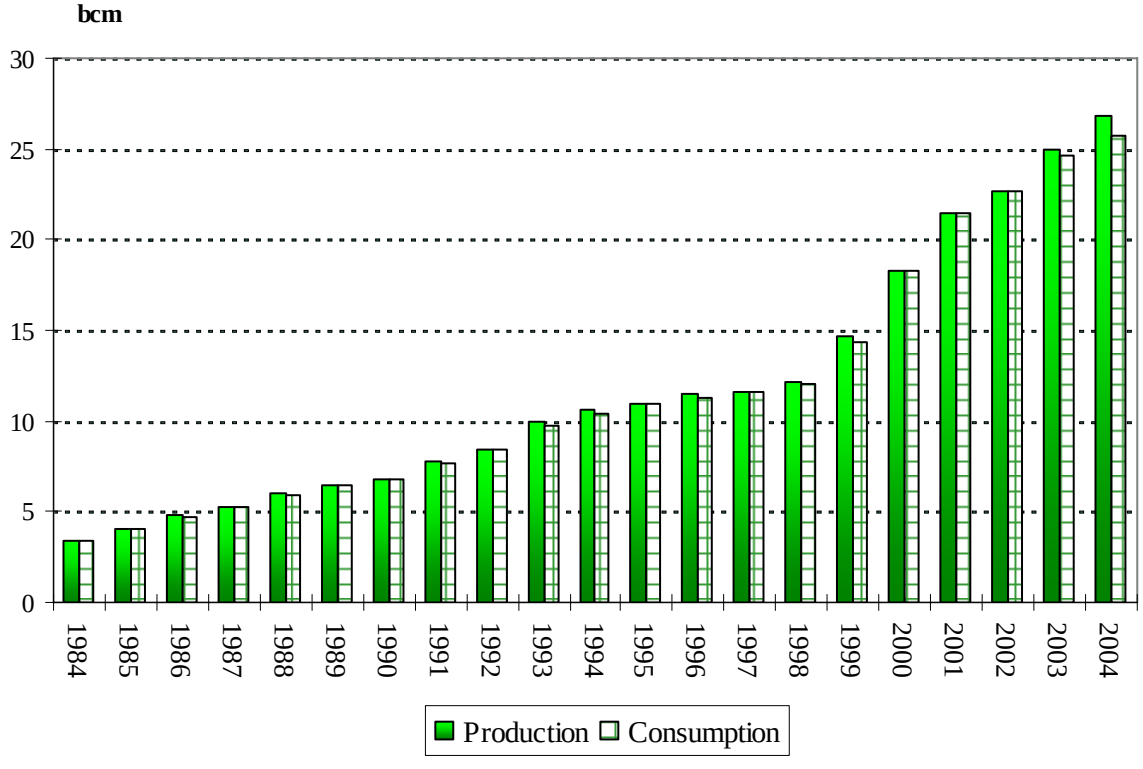
This study tracks the shift to gas in Egyptian energy in three stages. The next section gives an overall context for the industry. It follows the building up of the national grid physically and legislatively. It considers the main features of the downstream, establishing who financed and organised the construction of gas networks, and the entry of private distribution companies. Section 3 considers market creation. After establishing the overall features of current demand, it looks in turn at power generation, industry, and finally households and transport. In power generation, the dash for gas was led by state-owned companies in both gas and electricity. This was done through fuel switching, but also by opting for gas turbines for all new capacity. In industry, the largest users – heavy industry–, were already placed near gas fields and were using gas as feedstock. Other industries have been converting to gas use all over the country, almost as rapidly as the national grid was expanding. However, gas penetration in this market is far from complete, and financing problems have hindered the process. A different picture emerges in household gas and transport, where expansion has been driven by the price differentials between bottled gas and gasoline. In all three markets, it is difficult to talk of a gas chain as such, as most prices are still centrally determined. Section 4 seeks to identify some key factors that shaped the Egyptian experience in developing these domestic markets, and their potential relevance for other developing regions. Section 5 draws conclusions.

2. THE DEVELOPMENT OF THE EGYPTIAN GAS INDUSTRY

2.1 The physical infrastructure

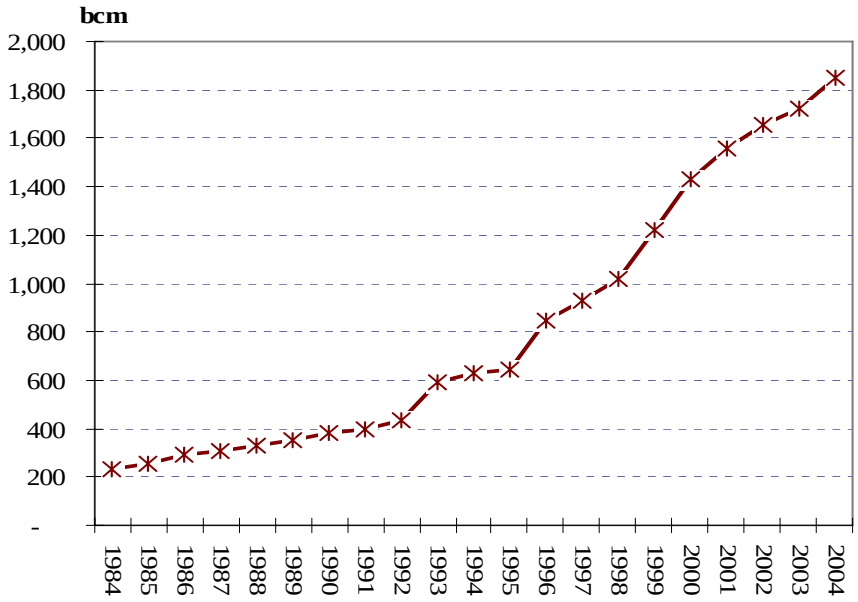
Natural gas has been produced from Egypt's offshore since 1970, in Abu Qir (east of Alexandria) and in Abu Madi (Nile Delta). However, production levels only became significant with the coming on stream of associated gas in the Gulf of Suez in 1983. As Figure 1 below shows, over the last 20 years, Egypt has managed to increase the production, delivery and consumption of ever increasing volumes of natural gas, with output and consumption levels quintupling over that time. But as Figure 2 also illustrates, reserves are now 10 times higher than 20 years ago, creating for the first time real room for exports. In a nutshell, the evolution of the domestic gas infrastructure largely reflects this history. The current policy of exporting gas as LNG suggests that the national grid is unlikely to witness major or imminent changes. Instead, it is likely to witness consolidation and de-bottlenecking.

Figure 1: Egyptian natural gas production and consumption, 1984-2004



Source: BP, *Statistical Review of World Energy* (June 2005)

Figure 2: Egyptian natural gas reserves, 1984-2004



Source: BP, *Statistical Review of World Energy* (June 2005)

Up to the late 1980s, most new gas gathering and transmission projects concentrated on the Abu-Qir and Abu-Madi areas in the Nile Delta. A core part of the national grid at that time was therefore the pipelines from gathering stations in those fields to the southeast, that is, to Mahmoudya and Talkha, and onwards to Tanta and Cairo. Another key building block was the Suez system, which began by linking facilities in Port Fuad to Port Said on the Mediterranean offshore to Suez city, 150 km south. In 1983, a gathering and processing system was completed in Ras Shukeir in central Suez (256 km south of the Gulf), gathering gas from four major offshore fields in the Canal of Suez area. Its initial capacity of 80 mcf/d (2.24 mcm/d) was expanded to process 160 mcf/d in 1989 (*Arab Oil and Gas Directory 1995)*. In 1990, work began on another part of the Gulf of Suez grid, the multi-phase Trans-Gulf Project. The first phase of the project, completed by 1994, moved gas from the October field in the Gulf and Belayim in Sinai to Ras Bakr (192 km south of the Canal). From there, gas was be separated into a wet stream (30 mcf/d or 0.84 mcm/d) and a lean stream (70 mcf/d or 1.96 mcm/d). The former carried carried to Ras Shukeir, while the latter was fed to the Suez—Shukeir trunk line, a two-way 16 inch pipeline system.

Elsewhere, in the Western Desert, the main pipelines added in that period were from the Beddredine fields to Ameriya (270 km east), and from the offshore fields of Matrouh to Khalda (95 km southeast). By 1992/93, Baddredine accounted for over 18 per cent of Egyptian gas

output. An LPG recovery plant at Ameriya was completed in 1993, with the location becoming a key industrial and processing complex. All these pipelines added about 622 km to the national grid, that is, about 20 per cent of the total length of 3,000 km reported in the late 1990s. GASCO's map for the current grid is reproduced below.

Map 1: Current grid Egypt

Source: Based on a map produced by Egyptian Gas Holding Company (2005)

Map 2: Current grid Egypt showing detail of central Egypt

Source: Based on a map produced by Egyptian Gas Holding Company (2005)

Egypt's oldest gas producing area, Abu Qir, also received attention, including further field development and new compressors. The latter project was to boost the productive capacity of the processing station to 30 mcf/d (0.84 mcm/d), in order to guarantee the supply of gas to nearby power stations and industrial plants. As such, these projects marked the beginning of an ongoing strategy of utilising natural gas as fuel and feedstock in power and industry. This strategy was given a boost as more gas reserves were discovered throughout the period.

Supplying households with pipeline gas also took off as of the early 1990s. In 1992, part of a World Bank loan was used to finance the extension of Cairo's gas distribution network (*Middle East Economic Survey (MEES)* 1/7/1992). Similarly, the government's *1998 Yearbook* confirms the completion of Phase I of a project to supply pipeline gas to key Egyptian towns. 50,000 consumers were connected in Port Said (eastwards in Sinai), 85,000 in Alexandria (northwest), 40,000 in Suez City, Ismailiya (northern shore of Suez), Banha and Tanta (north of Cairo). These towns have therefore benefited from their location along one of the gas grid's oldest arteries connecting the northern gas fields to the capital (the Talkha–Shabshir–Cairo line).

Thus, by the second half of the 1990s, the Egyptian gas grid was composed of four separate systems. These were built around the main gas production fields in the country, namely: Western Desert, Gulf of Suez, Abu Qir and Abu Madi. The grid management plan for the 1990s focused on two aims:

1) to unify the grid, which required in the first instance the installation of a grid management system;
2) to develop more processing and dispatching facilities.

As more gas reserves were discovered, Egypt already had in place a basic delivery infrastructure to move gas to consumption points. Up to the mid-1990s, development work as overseen by the Egyptian General Petroleum Corporation (EGPC), with Petrojet and Egypt Gas, two state-owned companies (SOEs), in charge of construction and project implementation. Generally speaking, the former carried out most of the work in the upstream, around gas fields and processing facilities, while the latter concentrated on the downstream and consumer end. The functions of transmission and distribution in the gas sector were not given a separate corporate identity until the EGPC established a separate affiliated company in 1997, namely the Egyptian Natural Gas Company (GASCO).

GASCO was given the responsibility for rehabilitating, managing and expanding the national gas network, that is, both the high and low pressure pipelines. It inherited 3,000 km of old pipelines, and quickly proceeded to organise this network using a Supervisory Control and Data Acquisition or SCADA system (*MEES*, 20/8/1993). Most existing pipelines were buried according to inaccurate copy plans, and were below international safety standards. According to Shaw (2002), GASCO constructed a grid control system using a high accuracy reference network established for the Egyptian Survey Authority, as well as new technologies (Inertial Navigation System integrated within an Inspection Pig Tool; and a Global Positioning System to control navigation). Today, GASCO has a computerised National Advanced Control Centre and an impressive capacity to manage the grid.

As of 1998, GASCO went beyond upgrading and unifying the grid onto an expansion plan. Because at the same time, the government was also involved in major economy-wide reforms, GASCO embarked on this expansion while abandoning gas distribution, that is, low pressure pipelines, to private operators. This was because the Investment Law No8 of 1997 initiated the opening up of the downstream to the private sector. As will be seen below, this liberalisation was

rather specific: the bulk of existing connections to customers were divided into concession areas that were granted to six private operators, or local distribution companies (LDCs). As of 1998, LDCs have been in charge of point delivery, and developing low pressure pipeline networks. However, Petrotrade, an SOE (state owned enterprise), still collects the bills nationwide. As will be explained in the next section, the continued operation of Petrotrade was necessitated by the continued prevalence of subsidisation of gas prices.

On the back of expanding reserves, Egypt's fourth development plan of 1997-2002 accentuated the push to increase domestic natural gas consumption. Public companies, led by GASCO, were mostly in charge of additions of facilities and high-pressure cross-country pipelines, including to new industrial and urban areas under construction. They carried out most of the upgrading and installation work for feeding stations in power and industry. As part of this pattern, the European Investment Bank (EIB) granted GASCO a €28.25 million ($30.5 million) loan for a 164-km natural gas pipeline from Suez to the Meit Nama distribution plant north of Cairo (*MEES*, 27/9/1999).

The expansion plan for the Western Desert in the late 1990s was a response to rising production in the Western Desert and the West Mediterranean offshore. It aimed to move more gas to al-Ameriya processing and petrochemical complex (in Wadi al Natrun), and from there to distribution and consumption points east and north of the complex. In the first instance, these efforts involved international oil companies (IOCs) in the construction of the Northern Line, a 280-km pipeline, with a capacity of 650 mcf/d (18.2 mcm/d). In the second instance, pipeline projects involved more extensions from Ameriya, including from:

- Ameriya northwest to Sidi Kerir: 24 inch, 28 km, 200 mcf/d (5.6 mcm/d) to Sidi Kerir power facility;
- Ameriya eastwards to Dahshour (south centre): 32 inch, 200 km, 550 mcf/d (15.4 mcm/d) to industrial areas in Dahshour.

The Gulf of Suez grid also continued to be expanded in the second half of the 1990s. In particular, progress was made in the second phase of the Trans-Gulf project, involving three elements. The first involved upgrading and expanding the LPG recovery plant at Ras Bakr. Secondly, more associated gas was to be moved from the main offshore fields. New connections to the grid were to be established in areas east and south of the Canal, with a new spur to serve residential and industrial areas along the Suez city–Sokhna stretch. Petrojet, the main contractor, confirms on its

website that most of the related pipelines were completed in 1999-2000, that is, slightly later than projected. Thirdly, pipelines were also constructed to serve the north and south of the Sinai, the latter serving a new power station at Ayoun Moussa.

Lastly, the late 1990s marked an expansion of the grid in a new direction, namely Upper Egypt. GASCO undertook the construction of pipelines to two new power stations, Tebbin and Koraymat. This southern expansion project, dubbed the Seti (Southern Egyptian Transmission Infrastructure), was eventually handed over to the Nile Valley Gas Company (NVGC), one of the new LDCs that took over the domestic delivery system after deregulation. The NVGC's concession went beyond distribution rights: it was required to finish the main gas transmission line to the south, that is, from Koreimat to Beni Sueif (*Al-Ahram Weekly,* 29 July-4 August 1999). Phase 2 and Phase 3 of the SETI, meant to link Beni Sueif to 6th October City and Assyut (350 km south), were still under study in 2004. Note that this was an exceptional contract: other LDCs are not involved in high pressure line construction.

Developments since 2000/01 have gone in similar directions. As more fields came on stream, particularly in the Mediterranean and Nile Delta, operating companies sustained pipeline construction to move more gas to processing and gathering facilities in those regions. Between gas production facilities and consumption points, GASCO continued to organise the construction of new high pressure links both to ease bottlenecks, and to service new customers, particularly in industry. This is reflected, for example, in the pipeline projects mentioned in *MEES* (24/12/2001):

- in the Western Desert (24 inch/60km from Alexandria southwest-wards to Borg Elarab);
- in the Nile Delta (32 inch/170km from Idku to Damietta, 15 mcm/d);
- around Cairo (32 inch/140km from Meit Nama to the Cairo hub, 20 mcm/d); and
- across the Sinai (24 inch/40km) a spur continuing the north Sinai pipeline eastwards from Arish to the Sinai Cement Company.

SOEs like Petrojet[1] were involved in the construction, but so were private operators. For example, in 2001, City Gas created a fully owned subsidiary to construct a pressure reducing station and a 43 km, 24 inch pipeline to the Nubaria power plant (east of Cairo).

[1] Petrojet is a national joint stock company established in 1975. It executes oil and gas projects but also participates in establishing companies in the sector, as with al-Fajr Pipeline company and Gastech, the CNG company.

On the whole, GASCO reports being involved in 27 pipeline projects since 2000 (GASCO's website). As a result, the national grid expanded from about 3,000 km in the mid-1990s to 4,500-4,700 km of high pressure pipelines at present (Suleiman, 2005).[2] Of these, only the Sinai pipeline to Taba (264 km, 36 inch) and the pipeline in the Nile Delta from Bourolus to LNG Fenosa (160 km, 16 inch) are related to Egypt's gas exports. Otherwise, most additions to the grid have centred on the domestic market. Likewise, as Table 1 below shows, the national grid's capacity appeared to have expanded most rapidly in the late 1990s. According to Soliman (2005), the capacity rose from 0.036 bcm/d in 1996/97 to 0.1 bcm/d in 2001/02.

Table 1: The Egyptian national gas grid, 1996-2004

	1996/97	*1997/98*	*1999/00*	*2000/01*	*2004*
Length (km)	3,000	3,000			4,700
Capacity (bcm/day)	0.036	0.042	0.067	0.100	0.130

Note: A 1993 estimate puts capacity at 1.4 bcf/day (about 39 mcm/day)
Sources: For 1996/97, 2000/01, 2004, Soliman (2005); for others *MEES* (28/6/99)

The current map of Egypt's national grid details all major pipelines, distribution and processing facilities; distribution companies active in each location; main power stations; and large industrial users. The information provided is summarised in Table 2 below. As such, the map outlines nearly 3,800 km of pipelines, that is, 81 per cent of the current grid. About half of this length is covered by 16 and 24 inch pipelines. Reflecting the historical development of the grid around Alexandria, Nile Delta, Suez and Cairo, most of the mileage added since 2000 has been on the outskirts of the grid. The expansion took two forms:

- from new production areas in the Western Mediterranean and Western Desert to the national grid; and
- from the grid to previously neglected remote areas, namely the Sinai Desert and Upper Egypt.

Hence, pipelines from Matrouh, El-Obyed, Abu Sannan (Western Desert), and pipelines to Assiut (south centre) and to Taba (Sinai), together add up to 1,119 km, that is, about a quarter of the current grid length.

[2] According to Ministry of Petroleum data provided to OIES in September 2005, the current length of the main grid, including pipelines to industrial zones and LNG sites, stands at 5,564 km.

Table 2: The Egyptian gas grid by pipeline type and length

Diameter	Length	Number of pipelines
12	14	1
16	869	7
18	163	1
20	109	2
22	168	3
24	949	10
28	218	3
30	45	1
32	523	3
34	234	1
36	460	2
42	39	1
TOTAL	*3791*	*35*

Source: GASCO's map (2005)

The map also shows the continued importance of Town Gas and Egypt Gas, two public companies involved in gas delivery projects since the 1980s. The oldest two parts of the grid, namely the Talkha–Shabshir–Cairo line, and the Port Said–Sokhna line, are respectively in the hands of Egypt Gas and City Gas. The former is also the main distributor in Cairo city. Of the six private LDCs, NatGas and City Gas appear to cover the largest concession areas. Fayum, National Gas and Repco operate over a smaller area. The Nile Valley Gas Company (NVGC) can expect to grow most, as it is licensed to reach a large unserved area of the country. According to the Ministry of Petroleum (2005), the length of medium and low pressure pipelines now handled by LDCs stands at 8,023 km, a figure that highlights their achievements.

Abubakr (2005) details the distribution of gas demand for 2003 among LDCs. His data are reproduced in Table 3. The data show City Gas's dominance, accounting for 73 per cent of the 3,151 mcm consumed in 2004. Egypt Gas, the only public company still delivering to customers, is second in importance with 11 per cent of Egyptian domestic gas demand. City Gas's large share may be explained by the fact that it serves a cluster of heavy industries around Suez City, including two power plants and several other industries (pharmaceuticals, cement, fertilisers, steel).

Table 3: Marketed household gas: share by local distribution company

		mcm/year	*Share of total*
City Gas	Suez, Red Sea, Sinai, Ras Gharib	2,300	73.0%
Egypt Gas	Munufia, Ghabia, Dakhlia, Kulubyia	351	11.1%
Nile Valley	Upper Egypt	287	9.1%
NatGas	Behira, Borg Elarab, new cities in greater Cairo	130	4.1%
National Gas	Sharkyia, 10th Ramadan	34	1.1%
Fayoum Gas	Fayoum	46	1.5%
Repco	Damietta	3	0.1%
TOTAL		**3,151**	**100%**

Source: Abubakr (April 2005)

Lastly, throughout the 1990s, Egyptian natural gas products were delivered from 12 processing facilities. Al-Ameriya processing plant was commissioned in 1993 and came on stream in 1995 (Petrojet 2005). According the *Arab Oil and Gas Directory* (1995, 1998, 2001), the combined processing capacity of these plants rose from 1,675 mcf/d in the early 1990s to 1,800 mcf/d in 1997/98 to 2,205 mcf/d in 2000/01 (respectively 46.9, 50.4 and 55.1 mcm/d). The processing capacity crossed the 2 bcf/d (56 mcm/d) line with the coming on stream of the Western Desert Complex in March 2000. It jumped up further in 2004 with the latest addition to the system, namely the Mediterranean United Gas Derivates Complex, completed in 2003/04. The complex has a design capacity of 1,100 mcf/d (30.8 mcm/d), and is a joint venture between GASCO, BP and IEOC, ENI's subsidiary in Egypt, and was financed accordingly (*MEES*, 10/12/2005). The two complexes required some $628 million in public investment.

2.2. Regulatory and legislative aspects

In line with the evolving production and distribution infrastructure, Egyptian efforts to establish the regulatory and legislative frameworks of its natural gas sector is very much work in progress. This section agrees with the assessment of the European Union's MEDA (EU-Mediterranean partnership) programme, that despite having evolved, the supportive legislative and regulatory bases are only just beginning to take shape. Indeed, the sector moved from being a minor segment of a state-dominated petroleum sector in the 1980s, to a target for disengagement in the 1990s. Since the late 1990s, the sector has been managed as a key national asset to be developed by massive government efforts. These efforts aim to pushing the sector to become a fully fledged gas market led by private companies. That is not only because of the government's emphasis on private investment as an engine of growth, but also because of the need to align Egyptian institutions with those organising the European gas markets. Abubakr (2005) also identifies three

phases. He argues that the gas sector moved from a simple case of a state monopoly or 'Pilot Project Phase' in 1979-83, to a slightly more ambitious 'National Project Phase' in 1983-96, to the current ongoing 'Deregulation and Expansion Phase', led by private companies. However this characterisation understates the role of government efforts in creating gas demand, for the issue here is not merely about delegating ownership to private hands.

Up to the mid-1990s, the overall regulatory framework of the gas sector was provided by the Ministry of Petroleum. Field development and the construction of facilities were integrated into the operation of the EGPC and its affiliates. Foreign technical or financial participation was assessed at ministerial level, often as part of discussions on industrial policy or foreign assistance.[3] Egyptian natural gas companies were publicly owned, Petrogas and Petrojet being the most important. Petrojet executed most of the upstream work, from processing facilities to cross-country pipelines. Egypt Gas was the main contractor in distribution and transmission between 1983 and 1996, building pressure reduction stations and new connections to industry, power plants and households.[4] As previously argued, as of 1997-1998, distributional functions, especially deliveries to households, were mostly delegated to LDCs, though Egypt Gas remained active in some regions.

However, the most important development to shape the sector in the 1990s is arguably Egypt's Economic Reform and Adjustment Program (ERSAP), agreed with the IMF and World Bank. The adoption of the programme set the government on a major and ongoing exercise in:

- downsizing its intervention and participation in the economy;
- revamping SOEs and preparing them for privatisation; and
- moving towards price liberalisation, and eliminating subsidies on goods and services.

The ERSAP had two main impacts on the natural gas sector, namely on organisational structure and pricing. In the first instance, legislation was passed to give all public sector companies, including those in the hydrocarbons sector, more autonomy and responsibility in the management of their operations. Prominent in this respect are: Law No. 203/1991, promulgating the establishment of public business companies and their regulations; and Prime Ministerial Decree No. 1590/1991 defining their articles of agreement and association *(Invest in Egypt 2004*). These

[3] According to the World Bank (1996), using domestic gas in a direct reduction iron plant was discussed at cabinet level in 1978. *Invest Egypt 2004* reports that the 1992 Cairo gas supply and distribution project between Egypt and the European Investment Bank was agreed through Presidential Decree 18/1992.
[4] See 'Chairman' and 'About us' on the website of GENCO, the main Egyptian private gas holding company, on www.genco.com.eg.

laws, together with subsequent amendments, helped to organise the sector along clearer and more defined functional lines, a necessary prerequisite to unbundling and privatisation.

With respect to pricing, most developing economies were being encouraged by international lenders to move towards cost-reflective pricing in all markets. Under the 1987 International Monetary Fund (IMF) agreement, Egypt was committed to moving domestic energy prices, including for natural gas, towards world prices.[5] Actual price increases were, however, only partial and gradual, spanning most of the 1990s. As documented by the World Energy Council (1998) and Abdel-Khalek (2001), price liberalisation under ERSAP set gas prices to rise by 11per cent each May from 1992 to 1995. Hence, the weighted average of domestic petroleum and natural gas products reached 83 per cent of world prices by 1992 (Abdel-Khalek, 2001).[6] In 1997, a further 17 per cent rise in natural gas prices was decreed to take effect from January 1998. At the same time, the government committed to freezing price levels until 2005, in an effort to promote the domestic use of gas and protect crude oil exports (World Energy Council, 1998).

1996-97 brought yet more changes to the sector, as a result of a continuing, multi-industry privatisation programme, which earmarked some energy companies for that purpose. In natural gas, the upstream was already operating under new production sharing agreements (PSAs) that are more favourable to IOCs. In parallel, the government found it appropriate to open the marketing end of the downstream, while keeping control of transmission. Hence, in 1997, it established GASCO as a legal monopoly for the import of natural gas and for high-pressure transmission. Low-pressure distribution was assigned to concessionaires. Unlike EGPC, GASCO is an SOE, not an economic authority.[7]

GASCO was established according to Investment Law No. 230/1989 amended by Law No. 8/1997. Law 8/1997 is also the legal basis on which the LDCs were established, most registering as joint stock companies in late 1997. Table 4 below details all the companies operating in the Egyptian natural gas chain. It shows that, between 1998 and 2002, the government went on to sign long-term concession contracts allocating specific geographic parts of the Egyptian gas market. A closer look at the shareholders of LDCs listed in the table reveals the limited nature of private Egyptian participation. The GENCO group, owned by one family, is arguably the most

[5] This vagueness of the terminology is the typical description of adjustment agreements worldwide, though the actual agreements contained more specific clauses and targets.
[6] Abdel-Khalek compiles these percentages from original agreement documents. World prices are the export prices of Egyptian crude and fuel oil.
[7] An economic authority, such as EGAS and the EGPC, is not subject to bankruptcy laws. SOEs are publicly owned companies meant to operate like other private corporations.

dominant. Its chairman moved from a high-ranking public sector position to establish a series of private entities and to chair the Egyptian Gas Association. Some IOCs, typically those with a long presence in the Egyptian upstream, also hold a substantial share of LDCs. Their participation was made possible by overall economic liberalisation. This liberalisation included more flexibility about foreign ownership and investment, and financial reforms that established the Cairo & Alexandria stock exchange.

Table 4: Who's who in the Egyptian gas industry

Sector /Company	Year created	Company type	Function or speciality	Ownership
Upstream (1)				
Badr Petroleum Company (Bapetco)	1980	Joint Operating	Exploration/ Production	Shell Egypt NV (67%), Shell Austria AG (33%). The company operates the Badr el Din fields, but also the Obaiyed field, where production started in 1999
Burullus Gas Company	1999	Joint Operating	Exploration/ Production	Egyptian General Petroleum Corporation (50%), British Gas Egypt (25%), and Edison Gas International (25%)- in the West Delta Deep Marine (WDDM) Concession
El Wastani Petroleum Company		Joint Operating	Exploration/ Production	Centurion (Canada) own 100% of the concession
Qantara Petroleum Company		Join Operating	Exploration/ Production	Merlon Egypt (54%) and Melrose Resources plc 45%
Rashid Petroleum Company (Rasheptco)	2000/ 2001	Join Operating	Exploration/ Production	Egyptian General Petroleum Corporation (50%), British Gas Egypt (40%) and Edison International (10%) in the Rosetta basin. British Gas had purchased Shell's share in the concession in November 2004
Shell Egypt NV (SENV)	1979	Foreign subsidiary	Exploration/ Production	Shell Egypt has many gas production assests, including in the North East Mediterranean Deep Water, Matruh, and Northwest Damietta
Processing & LNG				
United Gas Derivatives Company (UGDC)	2001	Special-purpose company	Condensates plant	Owned in equal parts by AGIP, BP Egypt and GASCO. The plant is to satisfy domestic demand, especially for LPG, and to export propane
Egyptian LNG (ELNG)	2001	Special-purpose company	Liquification plant	Ownership of TRAIN 1 (El Behera Natural Gas Liquefaction Company): British Gas 35.5%; Petronas 35.5%, Gaz de France 5%, EGAS 12%, and EGPC 12%. Ownership of TRAIN 2 (Idku Natural Gas Liquefaction Company): British Gas 38%; Petronas 38%, EGAS 12%, and EGPC
Spanish Egyptian Gas Company (SEGAS)	2002	Special-purpose company	Liquification plant	Fenosa Gas 80%, EGAS 10%, and EGPC 10%.
Transmission and distribution				
Egyptian Natural Gas Company (GASCO)	1997	Public	Governing body	Controls and manages the national gas transmission network
Egypt Gas (National Gas and Mining Project Company) (2)	1983	Public	Transmission & Distribution	EGPC owns 80% of the shares, the rest being owned by 20 institutional investors. It focused on connection and conversion projects, including some pipelines. It has been the distributor in: Monoufia, Ghabia, Dakhlia, Kalybiya. The company is on the government's current privatisation list
Egyptian Town Gas (ETG)	1997	Public	Transmission & Distribution	*Concession area: South eastern/ East of Suez*
Petrotrade	1975 (?)	Public	Billing	The company collects bills on behalf of all distribution companies
City Gas	1997	Joint stock company	Local Distribution	GENCO Group and AGIP own 80% and 20% of the shares respectively. *Concession area: North and East of Suez, i.e Suez and Ras Gharib residential areas, a power, cement, steel and fertiliser plants.*
Fayum Gas Company	2001	Foreign subsidiary	Local Distribution	Fayum was originally owned by Shell. In 2005, it had three main shareholders: Shell (with 51%), Egypt Kuwait Holding Company (27%) and GAIL India (19%). The remaining 3% is in private hands. *Concession area: Centre, i.e. Fayum area, between Cairo and Upper Egypt (3)*

Sector /Company	Year created	Company type	Function or speciality	Ownership
National Gas	1998	Joint Venture	Local Distribution (4)	*Concession area: Eastern Delta, Sharkiya and 10 Ramadan City*
National Gas Company (NATGAS)	1997	Joint venture	Local Distribution	Main shareholders: Egypt Kuwait Holding (52%), Shell Gas (18%), GAIL India (15%) Petrogas (10%), JAICORP (5%). *Concession area: Centre and North West (Sidi Kerir, Borg el Arab, new areas in Greater Cairo) (4* & 5*)*
Nile Valley Gas Company (NVGC) (6)	1998	Egyptian private	Local Distribution	British Gas (37.5%) Edison (37.5%); Orascom (20%) Middle East Gas Association (5%). *Concession area: Upper Egypt (Beni Suef, Minya, Asyut)*
REPCO Gas (7)	2000	Egyptian private	Local Distribution	Repco was acquired by the GENCO group in 2000. It develops and operates networks and facilities. Concession area: *Damietta (east of Alexandria).*
Eastern Company for Gas (EGC)	n/a	Consortium	Transmission & Distribution	Established by the Egyptian and Jordanian government to export gas to Jordan. It built the Taba-Aqaba pipeline
HOUSE gas **CNG companies**	1999	Joint stock company	Construction	The company is a contractor to local distributors. GENCO Group owns 74% of the shares, the rest being owned by staff
Egyptian International Gas Technology (8)	1996	Joint venture	Services	The main shareholders are: ENI/AGIP (40%), Misr Petroleum (20%), Misr Insurance Company (20%), Petrojet (10%) and Egypt Gas (10%).
Shell Compressed Natural Gas (also called Gas Express)	2002	Foreign subsidiary	Refuelling	Majority owned by Shell Egypt, it opened the first conversion and refuelling station in 2003. Today it has five refilling stations.
Arabia Gaz	2002/ 2003	Joint venture	Distribution for CNG vehicles	Owned by CTIP (Italy) and National Gas. It runs CNG refilling stations and conversion centres
Master Gas **Others**	2003/ 2004	Egyptian private	Distribution for CNG vehicles	Owned by the GENCO group, it runs 20 CNG refilling stations and 15 conversion centres
Petrojet	1975	Public	Construction	Owned by EGPC (97%) and ENPPI (2). A contracting company involved in the contruction of pipelines and facilities, and network services. ENPPI is Engineering for the Petroleum & Process Industries, an SOE
Petrogas	1970s	Public	Marketing	LPG refuelling plant and distribution
Egyptian Company for Gas Transportation (Butagasco)	2001	Public	LPG distributor	Distribution of LPG cylinders

1. Companies listed here account for most gas production. There are at least seven private Egyptian drilling and production companies, but these are rarely the sole operator. (EPEDCO, Forum, PICO, Egyptian Drilling Co, SAAM, NAPESCO, EGUSCO).
2. Information obtained from the minutes of AGMs of 2004 and 2005, downloaded from the Cairo & Alexandria Stock Exchanges website.
3. The local distribution sector was privatised in 1997, with six companies granted 20-year concessions in six geographic areas.
4. As confirmed by their respective websites, Shell acquired its share in 2001 and Gail in 2004. See also www.oilegypt.com on 17/8/2004.
5. JAICORP is an investment company owned by Abu-Dhabi Investment Authority; GAIL India entered the Egyptian domestic gas market in 2004.
6. Information from the GENCO group website. GENCO is a private holding company, involved thoroughout the domestic gas chain.
7. Information obtained from the minutes of the AGM of April 2005, downloaded from the Cairo & Alexandria Stock Exchanges website.
8. NVGC was the only concession to include the requirement to develop and build the SETI, Southern Egypt Transmission Infrastructure.
9. Transgas was the first private natural gas distributor to be established in 1995. However, it folded in March 1997 (*MEES*, 17/3/1997, vol. XL, No. 11).

According to MEDA (2005), LDCs were lured by an 18 per cent rate of return on capital invested. Their contracts involved receiving a fixed commission for transferred gas, the rate being fixed at 10 piastres (£E0.10) per cubic metre for commercial and residential customers, and 2 piastres (£E0.02) for power stations and industry.[8] From the government's point of view, this contractual structure encourages private operators to create demand, bringing in the process the capital required to expand gas delivery. However, it does little to encourage competition. MEDA (2005) notes that the long-term nature of these franchises may be 'significant structural obstacles' to establishing 'open markets'.[9] Similarly, a survey in the *OME Newsletter* (April 2005) finds that in the region and in Egypt, 'markets are often very immature and largely concentrated'. Yet, it is hard to see which other contract would work for a nascent industry in a rapidly changing context.

Up to the late 1990s, natural gas activity seemed a sector that could easily be delegated to private operators. Increasing domestic demand for gas really left the government free to concentrate on crude production and exports. As will be shown in Section 3, this initially meant replacing fuel oil and diesel in power and heating. However, once the extent of the reserves available began to be appreciated in the late 1990s, the government had little option but to re-engage with the sector by re-entering the upstream; continuing and scaling up the re-organisation of processing, transmission, and distribution. And while investing heavily in the infrastructure required the development of these facilities, it continued to liberalise the downstream so as to engage private capital. As such, the current structure of the Egyptian natural gas sector was arguably defined in 2000-01, when Law 2123/2000 created the High Committee for Natural Gas and the Prime Ministers Decree No. 1009/2001 established the Egyptian Holding Company for Natural Gas (EGAS).

At present, EGAS is the only domestic operator and buyer of gas in the upstream and it is EGAS which supplies distribution companies. Distribution, that is, delivery to consumers, has mostly been delegated to the private sector. GASCO remains the only manager and operator of the main national grid, that is, of the high pressure network. It focuses on transportation and transmission, having no trading function. In 2005, EGAS's chairman, Mr Soliman, was still stating that the liberalisation of the sector is a gradual process. The sector has yet to establish an independent regulator, and is very far from being a competitive wholesale market. The only move in this direction has been to allow third-party access for companies involved in LNG exports.

[8] At the average exchange rate for 2000, the US$ equivalent of these rates would have been 2.74 cts for residencies and 0.55 cts for larger users. At the average exchange rate for 2004, the US$ equivalent would have been 1.63 and 0.33 cts respectively.

[9] MEDA analyses to what extent and how each country has to change and what measures it has to introduce to truly have open markets, be it in terms of price determination, corporate independence, access rules, etc.

The expansion of reserves and production has complicated the picture by creating a sizeable processing and LNG segment. As is the case elsewhere in the world, this mid-stream and ambitions to export require large capital and extensive partnerships. Far from undermining the government's role, expanding the sector in this way has forced it to invest heavily in the supporting infrastructure, thereby reversing the logic with which the sector was managed a decade earlier. Throughout the world, Hayes and Victor (2005) and Esnault (2004) find that developing gas resources requires extensive public investments in the requisite infrastructure, or at least official guarantees underpinning these efforts. While throughout the 1980s and 1990s liberalisation programs called for the withdrawal of the state, nowadays, the organisational and financial muscles of the government in the gas sector are almost an imperative.

Lastly, in the Egyptian case, another imperative is now shaping the industry. As a result of its agreement with the EU,[10] the government has little choice but to move the sector towards open market structures. A survey on the impact of the EU's institutional policy actions on the investment climate of its Mediterranean neighbours finds that, in practice, these countries have 'to conform to European recommendations' (*OME Newsletter,* April 2005). In other words, there is an almost inevitable convergence of economic regulations towards European norms, although these are more geared to mature market issues, such as market access or congestion management. While this convergence should push the Egyptian natural gas market towards further unbundling and liberalisation, as MEDA (2005) finds, many thorny issues remain unaddressed. Not only is Egypt far from seeing commercial arrangements between power and industry, but it is also unclear on how fast it will move on subsidy elimination.

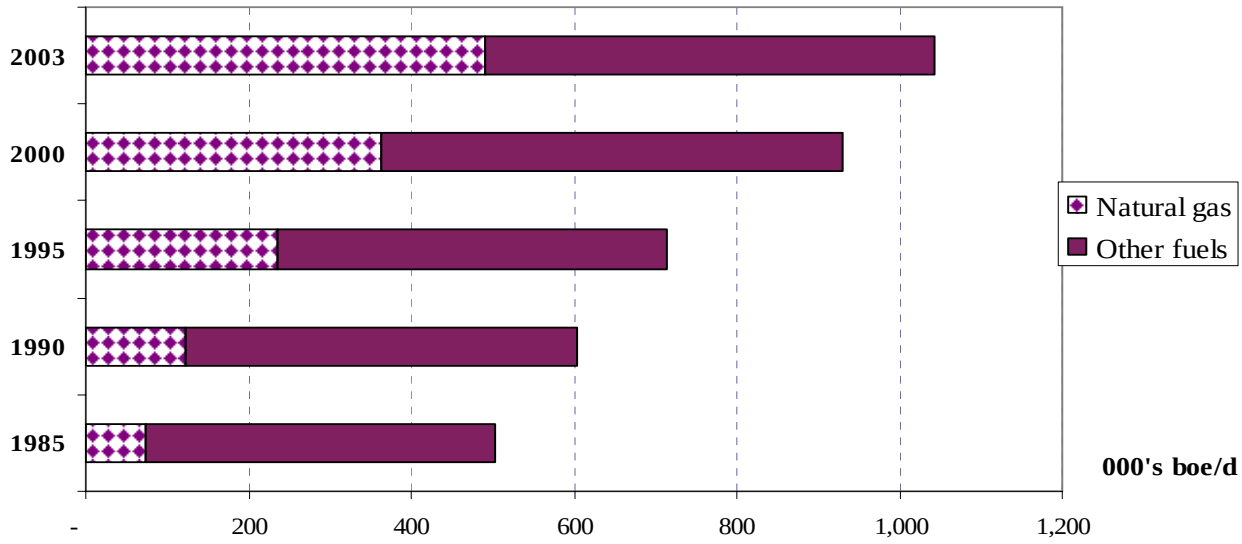
[10] The EU-Egypt Association Agreement was signed in June 2001. Under such agreements, the EU is to create a free trade area with its Mediterranean partners by 2010, 'based on market economy principles and economic integration, and involving the development of an appropriate institutional and regulatory framework'. In practice, the agreement is a framework to guide and finance the transitional efforts of its partners to align their economies and legislations with those in the EU. Currently, each partner works according to a National Indicative Program that include several projects and reform programs, including energy sector reform projects. In general, the objectives are competition; promoting policy dialogue and regional cooperation in the sector; improving foreign and private investment; and improving the environment. The specific steps taken and planned for each country are worked out in detail, and are extensively tabulated in MEDA (2005).

3. MARKETS FOR GAS

3.1. Overall features

Figure 3 below shows that while total primary energy consumption in Egypt doubled between 1985 and 2005, the share of natural gas in meeting that demand tripled from about 15 per cent to 47 per cent. Similarly, Soliman (2005) confirms that natural gas accounts for 55 per cent of Egyptian primary energy production. This expansion has come at the expense of petroleum products, fuel oil and diesel in particular.

Figure 3: Natural gas in Egypt's primary energy consumption, 1985-2003

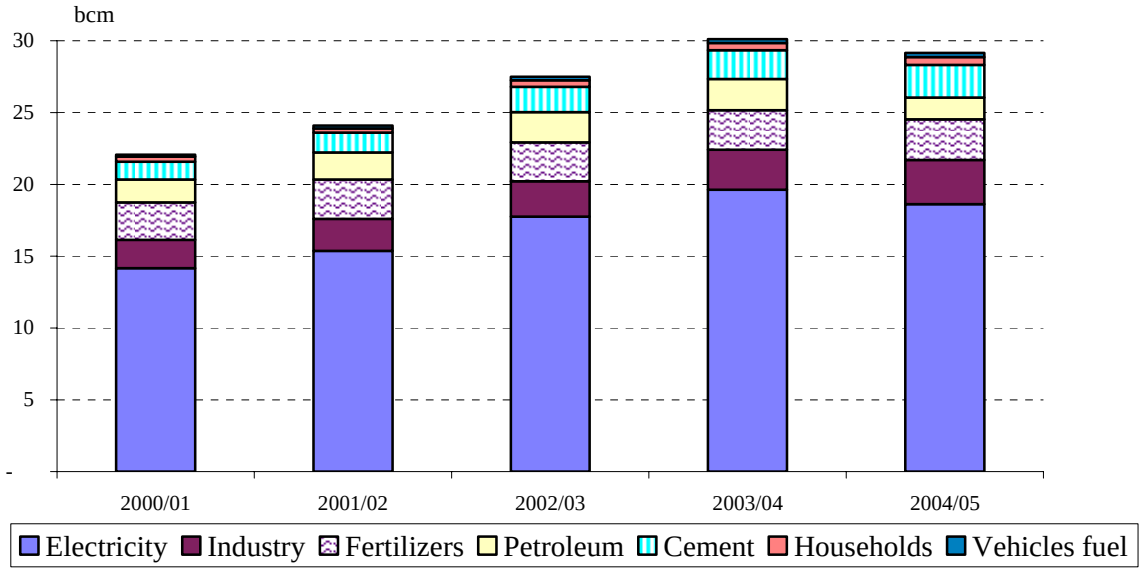


Source: OAPEC, *Annual Statistical Bulletin (*1997, 2002, 2004*)*

Data shown in Section 2 attest to the rapid growth in both demand and production, particularly since 2000. Similarly, according to OAPEC data, marketed gas in Egypt rose from 13.7 bcm in 1998 to 20 bcm in 2000, reaching 24.5 bcm in 2002. The rapid expansion is clearly illustrated in Figure 4 below, which features sectoral demand according to data provided by the marketing department of the Ministry of Petroleum (2005). Overall demand for gas increased by 24 per cent in volume over that period. While power generation remains the most dominant sector, smaller and more recently established sectors such as household gas and vehicle fuels have grown by a larger proportion. In fact, gas consumption by these two sectors rose by over 43 per cent from 0.49 bcm in 2000/01 to 0.83 bcm in 2004/05. Note that the gas used by the petroleum sector is mostly used for re-injection.

Also according to the Ministry of Petroleum, the value of this consumption rose by just over 37 per cent, from £E3.11 billion ($853.96 million) in 2000/01 to £E4.97 billion ($703.23 million). Interestingly, while the share of power generation in the total volume of gas consumed in Egypt stayed at around 64 per cent, the value of the sales to the sector fell from 64 per cent to 57 per cent of the total, due to the rising values and volumes of gas consumed by industry and construction.

Figure 4: Natural gas demand in Egypt, 2000-2005



Source: Ministry of Petroleum (2005)

The emerging pattern of demand is arguably more a reflection of the pattern of the physical expansion of the grid, rather than of price movements. While in the upstream, gas prices are related to international oil markets, domestic prices are set by the Ministry of Petroleum and/or the Cabinet. As with most publicly provided goods in Egypt, they are subsidised prices. As previously argued, price changes have therefore more to do with Egyptian public finance and its commitments under the reform program, rather than any supply or demand considerations. As has been the case with other goods, the government has slowly moved them to more realistic levels, that is, levels which approach cost recovery and/or long-run marginal costs.

Unfortunately, little specific data about such costs are publicly available, although clearly, they are on the mind of planners and industrialists involved in the sector. So all that can be said is that generally speaking, the country has moved from a complex multiple-rate system to more uniform pricing, as it did with its foreign exchange rates. In such a context of centrally determined pricing,

Egyptian domestic prices for gas can be summarised easily. Table 5 below confirms they have only changed a handful of times in the last 15 years. The last round of price rises in 2004 still keeps domestic prices at $1 per 1,000 cubic feet, which is well below current world levels of $5-6 per 1000 cubic feet. So the price rises still mean that Egypt has extremely low gas prices that are still far from market levels. The 2004 price rise also seems to have mainly concerned bulk purchases. It seems that socially sensitive markets – transport and households – are more protected, with CNG prices, for example, being unchanged since 1995.

Table 5: Domestic gas prices by date of change and ministerial decree

Type of Activity	Price	Unit	Decree No.	Issue date
All activities	2.64	piastre/cubic metre	121	26 April 1987
Cement/Brick /Gypsum/Pottery	3.02	piastre/cubic metre	120	26 April 1987
All activities	3.30	piastre/cubic metre	73	24 March 1989
All activities	4.67	piastre/cubic metre	66	06 May 1990
All activities except construction	7.50	piastre/cubic metre	54	03 May 1991
Houses and commercial units	10.00	up to 30 cubic metres	56	03 May 1991
	20.00	between 30-60 cubic metres		
	30.00	over 60 cubic metres		
All activities except construction	12.25	piastre/cubic metre	93	18 December 1992
Vehicles fuel	45.00	piastre/cubic metre	120	01 March 1995
All activities except housing	14.10	piastre/cubic metre	775	01 August 1997
All industry and power generation	18.5	piastre/cubic metre	470	18 March 2004
All industry and power generation	21.7	piastre/cubic metre	1516	09 September 2004

Notes: 1. 'All activities' is the term used by the Ministry. We understand it to cover commercial, residential, and industrial uses except as specified in the particular decree. **2.** One Egyptian pound is 100 piastres (£E =100 p). **3.** Prices for 2004 were officially posted respectively as: 3.00175 cts and 3.53147 cts per cubic metre. We converted these to Egyptian piastres per cubic metre at the 2004 exchange rate of £E6.153/$1.
Source: Ministry of Petroleum (2005)

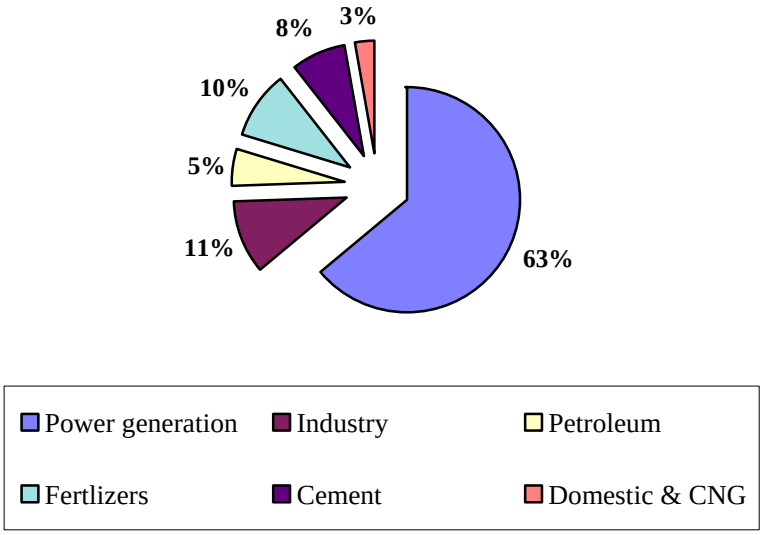
3.2. Power Generation

For the last 20 years, the single most important demand driver of gas consumption in Egypt has been power generation. Figure 5 shows that power generation absorbs 62 per cent of current Egyptian domestic gas consumption. According to *MEES* (30/8/1993), the government had been considering the possibilities of growth in gas reserves and electricity demand for some time.[11] Today, the policy can be said to have been successfully implemented, and gas penetration in power generation is almost complete. Natural gas now accounts for 92 per cent of total fuel used in Egyptian power plants versus 69 per cent in 1998/99. It is also used in 98 per cent of facilities

[11] Interestingly, government projections for gas demand for the end of the 1990s turned out to be fairly close to the levels that actually materialised.

compared to 52 per cent in 1989-90, and 21% in 1980-81.[12] As LDCs mention on their websites, most power plants in Egypt are connected to the grid. A significant corollary is that this market is unlikely to continue to increase its demand for gas at the same rapid rate as it did in the 1990s.

Figure 5: Natural gas consumption in Egypt, 2004/05



Source: Ministry of Petroleum (2005)

Table 6: Natural gas consumption in Egypt by sector, 2000-2005 (bcm)

	2000/01	2001/02	2002/03	2003/04	2004/05
Electricity	14.17	15.37	17.75	19.63	18.62
Industry	1.96	2.22	2.48	2.78	3.08
Petroleum	1.60	1.88	2.10	2.16	1.51
Fertilizers	2.62	2.76	2.70	2.76	2.83
Cement	1.24	1.39	1.77	2.01	2.28
Households	0.35	0.28	0.45	0.50	0.54
Vehicles fuel	0.14	0.20	0.24	0.26	0.29
Total	22.07	24.10	27.49	30.11	29.15

Source: Ministry of Petroleum (2005)

This transformation was achieved in two ways. First, by converting existing thermal power plants away from heavy fuel oil, and secondly, by choosing gas and the associated new technologies (combined cycles gas turbines or CCGTs) for new power plants. The fuel switching policy arguably emerged in relation to Egyptian environmental commitments following the 1992 Earth Summit in Rio de Janeiro. The Egyptian government committed itself to cleaning up its oil and energy sectors, establishing an environmental agency and decreeing as of 1994, the integration of

[12] See 'Electricity in the year 2003/04' and 'Percentage of Connected Power Station to Gas Network Period 1980/81-2002/03' on the website of the Egyptian Electricity Holding Company (www.eglec.com/English).

environmental impact analysis in all industrial activities. This coincided with increased availability of funds from bilateral and multilateral donors to reduce pollution and harmful emissions. By the mid-1990s, fuel switching became a key clean technology transfer option that OECD donors were more than willing to finance. Hence, Mobarak (2001) reports the EIB as being one of four organisations continuing to sponsor cleaner production projects, and donating €15 million for the rehabilitation of a power plant and for switching two industries to use natural gas.

Similarly, since 1998/99, all new power plant projects, as detailed by contractors and by Egyptian electricity companies, are meant to have single or combined cycle turbines. This policy began to be implemented in the mid-1990s, with the commissioning of three Build-Own-Operate-Transfer (BOOT) projects. These projects saw Intergen and Electricité de France constructing power plants in Sidi Kerir, Port Said and East of Suez (*MEES*, 24/12/2001). This policy also reinforced the links between power generation and the development of the national pipeline network.

In 2003/04, thermal installations were still the most dominant type of power generation used. There are only nine thermal stations running on gas in the current total of 45 plants. These provide only 1,019 MW of the current total 11,610 MW of Egyptian electric capacity, although this had doubled from the 715 MW installed in 1998/99 (Egyptian Electricity Holding Company, 2005). Six of these plants were commissioned before 1990 and placed near the two main gas reservoirs known at that time, namely
Abu-Qir and Port Said (Egyptian Electricity Holding Company, 2004). Additionally, and reflecting the aforementioned policy, Egypt now boasts nine stations with CCGTs, with a total installed capacity of 2,911 MW, that is, over 25 per cent of current installed capacity (Egyptian Electricity Holding Company, 2005).[13] In this sense, the conversion to gas has been a win-win situation from both industries' points of view.

Unlike the technical details about pipelines and facilities, the exact price at which gas has been supplied to power plants is almost never mentioned. An important exception is Abdel-Khalek (2001), who quotes the domestic prices of fuel oil and natural gas in 1992-93 at £E130/tonne and £E150/tonne respectively. Increased gas output may have reduced prices subsequently, but the price advantage of gas is more likely to have derived from the opportunity cost of exporting crude oil. The author also notes that the domestic price of natural gas was increased from under £E0.03

[13] CCGTs allowed Egypt to double the efficiency of its gas installations. For example, Mahmoudiya has a 1982 gas-fired power plant with an efficiency of 21.9 per cent, and a 1995 CC plant with an efficiency of 41.2 per cent.

per cubic metre in the 1980s to £E0.075 in 1991. As of 1992, it was fixed at £E0.1225 per cubic metre, rising again to £E0.14 in August 1997. The latest development to affect domestic gas prices has been the 25 per cent increase in price levels witnessed in May 2004, in line with rising hydrocarbons prices worldwide. This rise prompted the government to establish a special support fund to ease the impact of the rise on industry and power (*Al-Ahram al-Iqtisadi*, 24 May 2004). According to official sources, all power plants and industry now charged $1 per thousand cubic feet, that is, about $0.0352 per cubic metre (i.e. £E0.21-£E0.22 at the 2004 exchange rate).[14]

In terms of the impact of these prices on electricity costs, assuming a fuel mix of fuel oil and natural gas of 20 per cent and 80 per cent, Abdel-Khalek calculates that the long-run marginal cost of electricity in 1992/93 was at £E0.0354/kWh ($0.0106) using domestic prices. This cost is much higher – £E0.1237/kWh ($0.0369) – at world market prices. Official figures for that year put the average costs of electricity generated and sold at £E0.046/kWh and £E0.052/kWh respectively. The author argues that given ongoing price reforms of other inputs, gas prices would have been only one of the factors affecting the price of electricity.

Nowadays, contractual details about power plants continue to omit input prices. These are typically only mentioned in so far as they fall below international levels. *MEES* (1/3/2004) merely quotes that the Ministry of Petroleum is supplying the Kureimat power plant through a 25 km spur line at the rate of 3.6 mcm/d. Electricity tariffs currently published by the Egyptian Electricity Utility & Consumer Protection Regulatory Agency[15] have not changed much since July 1992: ultra-high voltage is still at £E0.068/kWh, and households using less than 50 kWh a month pay only £E0.05/kWh. Commercial and residential customers using more than 1,000 kWh a month are now charged £E0.25 and £E0.43/kWh respectively.

3.3. Industry

The potential role of gas as a feedstock and fuel for industry has been noted by the Egyptian Cabinet since the 1970s (World Bank, 1996). At that time, most of the gas had been flared, with the 1980s marking its increased use in the petroleum sector and industry. This role is also reflected in the location of many of Egypt's older industrial plants near oil and gas fields, particularly near Abu Qir in the north of the country, and eastwards along the Suez Canal. According to EGAS (2004), 25 per cent of the demand for natural gas in 2003/04 was due to

[14] Communication received from the Egyptian electricity regulator in August 2005.
[15] See 'Bills and Tariffs' on www.egyptera.com.

Egyptian industries (excluding petroleum). Fertilisers and cements/ceramics are the two largest clusters, accounting respectively for 10 per cent and 9 per cent of the 30.8 bcm consumed in 2003/04. Abubakr (2005) suggests that there are now 500 industrial plants and 13,000 commercial units using gas.

As is the case with power generation, apart from announcements in national plans, there is a dearth of studies on how this demand was created. As previously outlined, domestic prices have been administrative decisions that change according to economic plans, rather than in reaction to market conditions. To reiterate, prices reached £E0.1225 per cubic metre in 1992, rising to £E0.14 in August 1997, and to £E0.183 in 2004.

Abdel-Khalek (2001) does follow the impact of changing energy input prices, including gas, on Egyptian heavy industry, but only for the 1990s. As such, his works helps us to understand industrial demand for gas by considering industrial demand for power. The importance of this demand is illustrated by the fact that an aluminium plant absorbed 35-40 per cent of the electricity from the Aswan Dam, while the Helwan steel complex absorbed 25 per cent of industrial consumption of high voltage electricity. The author notes that under ERSAP, electricity tariffs for industry were raised by 32 per cent in July 1992 to 69 per cent of the long-run marginal cost, and a tariff of £E0.052kWh. The tariff for ultra-high voltage used by industry rose to £E0.063 kWh, although a fertiliser plant and an aluminium plant were charged respectively £E0.047/kWh and £E0.068/kWh. The HADISLOB steel plant saw tariffs rise from £E0.0518/kWh in 1990-91 to £E0.1535 in 1992-93, falling to £E0.1124/kWh in 1996-98. HADISLOB's financial position was undermined by simultaneous rises in the prices of coke and natural gas. On the other hand, HADISLOB was helped by its ability to raise its output prices by 60 per cent, and higher input prices did help to rationalise energy use and improve efficiency. In other words, gas price increases are only one of many overwhelming changes that hit Egyptian heavy industries during this period of economic liberalisation.

Much less is known about lighter industry. However, it seems these tend to use fuel oil or diesel, implying that current levels of gas demand may be less important for smaller factories.[16] As the Egyptian government imports diesel to the tune of several million dollars a year, and sells it at subsidised prices, the conversion of small to medium industries to gas will represent savings on external and internal balances. Beyond this incentive, the conversion of this market may be accelerated because of a synergy with another factor, namely environmental concerns. Project

[16] This is confirmed indirectly by the July 2005 IDSC poll on the use of diesel ('solar') in the tourist industry.

information suggests that the 'greening' of production technologies was an important driver of the shift to gas through most of the 1990s. An interesting example is that of a gas switching project for a cluster of 50 brick makers in Giza (near Cairo). The $4.2 million Climate Change Initiative project was mostly paid for by the Canadian International Development Agency. Town Gas was to upgrade their boilers to run on gas, with the brick makers signing contracts to buy gas upon installation. Elmassry (2004) documents similar initiatives and potential projects under the Clean Development Mechanism.

Demand for gas in new industry has also been created by explicit government support, and figured prominently in government plans for the late 1990s. In particular, the government's 'mega projects' of building new urban and industrial areas, including the Toshka Valley, anticipated that these new areas would have excellent infrastructure, including connections to the national grid. However, it seems that the pressures to serve existing and new customers took its toll on the public sector companies involved. Minutes of Egypt's Gas Annual General Meeting indicate that its financial exposure improved in 2004 when Town Gas repaid £E100 million of the £E280 million it owed. Town Gas's debts accounted for 63 per cent of Egypt Gas's uncollected credits. Town Gas fell into arrears while carrying out government plans to supply gas to existing and new urban areas (6 October and 10 Ramadan). A recent *al-Ahram Weekly* article (5-11 May 2005) notes that only 7 per cent of the 1,250 factories in the 10 Ramadan city have converted to natural gas, despite the signing of a protocol between the city's Investors Association and the Ministry of Petroleum. Industrialists are apparently only willing to pay for a small part of the costs, which can add up to anything from £E5,000-£E150,000. The article further argues that the government overlooked a source of funds readily available for promoting gas use in industry: the aforementioned international environmental protection programmes, which have already financed some conversion efforts.

Lastly, demand for gas from the fertilisers and petrochemicals industries is likely to receive a substantial boost between now and the end of the decade. The fertilisers market in Egypt is very tight, with market balance frequently disrupted by seasonal demand, hiccups in distribution, and erratic policies on tariffs and quotas on foreign trade. Plants that are meant to double domestic production capacity are coming on stream. Similarly, the domestic demand for key petrochemicals products is growing at 4 per cent-8 per cent year (*MEES*, 3/2/2003). The government's current ambitious 20-year plan has already moved into the financing and execution of the first three projects, expected to cost $1.9 billion (*MEES*, 3/2/2003, *al-Ahram Weekly*, 20-6 January 2005). The three world-scale plants will use: 1.2 mt/y of ethane, 430,000 t/y of propane,

263,000 t/y of benzene and 27,000 t/y of benzene. Using Soliman's (2005) data for daily production in 2004, annual outputs of ethane, propane, and butane were estimated respectively at: 511,000 tonnes; 438,000 tonnes, and 693,500 tonnes. According to OAPEC (2004), Egypt also produced 6.925 million tonnes of kerosene and jet fuel. Increased upstream output should allow feedstock targets to be met, with ethane production expected to reach 8 mt/y by 2009-10.

3.4.Vehicles and Households

Egyptian demand for natural gas from CNG vehicles *and* households has grown substantially from virtually nothing a decade ago. However, its share in the total demand for gas remains marginal, at only 3 per cent or 0.924 bcm of the 30.8 bcm consumed in 2003-04 (EGAS, 2004). Its growth has been fuelled by price differentials over gasoline and bottled gas, but also by two politically significant but very different drivers: pollution abatement and household energy needs.

Egypt's experience with CNG promotion has been applauded worldwide, as it took the country from a situation of managing two pilot projects between 1992 and 1995, to being eighth in the world in terms of the CNG fleet. According to El Ridi (2004), the pilot project was launched by the Ministry of Petroleum and two oil-producing companies, Gupco and Petrobel. The companies tested the technology and suitability of Egyptian gas for CNG on a fleet of 150 cars and 30 buses, the exercise also encompassing five dedicated fuelling stations. The trial set the scene for establishing two CNG companies in 1995 and 1996, the Natural Gas Vehicles Company (NGVC), and the Egyptian International Gas Technology Company (GASTEC). These were joined by Shell CNG in 2002, and Arabia Gas and Master Gas in 2003.

Pollution in Cairo in the 1990s, with dangerously high levels of lead, sulphur dioxide and nitrogen oxide, was a crucial motivating factor for the Egyptian government in pushing for CNG adoption. In 1997, the Egyptian Environmental Affairs Agency and USAID launched the Cairo Air Improvement Program (CAIP), with the USA contributing $60 million and Egypt $12 million. At the centre of the scheme was the conversion of all taxis and municipal buses to CNG. USAID Commodity Import Program financed the import of 50 chassis for buses at the cost of $17 million, with the Egyptian government adding $8.2 million for the bodies.[17] CNG companies were also given a five-year tax holiday (El Ridi, 2004). 1998 legislation gave the program a final push, requiring all taxis and general service vehicles in greater Cairo to use CNG by the end of 2000 (*MEES*, 28/6/1999).

[17] See 'Overview' on the USAID Egypt's website and *al-Ahram Weekly* (20-6 April 2000).

Surprisingly, the conversion program for private cars, including taxis, was done without subsidies. The substantial price differential between CNG and gasoline (£E0.45 per cubic metre of gas versus £E1 per litre of gasoline) was rightly judged to be a sufficient incentive. Initially, the £E5,000 cost of the conversion, was set to be paid back by drivers over an 18-month period. Nowadays, there is a Gas Card Scheme, whereby customers pay gasoline prices, but the difference over CNG prices is credited against their receivables' balance. The government also gains, namely by saving on foreign currency needed to finance the country's massive diesel imports.

As Table 7 shows, these concerted efforts helped the number of CNG vehicles and fuelling stations to quintuple since the 1990s. Currently, there are 50,000 to56,000 such vehicles, implying a daily rate of retrofitting 600-1000 vehicles (Verbeek 2003). Korkor and El-Behairy (2005) and Hantar[18] (2004) suggest that taxis constitute 77 per cent of the CNG fleet, with municipal buses and private cars accounting respectively for 12-13 per cent and 2-6 per cent of the total. This fleet consumes approximately 3 million cubic metres of CNG (Verbeek 2003). According to a recent census by the Information Decision Support Centre (IDSC, 2005), this fleet is served by 49 stations. Other higher estimates appear to be optimistic extrapolations, not actual measures.

Table 7: Household gas and CNG fleet, 1996-2004

	1996	**1999**	**2000/01**	**2003**	**2004**
Consumers connected	650,000	825,000	1.5 million		1.8 million
CNG stations	10	30	52	50 to 74	49 to 87
CNG cars		15,000	40,000	50,000	56,000

Sources: Arab Republic of Egypt (1998), *Egypt Yearbook (1999)* , Arab Republic of Egypt (2002), Verbeek (2003), Gas Express (2003), Information & Decision Support Centre (2005), Korkor and El-Behairy (2005)

Despite these achievements, several constraints may plague further growth in the CNG market (Abubakr 2005, Hantar 2004, Kraus 2004). If the initial import costs were covered by foreign aid, further imports of conversion kits are considered to be too expensive for what is essentially a poor country, these costs being further inflated by the devaluation of the Egyptian pound in 2003. There are efforts to manufacture some equipment locally, but problems with technical integrity have been reported. Technical training and health and safety issues also came to the fore following some accidents. Additionally, a 2004 customer survey noted the frustrations of users

[18] Hantar is the director of Gas Express, the subsidiary of Shell Egypt that operates CNG stations.

with the long waiting time at fuelling stations, and with the performance of some converted vehicles. Hence, CNG is unlikely to grow beyond the conversion of the rest of Cairo's municipal buses, and of taxis in other urban centres. Private vehicles are not a captive market in the same way, and it is hard to see a rapid or significant conversion in the near future.

Moving onto household gas, the government has been trying to meet demand via two policies:

- by continuing the expansion of natural gas production and facilities; and
- by delegating the delivery of gas to the financial and organisational muscles of LDCs.

With respect to the former, despite rising from 976,000 tonnes/year (i.e. 2,674 tonnes/day) in 1996, LPG production only reached 3,800 tonnes/day or 44,080 b/d in 2004, compared to a 2003 consumption figure of 84,100 b/d.[19] Success has also been partial with regard to the latter policy. As mentioned in Table 7, the number of households supplied with pipeline gas almost tripled from 650,000 in 1996 to 1.8 million in 2005 according to the IDSC 2005 survey, somewhat below the 2 million mark commonly circulated.

Most LDCs report on their websites the number and type of customers they reached in the past. However, data are outdated, and there are no complete data series as to the evolution of their customer base. Still, information on NatGas's website confirms a pattern of gradual expansion. It suggests that the company began conversion efforts in Beheira. It first reached industrial and commercial units and 77,430 residences in 1999/2000. Then it moved onto other concession areas, reaching a current total of 168,000 households in 2003/04. Similarly, Fayum Gas began Phase II of its expansion program in July 2005: having connected 25,000 households and 34 factories, it is now engaged in reaching a further 40,000 customers (*Shell in the Middle East*, July 2005). The total number of households reached by LDCs according to their websites is only 262,000. Although data are outdated and the coverage is incomplete, the discrepancy between this number and the number provided by the most recent survey indicates delays in meeting targets. It also confirms that SOEs are still important for distributing gas to households.

According to IDSC (2005), the 1.8 million households supplied with gas constitute on average 18 per cent of the population of the 14 governates. Within each governate, urban centres had a much higher coverage, the top three being Port Said (54%), Suez (36%) and Cairo (35%). Coverage is marginal in remote and rural areas, being still at 5 per cent in Fayum and 3.8 per cent in al-

[19] See respectively: Arab Republic of Egypt (1998), Soliman (2005) and OAPEC (2004).

Sharkiya. In a country with a population of 70 million, the potential for expansion is obvious. But there are also additional drivers. For households, pipeline gas would save them from the crises that repeatedly hit the bottled gas market. A 2000 report mentions a government subsidised price of £E3 per cylinder against a black market high of £E15 per cylinder (*al-Ahram Weekly*, 28 September-4 October 2000). According to OAPEC (2004), domestic LPG prices have been at £E0.11 since 1993, though the depreciation of the Egyptian pound meant that the dollar equivalent fell from $0.324 to $0.18 per litre at 2003 prices. For the government, expanding pipeline gas would free it from the cost of importing LPG, which stood at $300 million and about half of LPG consumption in 2000 (*al-Ahram Weekly*, 28 September-4 October 2000). In 2004, LPG accounted for $549 million in the $2.6 billion of Egyptian petroleum product imports (*Monthly Economic Digest-July 2005*, *Quarterly Economic Digest October-December 2004*). Petroleum products subsidies reached a new high of £E20 billion, up from LE14 billion in 2003-04 (*Information Decision Support Center*, 2005). Natural gas expansion would thus help improve the government's internal and external accounts at the same time.

4. THE DEVELOPMENT OF THE EGYPTIAN GAS INDUSTRY – LESSONS FOR OTHER DEVELOPING COUNTRIES

Drawing lessons from the development of the Egyptian gas industry is not obvious. To start with, the physical and institutional organisation of the industry is still evolving. It is largely premature to say where competitive efficiency needs to be improved or what is the scarcity factor in this new market, as has been done, for example, in the case of Mexico by Brito and Rosellon (2005). Further, the typically celebratory reports about its performance make it difficult to identify the obstacles that other countries should avoid when establishing their gas markets. On the other hand, as this section will argue, lessons from the Egyptian situation are likely to fall within the general message of Hayes and Victor (2005). In their study of seven developing countries, the state had a central role in orchestrating the investment efforts needed to establish domestic gas markets. In other words, government investment in infrastructure, is, in practice, a prerequisite for the creation of gas demand.

So what clues could Egyptian achievements and problems hold for other gas producers? Starting with the upstream segment of the gas chain, and as may be detected from Table 8 below, the revision of PSAs to encourage IOC investments was instrumental in increasing gas production. However, the rigidity of the take-or-pay clause imposed a hefty trade-off on the government. Egypt did secure a revision of the terms of contracts in 2000, but by 2002, it was already asking IOCs for deferral in payments for lifted gas. While neither the upturn in world gas prices nor the size of reserves uncovered could have been anticipated, more flexible contracts could have protected the government from changing circumstances. It would have eased the ongoing financial stress it is suffering in trying to meet infrastructural costs.

Table 8: Egyptian concession contract models

* All costs relating to exploration and field developments are recoverable.
* At commercial discovery, the contractor is awarded a development lease of up to 20 years.
* A production company must be established within a month of commercial discovery. It is governed by the bylaws of shareholders (EGPC/EGAS and Contractor). As of 2004, EGAS manages the bids and concessions.
* The contractor is liable to pay income tax, but this is typically paid in output.
* The contracts now provide for bonuses to be paid for gas activities as well.
* Up till recently, cost recovery was set at 20-25%, with an additional 15% going to the developer. The remaining 60% were split between EGPC and its partner. Cost recovery ceilings are now at 20%-40% of production, with exploration and development recovery at 20%-25% per annum.
* In 1993, the price of gas sold to EGPC was set at $3/MBTU, the pricing formula being linked to the spot price of Suez Blend. As of 2000, the reference oil was changed to Dated Brent. The price ranges between $1.50/MBTU when Brent is below $10 and $2.5 when Brent is over $22.
* The EGAS's share of profit gas is currently between 70-75%. Shares are negotiable, and vary according to production levels.
* As of 2000, contracts commit EGPC/EGAS to 'take or pay', i.e to lift partners'share in the absence of an export market.

Source: 'Oil & gas concessions in Egypt', *Invest 2004* , http://www.sis.gov.eg/eginfnew/economy/invegy.
Arab Oil and Gas Directory 2001; EGPC, 'Main Commercial Parameters, 2004 Second Bid Round', September 2004.

As for the downstream, initial liberalisation efforts in the 1990s reflected a general view of the gas sector as one of many activities that the state has over-involved in. But, currently, distribution is the only segment the government has divested from. Although the Egyptian private sector has responded to the new opportunity, it is only beginning to gain expertise in distribution networks, especially if compared to the stronger tradition in engineering services.[20] Similarly, total private investment in oil and gas in 2004 only reached £E2.8 billion: for all practical purposes, most of these flows would have come from foreign companies in upstream oil.

Even gas distribution is far from being a competitive market, as it is dominated by a handful of local and foreign companies. The contractual structure is rigid, consisting of long-term franchise agreements. While appropriate for a relatively immature market, the key function of this type of agreement was to allow the government to eschew subsidisation issues. By linking performance and rates of return to the rates at which households and other markets are converted to gas, the government succeeded in mobilising some private capital to expand the consumer base. However, since the government is still footing the bill for subsidised gas consumption, it is hard to tell to what extent the segment has moved near to cost recovery. All that can be said at this level of analysis is that is now more common for the government to pass on some of the price rises to consumers, and that many SOEs now openly discuss aims of financial viability and profitability. After all, the government is committed to keep a lid on its budget deficits and on its public debt.

[20] The Minister for Petroleum recently noted the small share of the Egyptian private sector particularly in the upstream (*Al-Ahram al Iqtisadi*, 23 May 2005).

Otherwise, the gas chain is still organised around a single buyer, EGAS, and a single transmission operator, GASCO. The creation of EGAS and GASCO moved the sector towards a clearer separation of technical and contractual functions, and allowed the unbundling of supply, transmission and distribution. Although it is still publicly owned, GASCO also benefited from more organisational independence. While the MEDA report (February 2005) criticises this structure for preventing access to the transmission system, this centralisation is largely appropriate given the evolving nature of the Egyptian grid, and was probably helpful for its continuous expansion.

On the whole, the greatest problem associated with creating the domestic market for gas has been the issue of monetisation, that is, the lag in receiving gas revenues to cover requisite infrastructural costs. Consequently, there have been substantive and ongoing pressures on the budgets of SOEs and the central government as a result of having to pay for most of these developmental costs. These commitments perhaps explain why in 2004, the mining sector in Egypt received 9.8 per cent of investments but produced 5.2 per cent of GDP (*Quarterly Economic Indicators October-July 2004*). Over 58 per cent of these investments came from the central government, economic authorities or SOEs, highlighting the weaker role of the private sector.

Financing pressures have been compounded by two factors: first, subsidised pricing, which limited the ability of the government to recover costs; secondly, the government's inability and/or unwillingness to force customers to pay for conversion upfront. On the other hand, Hayes and Victor (2005) document the widespread practice for governments worldwide to meet the sunk costs of infrastructural development from their coffers. This may be particularly relevant for a poor country like Egypt, where full cost recovery may have undermined fast demand creation. Perhaps the government should have budgeted for such costs more clearly from the outset, particularly when it embarked on expanding the national grid. The gas monetisation problem may be easing now that LNG export receipts are coming in, but both lead times and associated financial commitments could have been anticipated more frankly.

The government has had clear contractual relationships with foreign operators active for example in the CNG sector. It also did rather well in channelling foreign aid and concessional finance to pay for conversion projects and new facilities. The latest EIB financing for power stations indicates a continuation of this policy. However, a*l-Ahram Weekly* (5-11 May 2005) suggested that perhaps official financing should have been tapped for smaller conversion projects too, and

that this funding source should have been more clearly integrated with the development of gas markets.

In contrast, government interactions with domestic agents have been less smooth. The literature suggests the government hoped that it would pay for the main grid expansion, leaving private agents to pay for conversion and point delivery. Such details were often left unspecified, as the government assumed that switching to a cheaper fuel would be a sufficient incentive for the private sector to co-operate. In practice, many transmission and delivery projects were executed but unpaid for. As the situation in the 10 Ramadan city shows, current disputes over payments for conversion are slowing the expansion in gas demand. The SOEs involved are probably unable to shoulder more debts. They are under financial stress because contractual details were overlooked, and because they were used as mere instruments to expand the grid. These SOEs could have been less distressed had the expansion of domestic demand been slower, or if they had been able to raise more of their capital costs. Both possibilities could have occurred if:

- More revenues were secured from the upstream;
- if new cities were not prioritised in the same way as existing population centres; or
- SOEs had been allowed to achieve the same rate of return guaranteed to private LDCs.

The complex web of government interventions in industry, energy, external trade, and customer protection complicate further privatisation of the natural gas sector, especially that price controls remain pervasive in the Egyptian economy. The government has tried to continually expand markets for gas without working out the consequences for markets' structures. In the case of electricity, there were few sectoral issues, and tariffs were already being moved towards cost recovery, with rates for over 50 kWh doubling to above the long-run marginal cost calculated by Abdel-Khalek (2001). In the case of LPG, the existence of a black market in bottled gas was rightly picked up by the government as indicating that elimination of subsidies would be possible, and that de-bottlenecking projects would be worthwhile. Matters are more complicated when it comes to gas penetration in markets such as petrochemicals or fertilisers. The government needs to decide if it is promoting foreign investment, protecting customers, nurturing producers or pushing the industry to operate on a commercial basis.

Lastly, the government has also helped market creation indirectly through reforming financial and capital markets. These reforms have enabled gas companies to raise some capital through Egyptian stock exchanges, mainly by opening up ownership to domestic and foreign private

agents. Hence, Indian companies recently entered into distribution. Likewise, Egyptian banks have led the financing of the export pipeline to Jordan, and are involved in the latest petrochemical projects. Improving financial regulations has thus been indirectly helpful in meeting the capital costs of an expanding industry.

5. CONCLUSIONS AND OUTLOOK

In quantitative terms, the development of Egypt's domestic gas market over the last 20 years has been a success. It moved the country from a dependency on oil to using gas to meet almost half of its energy needs. The momentum has been sustained by explicit policies as well as favourable circumstances, which can be grouped under three general headings.

First, Egypt had the necessary reserves to sustain the demand being created, and demand creation was successfully linked to upward revisions in reserve availability. However, the same generous upstream terms that helped IOCs to deliver the gas turned into a costly oversight for the government: its revenues from the upstream have been well below the capital costs of new processing, transmission and distribution facilities. Secondly, as elsewhere in the world, gas demand has been driven by environmental concerns. These include domestic concerns about pollution, but also international commitments. These commitments brought with them international finance from OECD donors to assist clean energy generation, which, *interalia*, supported conversion to gas. The third factor that helped distribution in particular has been the government's reform program of the 1990s, which included measures in the energy sector. Although these concentrated on clearer bundling of functions along the gas chain, they also opened the way for the private sector to take over distribution and expand the nascent low-pressure network. New business and foreign investment regulations resulted in some foreign interest in the downstream, though the number of companies active in the segment remains small.

Egypt's success has largely been orchestrated by the government. GASCO, which is still in charge of transmission, has been the key body that systematically implemented plans to integrate and expand the national grid. As with other developing countries, this expansion initially targeted connections to power plants, which is why nowadays, gas penetration in power generation is almost complete. Supplying industry has been the second priority of demand creation. Although this sector is now the second largest consumer of gas, it is difficult to ascertain the percentage share of industries using gas. However, gas is clearly more important for heavy and large industries than for smaller plants and factories. Supplying household gas has also been a success, with the number of households connected having more than tripled in about 10 years. Private LDCs were key to delivering this success. Sustained and scaled efforts are required to expand the overall reach, which is about only 18 per cent of households. Lastly, Egypt's experience in introducing CNG has been a success in international terms: about 50 stations are currently

operational. However, conversion is limited to Cairo's taxis and a good part of its municipal bus fleet. Further progress may be slowed by a limited ability to manufacture conversion kits locally.

On the whole, Egypt can be said to have acquired a fairly developed gas chain from well-head to delivery point. Yet, this chain is far from constituting a dynamic market. Once the gas leaves the well-head, it is priced at levels determined by ministers, with successive decisions merely moving levels to partial cost recovery. With all energy prices being subsidised, one can only talk about relative price movements. In the case of household gas and CNG, there was some demand creation due to differentials between bottled gas and gasoline prices. Isolating a similar effect in other markets is more difficult, given the multiplicity of government interventions. However, it can be argued that 'the dash for gas in power generation' has been mutually beneficial, because despite rising input prices, the power sector received an enormous boost in efficiency and capacity.

Thus, for all practical purposes, the Egyptian domestic gas market has only just been created, and its basic building blocks have been financed from government coffers. In doing so, the government has saved on costly fuel imports, but not without substantive sunk capital costs. These costs have still not been fully amortised, featuring as outstanding debts to the public bodies that delivered the new pipelines and facilities. Current government policy has shifted towards trying to recover some of the costs of new connections, and has engaged the private sector to finance the onoing construction of low pressure distribution systems. The reluctance of customers to pay for connections indicates that earlier attempts at full-cost recovery would probably have slowed down demand creation.

With the private sector engaged in long-term franchise agreements for gas delivery in the marketing end, the Egyptian gas chain can be said at best to be an emerging market. Prices are still centrally controlled, fuel delivery is still a bundled service, and private participation concentrated in a few private companies. Having only just allowed them into the gas chain, the government has neither defined competition rules, nor installed a regulator. According to Soliman (2005), preliminary work on these issues has just begun. This incomplete, controlled and evolving domestic market is destined to move towards open structures because of Egyptian commitments to the European Union to create free markets in all sectors. Thus, it is only now that Egypt can begin to address the questions usually asked of other markets, namely when and how it can liberalise, and for whose benefit.

REFERENCES

Abdel-Khalek, G., *Stabilization and Adjustment in Egypt: Reform or De-industrialization*, Edward Elgar, Cheltenham and Northampton, MA, 2001.

Abubakr, K., 'Development and future of natural gas in Egypt', British-Egyptian Business Association, *Future Opportunities for UK/Egypt Collaboration: roundtable discussion on oil, gas and petrochemicals*, Cairo, 26 April 2005, http://www.beba.org.eg/Resources/pps/Presentation-KhaledAbubakr.pps (July 2005).

Al-Ahram Al-Iqtisadi, Cairo, http://ik.ahram.org.eg (in Arabic)

'Price support fund for gas sales to industry and electricity', 24/5/2004, http://ik.ahram.org.eg/IK/Ahram/2004/5/24/BANO5.HTM.

- 'A road map for the private sector in petroleum', 23/5/2005, http://ik.ahram.org.eg/IK/Ahram/2005/5/23/INVE2.HTM
- 'Fertlizers in a circle of crises', 27/6/2005, http://ik.ahram.org.eg/IK/Ahram/2005/6/27/INVE2.HTM.

Al-Ahram Weekly, Cairo, http://weekly.ahram.org/eg (accessed January-August 2005):

- 'Upbeat about oil', Issue 420, 11-17 March 1999.
- 'Energising the south', Issue 440, 4-11 August 1999.
- 'Mega-projects under scrutiny', Issue 459, 5-15 December 1999.
- 'Red menace, farewell', Issue 478, 20-6 April 2000.
- 'Good to the last drop', Issue 515, 4-10 January 2001.
- 'The year's hot potato', Issue 567, 3-9 January 2002.
- 'Where has all the money gone?', Issue 572, 7-13 February 2002.
- 'Ebeid's balance sheet', Issue 582, 18-24 April 2002.
- 'Cleaning up the banks', Issue 607, 10-16 October 2002.
- 'Fuelling the future', Issue 639, 22-8 May 2003.
- 'A natural way to unite', Issue 649, 31 July-6 August 2003
- 'S&P downgrades Egypt's credit rating', Issue 653, 28 August-3 September 2003.
- 'Bright prospects for gas', Issue 658, 2-8 October 2003.
- 'Tight rope act', Issue 702, 5-11 August 2004.
- 'How sweet is it?', Issue 725, 13-19 January 2005.
- 'Afloat on natural gas', Issue 726, 20-6 January 2005.
- 'The natural choice', Issue 741, 5-11 May 2005.

American Chamber of Commerce in Egypt, Zeal to export fertilizer brings domestic shortage', *Business Monthly*, Cairo, June 2003.

American Chamber of Commerce in Egypt, *The Petroleum Industry in Egypt: Investment and Prospects*, Cairo, December 2003.

American Chamber of Commerce in Egypt, 'New balance of power', *Business Monthly*, Cairo, June 2004.

Arab Oil and Gas Directory 1995.

Arab Petroleum Research Centre, 'Egypt', *Arab Oil and Gas Directory*, Paris: 1995, 1998, and 2001.

Arab Republic of Egypt, 'Country Paper', in Sixth Arab Energy Conference, Damascus, Syria, May 1998, pp. 417-95.
Arab Republic of Egypt, 'Country Paper', in Seventh Arab Energy Conference, Cairo, Egypt, May 2002.

Arab Republic of Egypt, *Annual Yearbook 1996*, http://www.sis.gov.eg/public/yearbook/YEARBOOK/CH11SC07.HTM
Arab Republic of Egypt, *Annual Yearbook 1998*, http://www.sis.gov.eg/public/yearbook98/html/front.htm
Arab Republic of Egypt, *Annual Yearbook 1999*, http://www.sis.gov.eg/public/yearbook99/html/front.htm

The Banker, 'Rebuilding confidence', 2 August 2004, http://www.thebanker.com/news/printpage.php/aid/1882/Rebuilding_confidence.html

British Petroleum, *BP Statistical Review of World Energy 2005*, London, June 2005.

British Gas, 'BG to develop gas market in Upper Egypt', Press Release, 20 April 1998, http://www. bg-group.com/media/archive_1998/pr-045.html, accessed June 2005.

Brito, D., and J. Rosellon, 'Price regulation in vertically integrated nat gas industry: the case of Mexico', *Review of Network Economics*, Vol.4, Issue 1– March 2005, pp.75-88.

Business Today Egypt 'Egypt, Ancient and New', Special Advertising Section, Cairo, June 2002, http://www.businessweek.com/adsections/2002/country/egypt.htm

Cairo and Alexandria Stock Exchange, 'Main indicators', http://www.egyptse.com/Main_Market_Indicators_a.asp, accessed 3/3/2005.

Canadian International Development Agency's Egypt Program, 'Climate change initiative: project overview', http://www.egyptpsu.com/projects Bank .html, accessed 8/6/2005.

Central Bank of Egypt, *Annual Report*, 2002/2003 (English), http://www.cbe.org.eg/publications

Central Bank of Egypt, *Annual Report*, 2003/2004 (Arabic), http://www.cbe.org.eg/publications

Central of Egypt, *Economic Review*, No. 2, Vol. 44, 2003/2004, http://www.cbe.org.eg/publications

Clean Development Mechanism Egypt, *Egypt National Strategy Study on the Clean Development Mechanism*, www.cdmegypt.org/NSS.htm, last updated 12 March 2005.

Economic and Social Commission for Western Asia (ESCWA), 'Chapter 7: energy', *Statistical Abstracts of the ESCWA Region*, 23rd Issue, United Nations, Beirut, 2004.

Economist Intelligence Unit, 'Egypt: collateral gas', *Business Middle East*, London, 16 October 2004.

Economist Intelligence Unit (EIU), Egypt*: Country Report*, London, August 2004.

'Egypt becomes potential LNG supply source for US market', *Egypt Watch Bulletin*, Cairo, 15 January 2005.

Egypt Gas Company, 'AGM Minutes Before Certification', 11 April 2005, Cairo, http://www.egyptse.com/downloads/egypt_gas11-4-05_english.pdf, accessed July 2005.

Egypt Gas Company, 'AGM & EGM Minutes After Certification', 10 May 2004, Cairo, http://www.egyptse.com/downloads/egypt_gas_after_certification_10-5-2004_english.pdf, accessed July 2005.

Egyptian Electricity Holding Company (EEHC), 'Statistics: installed capacity', http://www.egelec.com/arabic/DA-pres/energysale-en.htm, accessed July 2005.

EEHC, 'Sold electric energy for different from 2003-2004', http://www.egelec.com/arabic/DA-pres/energysale-en.htm, accessed July 2005.

EEHC, 'Electricity in the year 2003-2004', *Annual Report 2004*, http://www.egelec.com/english/annualreport2004/8-9.htm, accessed July 2005.

Egyptian General Petroleum Company (EGPC), 'The Egyptian gas industry', *Oil and Arab Co-operation*, Vol. 24, Issue 87, 1998, pp. 29-75.

Egyptian Electricity Utility & Consumer Protection Regulatory Agency, "Bills and Tariffs", www.egyptera.com/en/Bill_Tariffs.htm, accessed August 2005.

Egyptian International Gas Technology Company (GASTECH), 'AGM minutes (before certification)', Cairo, 26/04/2005, http://www.egyptse.com/downloads/egyptian_international_gas26-4-05_english.pdf

Egyptian LNG, 'About Us', http://www.egyptianlng.com, accessed February 2005.

Egyptian Natural Gas Holding Company (EGAS), 'Expanding local energy markets utilizing gas', http://www.egas.com.eg/docs/major_expanding.htm, accessed February 2005.

EGAS, 'Financial close of the first train of The Egyptian LNG project', May 2004, http://www.egas.com.eg/docs/selectednews15.asp (accessed February 2005).

'The Egyptian petroleum sector', Egyptian government, http://www.emp.gov.eg/ENGLISH/eps.html accessed February 2005.

Elmassry, I., 'CDM/Energy efficiency projects Egypt', CDM Investment Forum, Djerba, Tunisia, September 2004.

El Ridi, Y., 'Analysis of CNG development & marketing in Egypt', *International Association of Natural Gas Vehicles Association Annual Conference*, Buenos Aires, October 2004, http://www.iangv.org/default.php?PageID=226, accessed May 2005.

Energy Information Administration (EIA), 'Egypt', Country Analysis Briefs, February 2004, http://www.eia.doe.gov/emeu/cabs/egypt.html

Esnault, B., 'Les enjeux des réformes institutionnelles dans le secteur du gaz en Méditerranée', *Colloque 'Les enjeux de la restructuration des marchés gaziers dans les pays voisins de l'Union européenne'*, Université Paris Dauphine, Paris, 16 June 2004.

European Investment Bank (EIB), 'Signing of a USD250 mio loan for a public-private partnership energy project in Egypt', Press release, 16/12/2004**,** http://www.eib.org/news/press/press.asp?press=2886.

EIB, 'FEMIP lends Eur160 million for clean energy', Press release, 17/12/2004**,** http://www.eib.org/news/press/press.asp?press=2889.

Euro-Med Partnership, *Egypt: Country Strategy Paper 2002-2006 & National Indicative Programme 2002-2004*, European Commission, Brussels, 2003.

European Commission, *Economic Review of EU Mediterranean Partners*, Occasional Paper No. 6, Directorate General for Economy and Financial Affairs, Brussels, March 2004.

Gavin, J., 'LNG financing – banks pile in", *Petroleum Economist*, November 2004, pp. 19-20.

Gaz de France, 'Port Said and Gulf of Suez power plants: applying the principles of sustainable development', Sheet No.15, Second Earth Summit, Johannesburg, 24 August-2 August 2002.

GENCO-Group, 'Founder', 'Structure', 'Board of Directors', http://www.genco-group.com/index.html, accessed June and July 2005.

Hantar, G., 'Current practices and future trends in the NGV sector: The experience in Egypt', presentation by the managing director of Shell CNG Egypt, Second Asia Gas Buyers Summit, Federation of Indian Chambers of Commerce and Industry, 2-3 February, 2004, Mumbai, http://www.ficci.com/ficci/media-room/ speeches-presentations/2004/feb/feb3-gassar-hunter_2.ppt, accessed August 2005.

Hayes, M.H. and D.G. Victor, 'Politics, markets and the shift to gas: insights from seven historical case studies', Working Paper #35, Program on Energy and Sustainable Development, Stanford University, February 2005, http://pesd.stanford.edu

Information and Decision Support Center (IDSC), *The Fertilizers Market in Egypt:Crisis and Policies for Solution* (in Arabic), November 2003, http://idsc.gov.eg/uploads/docs/2/Petroleumproducts.pdf, accessed July 2005.

IDSC, *Report about Petrolium Products* (sic), March 2005, http://idsc.gov.eg/uploads/docs/2/Petroleumproducts.pdf, accessed May 2005 (in Arabic).
IDSC, *Poll on Measure Hotels Conscious about Solar* (sic), July 2005, http://idsc.gov.eg/uploads/docs/4/hotelFeedbacks.pdf, accessed August 2005 (in Arabic).
IDSC, 'Value of government subsidies to petroleum products', http://www.idsc.gov.eg/MainIssues/issues_indicator_detail_xml.asp?MainIssue_id=3&issue...
IDSC, 'Value of imports of crude petroleum and petroleum products, 1991-2004", http://www.idsc.gov.eg/English/NDSsearch/NDsResrult_Details.asp?IndicatorID=4618, accessed July 2005.
IMF, 'IMF concludes 2004 Article IV consultation with the Arab Republic of Egypt', Public Information Notice (PIN) No. 04/69, Washington DC, July 2004.

International Petroleum Encyclopaedia, 'Egypt', 2003 and 2004.

Invest in Egypt 2004.

Korkor, A., and El-Behairy, S., 'Natural gas role in protecting the environment and attaining energy efficiency in Egypt', *GASTECH* Conference, Paris, 2005.

Kraus, J., 'Fired up', *Business Today Egypt*, Cairo, June 2004, http://www.businesstodayegypt.com/article.aspx?ArticleID=1504, accessed May 2005.

MEDA, *Regional Energy Project under the Framework of the MEDA Regulation: Reform of the Legal & Institutional Energy Sector Framework*, SCR-E/110424/C/SVMP, Report on the final seminar in Salzburg, 15-17 February 2005, March 2005.

Middle East Economic Survey (MEES), Nicosia, http://www.mees.com:

- 'France's Thermodyn to Supply Compressors for Trans-Gulf Gas Project', 5/10/1992, No.1 Vol. XXXVI.
- 'Prospects for Gas Supply/Demand in Egypt', 30/8/1993, No. 48, Vol. XXXVI.
- 'Egypt plans to offer greater incentives for gas exploration', 10/12/1994, No. 9, Vol. XXXVIII.
- 'Egypt plans massive investments over next five years', 26/12/1994-2 /1/1995, Nos. 13/14, Vol. XXXVIII.
- 'Egypt to embark on construction of trans-Sinai gas line", 10/8/1998, No. 32, Vol. XLI.
- 'Gasco expanding Egypt's gas grid', 28/6/1999, No. 26, Vol. XLII.
- 'EIB advances $153mn euro loan to Egypt', 27/9/1999, No. 39, Vol. XLII.
- 'EGPC agrees with IOCs to change gas price formula', 25/9/2000, No. 39, Vol. XLIII.
- 'Egypt's GASCO secures $104Mn loan from APICORP-led consortium for NGL project', 10/12/2001, No. 50, Vol.XLIV.
- 'Egypt fast tracks gas development as export schemes move ahead', 24/12/2001, No. 52, Vol. XLIV.
- 'Egypt Moves Ahead On Phase One Of Petrochemicals Master Plan', 3/02/2003, No. 5, Vol. XLVI.
- 'Egypt publishes details of KFAED loan for nubariya power plant", 9/03/2004, No. 9, Vol. XLVII.
- 'Tharwa Petroleum/Sinopec form drilling company', 30/8/2004, No. 35, Vol. XLVII.
- 'Egypt: budgets and revenues", 30/8/2004, No. 35, Vol. XLVII.
- 'NBE seeks to sell its 38% Midor refinery stake', 15/11/2004, No. 46, Vol. XLVII.
- 'Banks short-listed for EGPC debt securities placement', 13/12/2004, No.48, Vol. XLVII.
- 'Egyptian government plans to remedy poor FDI record", 13/12/2004, No. 48, Vol. XLVII.

- ‘ELNG Train 2 financing to follow completion of Train 1 general syndication’, 19/1/2005, No. 3,
- Vol.XLVII.
- ‘Egyptian Natural Gas Company gets €50mn loan from EIB for pipelines’, 18/7/2005, No. 29, Vol. XLVIII.

Ministry of Finance, ‘Value of government subsidies to petroleum products’, Cairo, Egypt, 2003-2004, http://www.idsc.gov.eg/English/NDSSearch/NdsResult_Details.asp?IndicatorID=3678

Ministry of Foreign Trade and Industry, *Investing in Egypt 2004*, Cairo, http://www.economy.gov.eg/English/Periodical_Reports/Investing/Investing.stm, accessed June 2005.

Ministry of Foreign Trade and Industry, *Quarterly Economic Digest October-December 2004*, Volume X, No. 4, http://www.mfti.gov.eg/english/Downloads/Tocdownload.stm, accessed August 2005.

Ministry of Foreign Trade and Industry, *Monthly Economic Digest-July 2005*, http://www.mfti.gov.eg/english/Downloads/Tocdownload.stm, accessed August 2005.

Ministry of Petroleum, ‘List of all Ministerial decrees setting gas price’, ‘Natural gas grid lines length in Egypt’, ‘Natural Gas Domestic Demand by Sectors’, EXCEL data sheets, provided to the Oxford Institute for Energy Studies, September 2005.

Mobarak, A., ‘The challenges of sustainable industrial development in Egypt’, Industry and Energy Committee, Egyptian People’s Assembly, Cairo, October 2001, www.unido.org/userfiles/ timminsk/RIO10-IND-egypt-eng.pdf, accessed June 2005.

Newendorp, T., ‘Middle East and Africa LNG activity’, Presentation, Infrastructure Journal LNG Conference, Versailles, June 2004.

Organisation of Arab Petroleum Exporting Countries (OAPEC), *Annual Statistical Bulletin*, Vienna: 1997, 2002, 2004.

OAPEC Technical Affairs Dept, ‘Energy conservation and environmental protection in the petroleum industry–OAPEC Seminar, Cairo, June 2004’, *Oil and Arab Co-operation*, Vol. 30, Issue 111, 2004, pp. 116-44.

Observatoire Méditerranéen de l’Energie (OME), *The Institutional Framework of Electricity and Natural Gas Industries in Southern and Eastern Mediterranean Countries*, Preliminary report, Sophia Antipolis, France, April 2004.

OME, ‘The impact of EU’s institutional policy actions on the Southern & Eastern Mediterranean Countries’ investment climate’, *OME Newsletter*, No. 27, April 2005.

Petrojet, ‘Profile’, http://www.petrojet.com.eg/en/profile/history.htm, accessed May 2005.

Petrojet, ‘Projects’, http://www.petrojet.com.eg/en/projects/pipes/menu.htm, accessed May 2005.

Petrojet, ‘United Gas Derivatives – NGL Process Facilities’, http://www.petrojet.com.eg/en/projects/processplants/menu.htm, accessed May 2005.

Shaw, P., ‘Pipeline mapping in GASCO’, presentation at Glasgow University, 22/10/2002, www.geovision.co.uk/Presentations-and-Papers/GU-lecture-Oct02.htm.

Shell, ‘EGAS and Shell agree Phase II for Fayum Gas’, *Shell in the Middle East*, July 2005, http://www.shell-me.com/english/jul05/news-me2.htm.

Soliman, H., ‘Egyptian natural gas industry development.’ Presentation by the Egyptian Natural Gas Company (EGAS) Seminar on Reform of the Legal and Institutional Energy Sector Framework, EU-MEDA program, Salzburg, 16 February 2005.

UNCTAD, 'Country fact sheet: Egypt', *World Investment Report 2004,* http://www.unctad.org/fdistatistics.

USAID, 'Overview', http://www.usaid-eg.org/detail.asp?id=5, accessed June 2005.

US-Egypt Business Council, 'Overview of US Investment in Egypt', http://www.us-egypt.org/inve.html

Verbeek, H., 'Utilization of gases for domestic, commercial and transportation", Japan Working Committee 6, Tokyo, 22nd World Gas Conference, June 2003, http://www.nigc.org/TLF_Man/Gas2003/pdf/woc_r_6_6.pdf , accessed May 2005.

World Bank, 'Arab Republic of Egypt: El-Dikheila reinforcing bar project', Operations Evaluation Department, Washington DC, 1996, http://lnweb18.worldbank.org/oed/oeddoclib.nsf/ DocUNIDViewForJavaSearch/C38FE…., accessed May 2005.

World Energy Council, 'Chapter 4: Downstream Gas', *Benefits and Deficiencies of Energy Sector Liberalisation, Volume II*, London 1998, http://www.worldenergy.org/wec-geis/publications/reports/current_cls/ClsDGAS.asp, accessed May 2005.