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EGYPT: A MARKET FOR NATURAL GAS FROM CYPRUS AND ISRAEL?

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Egypt: A Market for Natural Gas from Cyprus and Israel?

Foreign and Security Policy Paper Series

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Nikos Tsafos[1]

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Preface

In the latest series of GMF's policy papers on Eastern Mediterranean Energy, Nikos Tsafos has written a path-breaking analysis of the opportunities and risks associated with the possible export of gas from the offshore fields of Israel and Cyprus to Egypt. He shows that there will be significant shortfalls in gas supplies to the Egyptian market during the decade ahead, despite major new discoveries — such as the 30 tcf Zohr discovery announced by ENI in August 2015 — the reduction of subsidies, and major efforts to improve energy efficiency.

ENI's announcement set off a wave of speculation that this might make future exports to Egypt from Israel and Cyprus untenable. It was even suggested that the Aphrodite field offshore Cyprus and the Leviathan field offshore Israel might not be developed at all for want of export markets. However Egyptian, Israeli, and Cypriot political leaders, as well as the companies directly concerned, have reaffirmed their commitment to future exports from these offshore fields to Egypt. Exploration offshore Cyprus, in areas close to the Zohr field, is continuing and there may be additional discoveries. To be sure, a number of political, regulatory, and financial hurdles remain to be overcome in order for the development of these fields to go ahead.

Egypt's increased production will be largely absorbed by the domestic market for the foreseeable future, given the country's surging energy use, population growth, increased consumer demand, and gradual economic recovery. Indeed imports will be required to satisfy domestic demand until the mid-2020s, according to Tsafos's analysis. Export of Egypt's own resources, while shortages persist at home, would be deeply unpopular in the country. The Egyptian government will be reluctant, therefore, to divert gas to the country's two under-used LNG plants, owned by Spanish, Italian, and British companies, until stable supplies to the domestic market are assured.

The commercial viability of gas imports from Israel and Cyprus to Egypt hinges on re-exports to markets in Asia and Europe as LNG rather than sales to Egyptian consumers. It is urgent, therefore, that Israel overcome its regulatory and political deadlock to permit the development of the Leviathan field and the expansion of the smaller Tamar field. Any further significant delays might close Israel's window of opportunity in light of the new sources of energy, and especially LNG, which are constantly coming on stream around the world, at a time of reduced international demand.

Provided such obstacles are overcome, future exports to Egypt will depend primarily on the bankability of the specific projects concerned. Egypt will need to play its part by improving the enforceability of contracts and the country's track record in paying creditors. It would be helpful if the European Investment Bank and the European Bank for Reconstruction and Development served as pump primers for the necessary private sector investments.

This paper will raise awareness and understanding of the challenges facing gas trade in the Eastern Mediterranean and thus contribute to the search for solutions that will benefit all the parties involved.

Sir Michael Leigh
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1 Egypt's Energy Challenge

Egypt is a hydrocarbon-rich but energy-poor country. Its oil and gas reserves place it 21st in the world and its gas reserves are greater than Norway's or Canada's.[1] Yet consumers in Egypt face chronic energy shortages, and an Egyptian uses less energy, on average, than a consumer in Iraq, Jordan, or Algeria.[2] In recent years, Egypt has changed from being an exporter of oil and gas into a net importer. Ensuring reliable, affordable, and sustainable energy is a major challenge for the Egyptian state.

The change in Egypt's energy position is most obvious when it comes to natural gas, which provides half of the country's total energy (Table 1, Appendix).[3] In July 2003, Egypt began to export gas to Jordan by pipeline and it soon thereafter started to export gas through two liquefied natural gas (LNG) facilities to various markets. In fiscal year (FY) 2007-08, Egypt earned $3.2 billion from gas exports; it sent gas to Israel and Syria and planned to export to Lebanon and Turkey; it had also become the world's eighth largest LNG exporter.[4]

Yet by 2015, Egypt no longer exported gas at all. Instead, in April 2015, Egypt took delivery of a vessel that would allow it to import LNG, and Egyptian officials estimated that the country could spend $2.5 to $3.5 billion for imported LNG in FY 2015-16.[5] At the same time, Egyptian companies were in talks to import gas from Israel and the government signed a memorandum of understanding (MOU) with Cyprus to import gas from the Aphrodite field.

These developments pose a number of questions that this policy brief will address:

- How did Egypt go from being a booming exporter in the mid-2000s to an importer a decade later?
- How did a $3.2 billion surplus on trade in natural gas turn into a $3.5 billion deficit?
- What role did reserves, production, demand, prices, and subsidies play in the turnaround?
- How will Egypt's gas supply and demand balance evolve?
- Does Egypt face a supply gap in the future?
- If so, how wide is the gap and for what period is it likely to last, especially after ENI announced in August 2015 that it had discovered a very large offshore gas field, known as Zohr, in Egypt?
- Can imports from Israel and Cyprus fill this gap and are these imports viable technically and commercially?

Egypt is a hydrocarbon-rich but energy-poor country. Its oil and gas reserves place it 21st in the world and its gas reserves are greater than Norway's or Canada's. Yet consumers in Egypt face chronic energy shortages.

[1] Reserves were 17.3 billion barrels of oil equivalent in 2014, of which 75% was gas (Gas converted to barrel of oil equivalent using a conversion of 6,000 cubic feet to one barrel). Energy Information Administration, International Energy Statistics, Petroleum and Natural Gas Reserves for 2014.

[2] International Energy Agency (IEA), Statistics Search, http://www.iea.org.

[3] Ibid.

[4] In fiscal year 2007-08 (fiscal year is from July to June). Egypt, Ministry of Finance, http://www.mof.gov.eg/english/Pages/Home.aspx

[5] "EGPC Put In Charge of Future LNG Imports," *Daily News Egypt*, Tuesday, March 31, 2015; "Egypt to import $3.55 bln worth of LNG in 2015-2016," *Reuters*, April 14, 2015.

2 Egypt's Supply and Demand Outlook

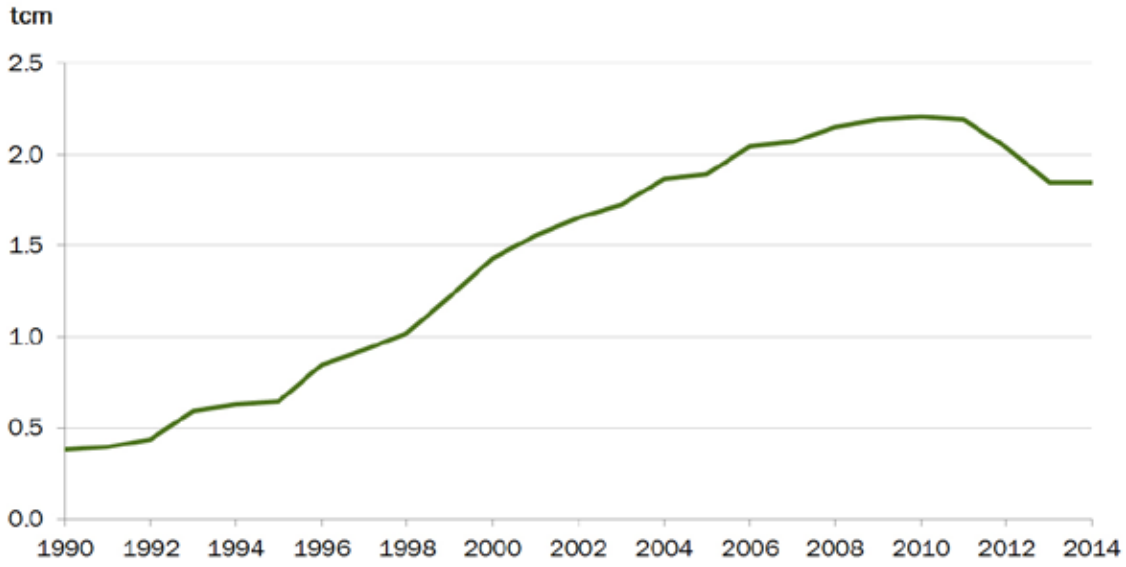
Egypt is gas-rich and its reserves have grown steadily over time — until recently (Figure 1). From 1995 to 2010, proven reserves more than tripled from 22.8 trillion cubic feet (tcf) to 78 tcf; but since 2010, remaining proven reserves have declined by 17%. For years, Egypt had not found enough new gas to replace the gas it produces, although the recently announced Zohr discovery reverses this trend by adding up to 30 tcf (850 billion cubic meters) to Egypt's reserves. The country's supply and demand balance has followed a similar path. Demand reached a turning point in 1999 and rose by 10% a year through 2012. It then registered a drop in 2012-14, mostly due to lack of supply. On the supply side, production rose by 11% between 1999 and 2012; however, domestic production peaked in 2010, and it has since declined sharply.

What explains these trends? On the demand side, there has been an overall growth in energy use, driven by population growth, rising living standards, and cheap energy. Between 2000 and 2012, overall energy consumption rose by 5.6% per year, but gas demand grew by 8.7% (see Table 1). Gas gained market share, providing 50% of the country's total energy in 2012 compared with 35% in 2000. Gas use is spread across many sectors: 55-60% goes into power generation and the remainder is split among industry, residential and commercial use, energy industry own use (upstream operations and LNG facilities), and non-energy use (gas used as feed-stock in petrochemicals).[6]

On the supply side, production rose in the mid 2000s when a series of new fields came on stream to supply the country's export projects. Yet production peaked in 2010, as noted above, and has since declined. Since the early 2000s, the authorities have capped the price at which the Egyptian

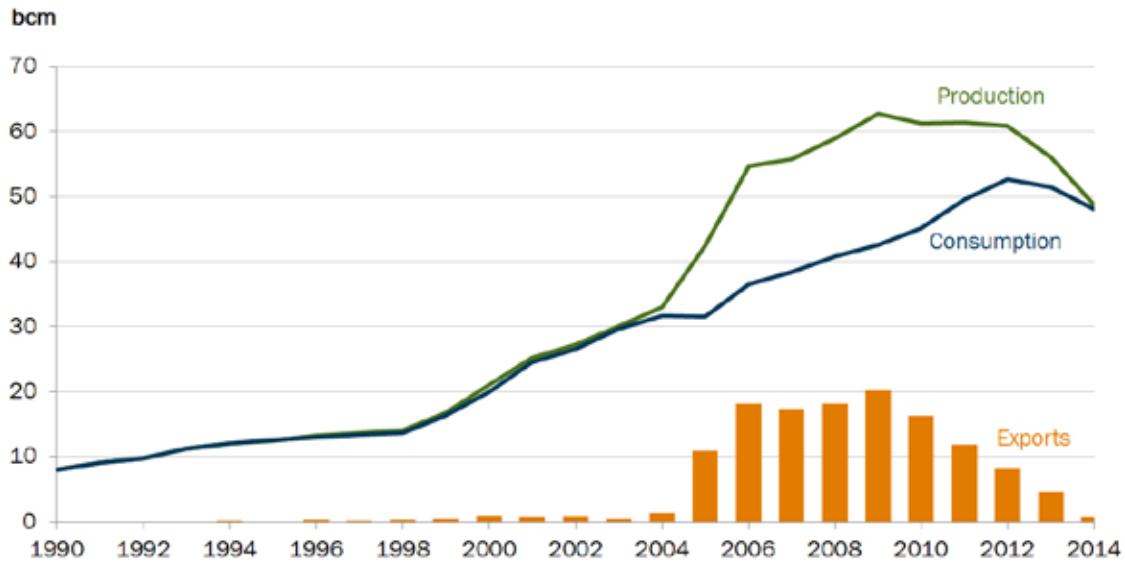
[6] All data from International Energy Agency (IEA), Statistics Search, http://www.iea.org.

Figure 1: Egypt's Proven Natural Gas Reserves



Source: BP Statistical Review of World Energy, June 2015, www.bp.com.

Figure 2: Egypt's Gas Supply and Demand Balance



Source: BP Statistical Review of World Energy, June 2015, www.bp.com.

General Petroleum Corporation (EGPC) buys gas from foreign operators at $2.65/Million British Thermal Units (MMBtu). This cap has discouraged investment, especially given higher gas prices elsewhere in the world and rising costs.

How will Egypt's supply and demand for gas evolve over the next decade? The demand for gas will depend on the overall demand for energy and on the share of gas in the energy mix.

These are several of the factors that will affect the demand for energy in Egypt:

- Population is set to increase from 84.7 million in 2015 to 97 million by 2025.[7]
- Energy demand is growing faster than real GDP; per capita energy use is still 27% lower than the average outside the OECD. This indicates that the market has considerable scope to mature.[8]
- Vehicle penetration in Egypt is under 100 vehicles per 1,000 people, far below other countries in the region.[9]

In the future, energy demand might grow at a slower pace as the market matures, but it will still grow at a robust rate, probably in line with GDP (the International Monetary Fund forecasts annual growth in GDP at 4.6% in the period 2015-20).[10]

The share of gas in the energy mix is an even more important factor. Until now, gas has increased its market share by displacing oil. But Egypt wants

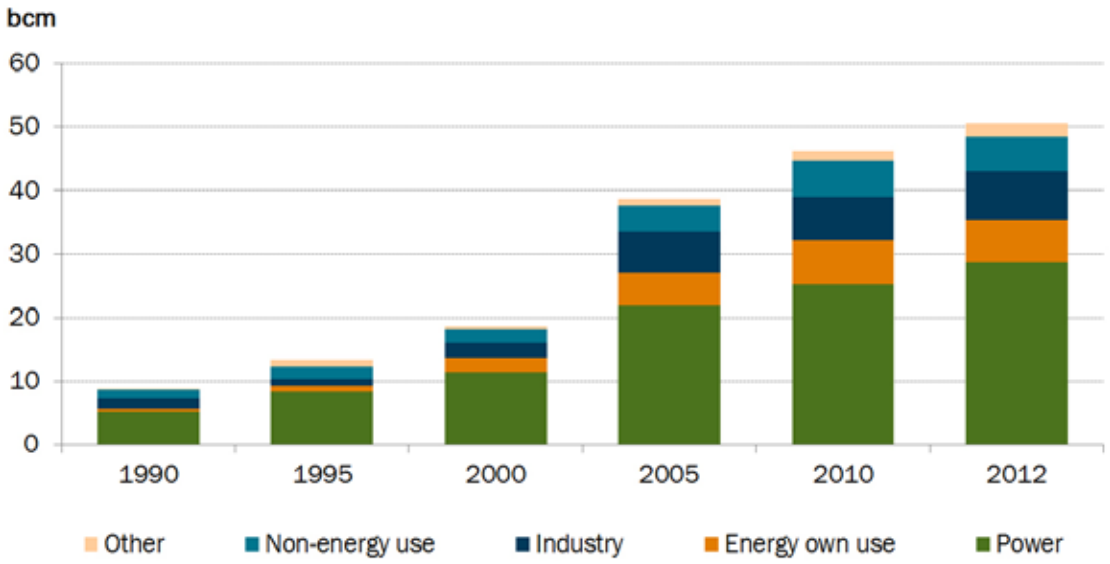
[7] Unite Nations, Population Prospects: 2012 Revision, http://esa.un.org/wpp/.

[8] International Energy Agency (IEA), Statistics Search, http://www.iea.org.

[9] Israel's vehicle penetration is 330 per 1,000 people; in Jordan, it is 177. *World Development Indicators*, Motor vehicles (per 1,000 people), http://data.worldbank.org/indicator.

[10] International Monetary Fund, World Economic Outlook Database, April 2015 update, http://www.imf.org.

Figure 3: Egypt's Gas Demand by Sector



Source: International Energy Agency. Statistics Search, http://www.iea.org

to develop alternatives to fossil fuels. In 2008, the government set a target of generating 20% of its electricity in 2020 from renewables: 12% from wind, 6% from hydro, and 2% from solar.[11] It has also explored options for building 6 GW of coal-fired power generation and has even investigated the prospects for nuclear energy.[12]

Yet it is hard to see the role of gas in power generation shrinking significantly in the next seven to ten years. In 2013-14, hydro generated 8% of the country's electricity, but wind and solar accounted for less than 1% (0.8% and 0.1%, respectively).[13] Egypt has less than 1 GW of wind power installed, under construction, or under contract.[14] Egypt would need 7.2 GW to reach the 2020 target, which is unlikely given the challenges facing new projects.[15] In coal and nuclear, investments would only have an impact after 2020, assuming that all commercial, legal, and political obstacles were overcome.

Outside the power sector, gas will continue to displace other fuels. The Egyptian government has secured World Bank funding for a $1.5 billion project to connect 1.5 million households to

[11] Egyptian Electricity Holding Company, Annual Report (various years).

[12] "$9.6 Billion for Egyptian-Owned Coal Power Plant," *Egypt Independent*, March 18, 2015; "Egypt Inks New Nuclear Power Plant Deal With Russia," *Ahram Online*, February 11, 2015.

[13] Egypt, Ministry of Planning, Fourth Quarter 2013-14 Indicators, October 14, 2014, http://www.mop.gov.eg/.

[14] Global Wind Energy Council, Global Statistics, http://www.gwec.net/global-figures/graphs/; Ministry of Electricity & Renewable Energy, New & Renewable Energy Authority (NREA), Press Release (February 19, 2015); http://constructionreviewonline.com/2014/08/italgen-egypts-suez-cement-announces-e150-million-investment/.

[15] International Energy Agency, http://www.iea.org/policiesandmeasures/pams/egypt/name-24583-en.php; The World Bank has noted several challenges, including insufficient credit, poor coordination, and low institutional capacity. World Bank, Egypt - Wind Power Development Project (P113416), Implementation Status & Results Report, February 2, 2015.

natural gas, switching from liquefied petroleum gas (LPG) to gas.[16] By April 2015, there were 214,000 compressed natural gas (CNG) vehicles on Egyptian roads and the government wants this to increase.[17] In industry, there is a shift away from gas to coal and oil, due to a lack of gas.[18] As gas supply becomes available, demand will follow, especially in a country that still obtains 46% of its energy from oil products, which are increasingly being imported. Rising prices resulting from subsidy reform could curb demand but only partly. International experience shows that demand can still grow despite higher prices and that higher prices can actually boost demand if they also generate more supply. In short, gas demand will keep growing, provided there is sufficient supply.

Foreign companies see the supply question as largely a function of price: if Egypt offered higher prices, more production would ensue. The Egyptian government shares this view and has negotiated exceptions to the $2.65/MMBtu ceiling, offering prices from $3.95 to $5.88/MMBtu for new projects.[19] Such pricing has advanced some projects that were hitherto stalled, the most important of which is the BP-operated West Nile Delta project. This project will produce 1.2 billion cubic feet a day by 2019 and costs $12 billion to develop.[20] A few smaller fields have also been approved recently; they should produce 200-300 million cubic feet a day (mmcf/d), by 2018-19.

More importantly, higher prices within Egypt itself have encouraged additional exploration, leading to the discovery of the Zohr field by ENI in August 2015, which is estimated to hold 30 tcf of gas initially in place.[21] Depending on how the field is developed, it could reach a peak production volume of 2.9 bcf/d (for a 15-year plateau). Such volume will only be reached over time and with multiple development phases.[22]

Yet it is important to put this volume into context. In 2013 and 2014, Egypt's production fell by 500 mmcf/d and 700 mmcf/d, respectively, and ministry officials forecast the annual decline at 15% to 25% (the former seems more plausible) in the years ahead.[23] Wood Mackenzie estimates that fields that are currently onstream would only produce around 1.8 bcf/d by 2022 (compared to 4.7 bcf/d in 2014), thus creating a 3 bcf/d gap between 2014 and 2022.[24]

In part, this decline is due to geology. Egypt relies heavily on deepwater fields, which decline faster than other fields. In part, too, it is due to companies holding back investment in response to

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[16] World Bank, EG: Household Natural Gas Connection Project (P146007), Integrated Safeguards Data Sheet Appraisal Stage, July 30, 2014.

[17] Menna Samir, "SFD allocates EGP 10m to convert 2,000 cars to natural gas," May 31, 2015.

[18] In April 2014, Egypt approved the import of coal by private companies, while the Egyptian Natural Gas Holding Company (EGAS) started in 2015 to supply fuel oil to cement factories rather than gas. Mohamed Adel, "Gas supplies to cement plants permanently stopped, fuel oil sent instead," *EGAS*, January 11, 2015, http://www.dailynewsegypt.com/.

[19] "Egypt Rethinks Pricing," *World Gas Intelligence*, May 21, 2014, 2014.

[20] BP, Form 10-K, 2010. Various reports put the price at $4.10/MMBtu. The changes in "governance structure" were reportedly a switch from a Production Sharing Contract to a tax and royalty system. BP, "BP Finalises Deal to Develop Egypt's West Nile Delta Gas Fields," Press Release, March 6, 2015.

[21] "Eni discovers a supergiant gas field in the Egyptian offshore, the largest ever found in the Mediterranean Sea," ENI Press Release, August 30, 2015, http://www.eni.com/en_IT/media/press-releases/2015/08/Eni_discovers_supergiant_gas_field_in_Egyptian_offshore_the_largest_ever_found_in_Mediterranean_Sea.shtml.

[22] Nikos Tsafos, "Egyptian Gas after Zohr," LinkedIn Pulse, September 7, 2015, https://www.linkedin.com/pulse/egyptian-gas-after-zohr-nikos-tsafos.

[23] "Egypt's Gas Production Will Not Increase in FY 2015/2016," The Daily News Egypt, February 9, 2015; "EGAS to link 16 gas production wells during FY 2014/2015," *The Daily News Egypt*, December 16, 2014.

[24] Wood Mackenzie, "Eni's giant discovery to transform Egypt's gas outlook," September 1, 2015, http://www.woodmac.com/public/views/eni-egypt-zohr-discovery.

non-payment of bills by the Egyptian authorities.[25] Given the natural decline, therefore, Egypt would need to develop an additional 3 bcf/d by 2022 merely to hold production at the 2014 levels, and it would need 4.2 bcf/d to restore production to its 2012 level. In other words, with Zohr producing at 2.9 bcf/d and the West Nile Delta producing at 1.2 bcf/d, Egypt would merely return, by 2022, to where it was in 2012. This is based on the assumption that Zohr is developed in a timely fashion and avoids the delays that have affected the West Nile Delta project.

The Egyptian authorities themselves see a growing supply-demand imbalance, although they have been more optimistic after the discovery of Zohr. In February 2015, "Egypt's Petroleum Ministry [expected] the country's natural gas production to drop by 3.6% to 4.85 bcf/d in FY 2017-18 from 5.03 bcf/day in FY 2014-15, while demand is expected to rise by 24% from 5.98 bcf/d to 7.42 bcf/d over the same period."[26] This implied a 2.5 bcf/d shortfall by FY 2017-18 to be met by imports or demand reduction (curtailing production at factories or shifting to competing fuels).

It is no wonder, then, that Egypt has seriously examined pipelines and started LNG imports: demand will keep rising due to economic growth and continued penetration of gas in the energy mix. But domestic production is unlikely to increase sufficiently to return the country to self-sufficiency before 2020. Before the Zohr discovery, Egypt's Minister of Petroleum had stated that imports would cease by 2020, probably a best-case scenario, although feasible in principle after Zohr.[27] Imports will play a central role in the gas balance at least until 2020 and possibly through 2025, depending on how quickly Zohr is developed and how much demand keeps growing.

[25] Mohamed Adel, "Petroleum companies operating in Egypt have reduced gas production: Ministry report," July 13, 2014.

[26] "Egypt's Natural Gas Production to Drop by 3.6% in 2017/2018," *Egypt Independent*, February 2, 2015.

[27] "Egypt to Halt LNG Imports by 2020: Sherif Ismail," Reuters, February 25, 2015.

3 What Role Will Imports Play in Egypt's Market?

Egypt could import gas via pipeline from Cyprus, Israel, or both, or it could import gas via LNG, as it started doing in April 2015. So far, the country has made more progress on LNG than on pipeline imports.

In 2014, Egypt leased a Floating Storage and Regasification Unit (FSRU) for a five-year period at a cost of $60 million a year.[28] FSRUs are attractive for new importers because they require limited upfront investment and can be brought online quickly. Moreover, if LNG imports are no longer necessary, the FSRU vessel can move to a new market. FSRUs are ideal for countries that need imports for only a limited period. The FSRU arrived in Egypt in April 2015, and in May 2015, Egypt launched a tender for a second FSRU, which arrived on September 30 2015.[29] Their combined import capacity will exceed 1 bcf/d.

There have been a number of preliminary agreements to connect the gas discoveries in Israel and Cyprus with Egypt by pipeline. At first, the idea was to pipe gas to Egypt and export it as LNG using Egypt's underutilized infrastructure. Plans to use Israeli and Cypriot gas to supply the domestic market arose only when Egypt's own gas production continued to fall. Now Egypt is considering imports both for re-export as LNG and for its own use. In 2014, the companies that hold the licenses to the largest discoveries in the Eastern Mediterranean signed three non-binding letters of intent to sell gas to Egypt:

- **Union Fenosa Gas (May 5, 2014):** 440 million cubic feet a day (mmcf/d) for a 15-year period from the Tamar field in Israel to Union Fenosa's LNG facility in Egypt for re-export. Prices would be linked to oil and be comparable to "other sales agreements."[30] There is no specified transfer point for the gas (where it changes ownership from buyer to seller).
- **BG Group (June 30, 2014):** 700 mmcf/d for a 15-year period from the Leviathan field in Israel to BG's LNG facility for re-export. The transfer point would be the Leviathan field, and BG Group, or another company, would build the pipeline. No reference to price.[31]
- **Dolphinus Holdings (October 17, 2014):** Up to 250 mmcf/d for a seven-year period from the Tamar field to the local Egyptian market, but without any firm annual commitments (only a cumulative commitment over a three-year period). Delek Group, which is a partner in both Tamar and Leviathan, provided these details: "The price of gas … is similar to the prices set in other agreements for the export of gas from Israel and is essentially based on linkage to the price of a barrel of Brent oil and includes a "floor price."" Moreover, "It is the parties' intention that the gas shall be transported via the IGL transport system to Ashkelon and from there to Egypt using the [existing East Mediterranean Gas] EMG Pipeline."[32]

Beyond these commercial negotiations, the governments of Egypt and Cyprus signed a

Meeting domestic demand, especially in the power sector, should be the top priority in government policy.

[28] "Höegh LNG - Signed FSRU contract with EGAS," November 3, 2014, Stock Exchange Release; "EGPC Put In Charge of Future LNG Imports," *Daily News Egypt*, Tuesday, March 31, 2015.

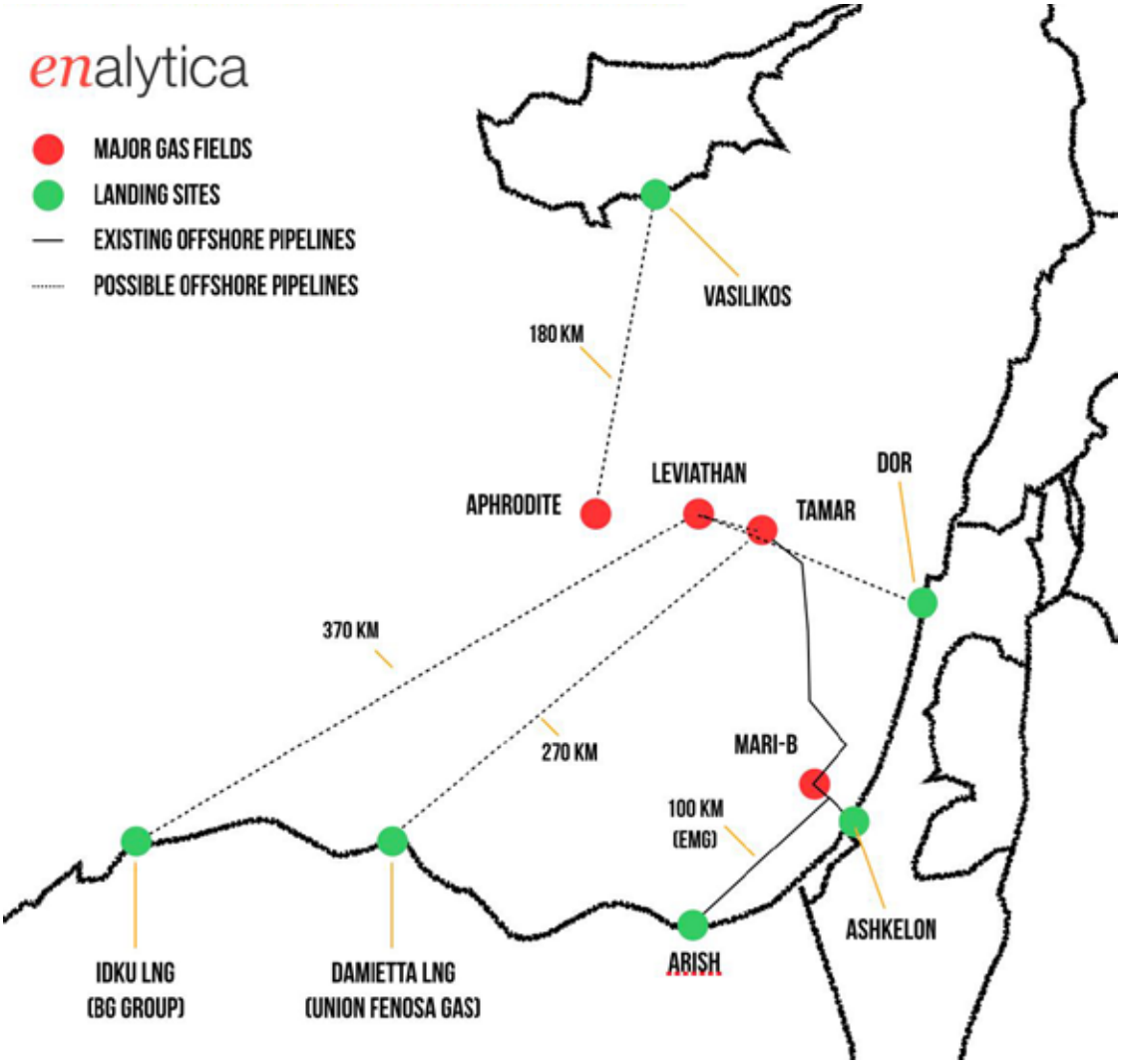
[29] "Egypt to Receive 2nd LNG Floating Terminal in August," Egypt Oil & Gas Web Portal, April 8, 2015; "Egypt Launches Tender for Second FSRU," May 4, 2015, http://www.lngworld-news.com/egypt-launches-tender-for-second-fsru/; "BW Gas floating LNG terminal arrives in Egypt -state gas board head," Reuters, September 30, 2015, http://af.reuters.com/article/commoditiesNews/idAFL5N1202T320150930.

[30] Noble Energy, "Noble Energy Announces Letter of Intent with Union Fenosa Gas for the Export of Tamar Natural Gas to Existing LNG Facility," Press Release, May 5, 2014, http://www.nobleenergyinc.com/.

[31] Noble Energy, "Noble Energy Announces Letter of Intent for Leviathan Export," Press Release, June 30, 2014, http://www.nobleenergyinc.com/.

[32] Delek Group, Letter of Intent for the Export of Natural Gas from the Tamar Project to Egypt, Press Release, October 19, 2014, http://www.delek-group.com/Default.aspx.

Figure 4: Select Gas Fields and Pipelines in the Eastern Mediterranean



Source: enalytica

Memorandum of Understanding in February 2015 to explore a potential partnership.[33] Meanwhile the licensees of the Aphrodite field offshore Cyprus issued a "declaration of commerciality" and submitted a development plan to the Cypriot government in June 2015. According to Delek Group, the plan entails production of 800 mmcf/d from Aphrodite at a cost of $3.5 to $4.5 billion (not including the pipeline to reach the end market) with the first gas coming on-stream in 2019-20.[34]

[33] Sharon Udasin, Cyprus, "Egypt sign MoU on gas export from Aphrodite reservoir," *Jerusalem Post*, February 16, 2015, http://www.jpost.com/Israel-News/Cyprus-Egypt-sign-MoU-on-gas-export-from-Aphrodite-reservoir-391234.

[34] Delek Group, "Annual Report 2014," pages A-120 and A-121; "Aphrodite plan probably a floating unit," *Cyprus Mail*, June 12, 2015.

Given the estimated size of the resource, Aphrodite could support such levels (800 mmcf/d) for 15 years, a similar period to that specified in the letters of intent for the supply of gas from Israel.[35]

These options have different strengths and weaknesses. Gas imported into Egypt would probably be more expensive than domestic production, if the new prices that Egypt is offering ($3.95 to $5.88/MMBtu) were sufficient to develop Zohr and any new discoveries. If not, prices may need to rise further to increase domestic production.

By comparison, Noble Energy sold gas in Israel from the Tamar field for $5.57/MMBtu in 2014, and such revenue earned the company a 15% post-tax return (excluding exploration costs).[36] Piping gas from Israel or Cyprus to Egypt could add $0.50/MMBtu to $1/MMBtu to the cost, so that gas could be delivered to Egypt for $6 to $6.5/MMBtu.[37] Egyptian LNG was exported at $7/MMBtu in the period 2012-14, when oil prices were around $100 per barrel. So LNG exports could prove commercially viable, though oil and gas prices are now lower and $7/MMBtu LNG is less attractive than it was between 2012 and 2014.

The price for imported LNG to supply the domestic market is less certain, especially as the price of such imports depends on the short-term market. To offer a comparison, Brazil, which also relies on the short-term market, imported LNG cargoes for prices ranging from $4.5/MMBtu to $21.5/MMBtu in a five-year period from 2010 to 2014, with an average price of $14/MMBtu (albeit in different market conditions than those of today).[38] The Egyptian authorities also face price fluctuations dependent on changing market conditions. In March 2015, the Egyptian General Petroleum Corporation (EGPC) indicated that it had budgeted $2.5 billion in FY 2015-16 to import LNG, although soon thereafter, the number rose to $3.55 billion.[39] In today's market, the $2.5 billion figure is more plausible, with prices around $7 to $10/MMBtu; but any tightness in the market raise prices quickly.

The commercial entities involved need to recoup their investments. This depends on additional factors beyond expected price. LNG imports are attractive because they require limited upfront investment and entail limited risk. In the event of a shock, such as non-payment of bills or a foreign exchange crisis, the LNG suppliers could simply cease deliveries and the FSRU owners could withdraw the ship and move it to a new location. The Egyptian importers, who have invested in the infrastructure to connect the FSRU to the local pipeline network, would bear the largest cost.[40]

By contrast, pipelines are assets with long-term risks. They require sizable investments both upstream (field) and midstream (pipelines). If all the preliminary sales agreements were formalized, Israel and Cyprus could export over 2 bcf/d to Egypt, of which 1.1 bcf/d would be re-exported. Such quantities are uncertain, however, and Israeli and Cypriot gas might compete with each other, in which case only one might succeed initially.

If all the preliminary sales agreements were formalized, Israel and Cyprus could export over 2 bcf/d to Egypt, of which 1.1 bcf/d would be re-exported..Overall, at least $7 to $10 billion might be needed in additional upstream investment in the Eastern Mediterranean to enable exports of this scale.

[35] In general, a field can produce about 70% of its reserves at a plateau level before going into decline.

[36] The reported price is $5.57/mcf (thousand cubic feet), which for simplicity is converted to $5.57/MMBtu (the precise conversion depends on the quality of the gas, but in Israel this conversion is reasonable). The rate of return is calculated by looking at total development expenditures for Tamar versus results from operations. Noble Energy, Form 10-K, various years, http://www.nobleenergyinc.com/.

[37] The LNG facilities owned by BG Group and Union Fenosa Gas are 140 kilometers apart; however, there are various offshore pipelines that gas could be fed into.

[38] Ministério de Minas e Energia, *Boletim Mensal de Acompanhamento da Indústria de Gás Natural*, various editions.

[39] "EGPC Put In Charge of Future LNG Imports," *Daily News Egypt*, March 31, 2015; "Egypt to import $3.55 bln worth of LNG in 2015-2016," *Reuters*, April 14, 2015.

[40] This risk profile applies to Egypt's case. In other LNG scenarios, where there is more upfront investment, the risk profile is considerably different.

In theory, reversing the flow of the pipeline that previously delivered Egyptian gas to Israel could lessen the need for additional investment. In practice, this could prove difficult and not very attractive.

Overall, at least $7 to $10 billion might be needed in additional upstream investment in the Eastern Mediterranean to enable exports of this scale, including smaller fields and expansions at the Tamar field. The level of investment required can be gauged by comparison with the first phase of the Tamar field, which produces 750 mmcf/d, and cost $3.3 billion,[41] as well as the Aphrodite field, offshore Cyprus, whose development cost is estimated at $3.5 to $4.5 billion.[42] Noble Energy has estimated that developing the Leviathan field could cost $2.9 to $4.6 billion depending on the plan chosen.[43]

Building a pipeline network could cost $1 to $3 billion, depending on the route, volume, and end-point of the system. The fields offshore Israel and Cyprus are approximately 350 km from BG Group's Idku LNG facility in Egypt, and 250 km from the Damietta port where the LNG facility owned by Union Fenosa Gas is located.[44] By comparison, the 210-km offshore Medgaz pipeline that came online in 2011 and connects Algeria and Spain cost €1 billion and carries 8 bcm/yr (774 mmcf/d);[45] the 520-km offshore Greenstream pipeline between Libya and Italy has a similar capacity and cost $953 million (€0.8 bn), when built in 2004;[46] and the 380-km offshore Blue Stream pipeline that connects Russia to Turkey cost $2.4 billion for 16 bcm/yr (double the capacity) and was completed in 2003.[47]

Thus total costs between $1 and $3 billion seem likely, based on comparable investments in the area, for a pipeline that could carry 8-16 bcm (0.8 to 1.6 bcf/d) to Egypt from the fields offshore Israel and Cyprus.

In theory, reversing the flow of the pipeline that previously delivered Egyptian gas to Israel could lessen the need for additional investment. In practice, this could prove difficult and not very attractive. First, the pipeline never carried more than 2.5 bcm/yr (241 mmcf/d), although it had a notional capacity of 7 bcm/yr (677 mmcf/d). This implies that it would not suffice to carry all the gas between Israel/Cyprus and Egypt. Secondly, EMG, which owns the pipeline, stated that it had no knowledge of the supposed transaction [the Dolphinus contract] to use its pipeline.[48] Thirdly, EMG has taken Egypt to arbitration and is itself in arbitration proceedings with Israel Electric (IEC), while some of EMG's smaller shareholders have filed for bankruptcy.[49]

Fourthly, PTT, the national oil company of Thailand, which bought a 25% stake in the pipeline in 2007 for $487 million, took a $130 million impairment charge in 2013, effectively writing off its investment.[50] In short, acquiring this pipeline could cost hundreds of millions of dollars and would require the buyers to navigate complex legal issues. The onshore portion of this pipeline between Arish and Port Said would face the security threats that plagued the pipeline in the past (offshore infrastructure is harder to attack). As such, this option presents serious challenges and is

[41] Cost refers to total spending between 2008 and the start-up of operations in 2013. Information from Delek Group, *Annual Reports*, www.delek-group.com.

[42] Delek Group, "Annual Report 2014," pages A-120 and A-121; "Aphrodite plan probably a floating unit," *Cyprus Mail*, June 12, 2015.

[43] Noble Energy, Analyst Conference, December 17, 2013, p. 145.

[44] Author estimates based on Google Earth.

[45] European Investment Bank, "The biggest EIB loan for energy in Mediterranean: EUR 500 million to MEDGAZ," November 23, 2010.

[46] ENI, 20F Annual Report 2003, p. 36.

[47] Ibid.

[48] Sharon Udasin, "Eastern Mediterranean Gas: Egyptian pipeline not part of Tamar partners, Dolphinus gas deal," *Jerusalem Post*, March 3, 2015.

[49] "Ampal seeks bankruptcy protection on Egypt loss," Agence France-Presse, August 31, 2012; Amiram Barkat, "IEC may withdraw $4.2b suit against Egypt," *Globes*, December 15, 2014.

[50] PTT, Management's Discussion and Analysis (MD&A) and operating results for the fourth quarter of 2013 and the year 2013 as a whole.

unlikely to relieve the participants from the capital needs of developing new infrastructure.

In enabling such investments, which could eventually exceed $10 billion, the challenge is to balance risk and reward and diminish various commercial, political, and legal risks. The cancelation of contracts could cost companies hundreds of millions of dollars, as was the case when Egyptian exports of pipeline gas and LNG ceased.[51]

These risks are encapsulated by the following questions:

- Can Israeli/Cypriot gas compete in the Egyptian market where most consumers pay less than $5/MMBtu even after the July 2014 price hikes?[52]
- Will Egyptian consumers continue to buy Israeli or Cypriot gas if cheaper domestic supply becomes available and will they sign contracts for imports if they expect domestic supply to grow?
- If there is a slowdown in demand, will contracts be honored?
- How will other risks (security, foreign exchange, regime change) be managed?

Gas destined for re-export faces its own challenges:

- Will Egypt allow exports if local industries and power plants are shut down for lack of gas?
- Will Egypt allow re-exports only if the local market is supplied as well and under what terms?
- Will exporters await the results of their own exploration efforts in Egypt in the hope that they may discover more gas that could be exported, or will they commit themselves to re-exporting imported gas?
- What guarantees could assure investors that their investments would not suffer the same fate as the pipeline and LNG projects that now lie idle in Egypt?
- If the plan is to reverse the direction of the now defunct pipeline that ran from Egypt to Israel, can the partners resolve the technical and legal challenges involved?[53]
- How will new exports affect old contracts? Union Fenosa Gas is in arbitration with its Egyptian partners, but the Egyptian authorities have stated that the arbitration should be settled before exports start again.[54]
- Can an agreement be reached?

Success will depend not only on mitigating such risks but also on apportioning risk fairly among the parties. Since field development will account for most of the investment ($7-$10 billion compared with $1-3 billion for the pipelines), the licensees in

In enabling investments, which could eventually exceed $10 billion, the challenge is to balance risk and reward and diminish various commercial, political, and legal risks.

[51] Israel Electric (IEC), which bought Egyptian gas until the pipeline from Egypt to Israel was shut down, spent twice as much on fuel in 2012 than in 2010, and the loss of Egyptian gas cost it $3.5 to $4 billion; *Israel Electric Corporation, Investor Presentation, December 2014*. In Jordan, the Central Electricity Generating Company spent a total of about $3 billion more on fuel in 2011-13 than in 2006-09 when Egyptian supplies were steady; *Jordan, Central Electricity Generating Company, Annual Reports, http://www.cegco.com.jo/*. Meanwhile, BG Group took two impairments related to its Egyptian business: a $1.3 billion post-tax impairment in 2013 and a $775 million post-tax impairment in 2014, while it also declared "force majeure" on its LNG deliveries from Egypt in 2014 and bought 28 spot cargoes in 2014 compared with 9 in 2013; *BG Group, Annual Report and Accounts, 2013 and 2014.*

[52] Kieran Clarke, "Egypt's Recent Subsidy Reforms," Energy Subsidy County Update, Global Subsidies Initiative & International Institute for Sustainable Development, August 2014.

[53] Sharon Udasin, Eastern Mediterranean Gas: Egyptian pipeline not part of Tamar partners, Dolphinus gas deal," *Jerusalem Post*, March 3, 2015. PTT, Management's Discussion and Analysis (MD&A) and operating results for the fourth quarter of 2013 and the year 2013 as a whole.

[54] Union Fenosa Gas Annual Report 2013, https://www.union-fenosagas.com/. "UPDATE 2-Egypt wants arbitration resolved to allow gas exports from Israel," Reuters, May 14, 2014.

The commercial viability of gas sales into the Egyptian market depends largely on the future price regime in the country and on the country's future supply-demand balance.

Israel and Cyprus will need to feel confident that they can recoup their investment. At this point, the license holders appear interested in selling their gas as close to the wellhead as possible and at a predictable price.

This approach would provide certainty to the sellers but shifts the commercial risk to the buyers, who are also likely to invest in the pipeline. The buyers would purchase gas from Israel and/or Cyprus and sell it either in Egypt (Dolphinus) or overseas as LNG (Union Fenosa Gas/BG Group), with the latter being more likely after the discovery of Zohr. The buyers would seek to ensure that the price spread is wide enough to justify the investment in the pipeline. In the case of re-exports, this is likely to be the case, but for the domestic Egyptian market, Eastern Mediterranean gas might be sold at a loss if prices are low. The commercial viability of gas sales into the Egyptian market depends largely on the future price regime in the country and on the country's future supply-demand balance.

In managing these risks, the parties could explore several mitigation strategies that have been employed successfully elsewhere. Public-sector loans, grants, or guarantees are helpful in spreading risk and facilitating investments.[55]

Another path would be for the companies involved in the different stages of production and end-user sales to invest in upstream field development and the necessary pipelines to bring the gas onshore. Various profit-sharing schemes could be envisaged. These are options that would allow each party to shoulder part of the risk while enabling the project to move forward.

Imports of LNG from different exporters are likely to be Egypt's short-term solution to domestic gas supply problems. LNG imports are simpler and quicker to arrange than new pipelines even if the gas itself is more costly than pipeline gas. Pipeline imports from offshore Israel and/or Cyprus would be larger and would provide sufficient gas to close any supply gap in Egypt in the medium term and would allow the country to restart exports. But all the parties involved will have to work hard to manage the numerous commercial, political, and legal risks and to find a formula that properly balances risk and rewards. Overall, it is important for Egypt to put into place a coherent and stable energy strategy providing predictable conditions for investors.

[55] See Anastasios Giamouridis and Nikos Tsafos, "Financing Gas Projects in the Eastern Mediterranean," The German Marshall Fund of the United States, July 2015, http://www.gmfus.org/publications/financing-gas-projects-eastern-mediterranean.

4 The Future of Egyptian Gas

Gas demand growth in Egypt is supported by strong fundamentals: demographics, higher living standards, and further penetration of gas compared with oil. In the short term, rising prices from subsidy reform could slow down the growth in demand, but international experience shows that demand can still grow despite higher prices. In the medium term, alternative sources of power generation could have a bigger impact, but the biggest competitors with gas — coal and nuclear — face numerous obstacles before they can materialize. Based on today's realities, only a political or economic shock or a lack of sufficient supply would seriously undermine gas demand growth.

Egypt's resource endowment is large enough to permit domestic gas to be developed but unattractive terms have slowed down investment and have led to a decline in production. The government is offering higher prices to foreign companies for producing gas, but these concessions are on a case-by-case basis. They take a long time to negotiate and are unpredictable for new investors.

Moreover, existing fields decline steeply, meaning that Egypt will need several large-scale projects to keep production steady. Only after Zohr starts to flow at high rates (over 2 bcf/d) can Egypt hope to reduce or eliminate imports; even then, demand growth may require further imports. At this stage, the window for supplying the Egyptian market post-2020 may have closed, but Zohr is not sufficient to re-activate the country's two idle liquefaction facilities.

Since Egypt will be short of gas for the new few years, it will need to rely on imports to meet its needs. In the short term, Egypt will focus on imports of LNG, not because this is most cost effective but because it is commercially simpler and does not involve the risks associated with new pipeline investments.

In the future, pipeline trade between Israel, Cyprus, and Egypt may develop. The commercial case for re-exports via Egypt is stronger than the case for supplying the Egyptian market, especially now that that market appears better supplied and the urgency to import large quantities of gas has subsided; both, however, face legal, political, and commercial challenges. A race between Israel and Cyprus might develop since possible re-exports from Egypt may not be large enough to accommodate gas from both. In the end, success in the pipeline trade will depend on finding a commercial structure that balances risks and reward for the different parties involved.

Overall, it is clear that Egypt will continue to require gas imports at least until the early -2020s and possibly for longer, depending on the pace of investment and the rate of demand growth. Egypt does provide a significant potential market for exports of gas from Cyprus and Israel but considerable risks and uncertainties need to be overcome in order for investment in the required infrastructure to be forthcoming.

Egypt will continue to require gas imports at least until the mid-2020s and probably for longer. Egypt does provide a significant potential market for exports of gas from Cyprus and Israel but considerable risks and uncertainties need to be overcome.

Appendix

Table 1: Egypt's Energy Market

Indicator	2000	2012	Growth	% Growth	2000=100
Population in millions	66.1	80.7	14.6	1.7%	122
GDP (2005 US$ billion)	75.4	125.9	50.5	4.4%	167
per capita	1,140	1,560	419.7	2.6%	137
Primary Energy Production by Fuel (in thousand tons of oil equivalent – ktoe)					
Crude oil	36,108	34,968	-1,140	-0.3%	97
Natural gas	14,432	44,184	29,752	9.8%	306
Total	53,090	82,046	28,956	3.7%	155
Primary Energy Consumption by Fuel (in ktoe)					
Natural gas	14,432	39,120	24,688	8.7%	271
Oil products	22,845	35,808	12,963	3.8%	157
Biomass	1,306	1,594	288	1.7%	122
Hydro	1,178	1,149	-29	-0.2%	98
Coal	923	448	-475	-5.8%	49
Wind & solar	12	129	117	21.9%	1,075
Electricity	-13	-34	-21	8.3%	262
Total	40,683	78,214	37,531	5.6%	192
per capita	0.62	0.97	0.35	3.8%	156
Final Energy Consumption by Sector (in ktoe)					
Transport	9,574	16,981	7,407	4.9%	177
Industry	9,851	13,358	3,507	2.6%	136
Residential	6,686	11,910	5,224	4.9%	178
Non-energy use	3,203	7,062	3,859	6.8%	220
Commercial	1,205	2,913	1,708	7.6%	242
Agriculture	294	2,842	2,548	20.8%	967
Other	667	814	147	1.7%	122
Total	31,480	55,880	24,400	4.9%	178
Electricity Generation by Fuel (in Gigawatt hours – GWh)					
Natural gas	41,996	124,550	82,554	9.5%	297
Oil products	22,313	24,959	2,646	0.9%	112
Hydro	13,697	13,358	-339	-0.2%	98
Wind	137	1,260	1,123	20.3%	920
Solar PV	0	237	237	n/a	n/a
Total	78,143	164,364	86,221	6.4%	210

Source: International Energy Agency (IEA), http://www.iea.org

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