

East-Mediterranean Gas potential: Opportunities and Barriers

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The Eastern Mediterranean region appeared on the new world gas map with the discovery of the Tamar field in 2009. Although the volumes of gas discovered were not a global game changer, potential resources could well boost the economies of the host countries and provide respectable gas volumes to the EU – an attractive opportunity given the current reliance on Russian gas. The discoveries also have the potential to promote regional stability through economic cooperation.

Using modelling tools and existing public figures we investigate the conditions and opportunities under which natural gas may reach European markets. We critically analyse the current official figures on regional production, consumption and export potential as well as a number of export infrastructure projects being considered up to the year 2030. We also assess the barriers to deployment of the potential resource.

Three elements are currently casting doubt over the opportunity of gas exports from the region. The first is the recent abrupt drop in oil prices and gas prices, which has delayed LNG projects and oil and gas investments worldwide. The second is the ongoing exploration campaign of ENI and Kogas in offshore Cyprus, which so far has not resulted into natural gas discoveries. Last but not least,

the evolution towards a more restrictive regulatory framework in Israel coincided with a period when major investment decisions were being finalised. This change in regulatory climate may delay Israeli export prospects. These issues are discussed and elaborated in this HET¹. Initially we start with an overview of current production and develop predictions for future production potential and export from the region.

Exploration and Resources

The USGS estimates that the Eastern Mediterranean area may hold up to 3,400 bcm of recoverable gas [1]. Despite very high exploratory costs, – up to \$100 million per well due to the depth of the gas –, already approximately 1,000 bcm have been discovered since 2009 [2]. A consortium led by the US firm Noble Energy, composed of Israeli firms Delek and Avner Oil, have been developing its concessions in the region. The distribution of resources and current proven reserves is presented in table 1. Countries are at different stages of exploration-production.

Exploratory successes in the region are likely to be slow. To date Cyprus, with one proven gas field, Aphrodite, has shown to contain much less than initially expected and the drilling process by companies that won the second call

¹ This HET primarily focusses on developments in Cyprus, Israel and Lebanon. Both Syria and the Palestinian

Territories are excluded as they are unlikely to affect the region's global gas export potential by 2030

for tender has not yet led to discoveries. ENI and KOGAS drilled two dry wells on Cyprus block 9, and Total announced in January 2015 that it failed to discover any targets to test drill [3]. This situation may result in Cyprus having to rely on gas imports up to 2020, as the recent call for tender on securing interim gas supply suggests [4].

Table 1: Regional reserves in dry gas (in bcm)

	Cyprus	Israel	Lebanon
Proven Reserves	141	940**	---
Estimated Resources	1132-1698*	1500	700

*does not include two dry drill on ENI-KOGAS's block 9
 **does not include recent discovery in Royee field by 3D seismic survey (90 bcm, around 3.2 Tcf)
 Sources: IFRI forthcoming study, [2], [5]–[7]

In Israel, there have been some disappointments in term of prospection but overall the exploratory process has been very successful. The most recent updates are the 90 bcm prospect of the Royee field, the Oz licence, and the update of the giant Leviathan field up to 613 bcm (21,9 Tcf)². Further exploration and production will most likely be delayed by the current disputes between operating companies and the government over the evolution of the regulatory framework.

In Lebanon the stalled regulatory process as discussed later, is pushing back in time the exploratory process.

Domestic Consumption of Natural Gas

In Cyprus, overall domestic consumption levels are low, so likely the majority of the gas produced will be directed to exports. A recent IRENA study has indicated that in the period 2023-2030 annual demand of natural gas for electricity generation in Cyprus may be approximately 0.8 to 0.9 bcm [8].

² Source: Delek Group

³The Israeli government has decided that no more than 40% of the proven reserves will be made available for

In Israel the future of gas consumption has been hotly debated as it is one of the main criteria for setting export volumes. The government has developed consumption forecasts (Table 3) [9], which are to be revised every five years. These forecasts correspond to a 75% switch to gas in the power sector and also a partial switch in the transport sector towards gas. These numbers look quite optimistic and consumption is unlikely to grow at a more rapid rate. New governmental forecasts show that consumption for 2015 is 10% lower than expected [10]. The industrial sector in particular is switching to gas more slowly than planned. Among the causes lie issues of governance in developing the gas distribution network, various standardisation procedures and changing gas tariffs. The introduction of export quotas³ means that domestic consumption will not affect the export potential of the country but rather production levels will be the determining factor of export potential.

Israel's domestic gas market is supplied by the Tamar gas field, for which a contract has been signed with the Israel Electricity Company IEC; this contract may only be partly renegotiated by 2017. This leaves the Leviathan gas field with no sufficient domestic market to justify its development, and dependent on securing one major export contract. This situation may be solved by the delay of production from Leviathan on the one hand, and an adjustment of the contract.

Lebanese future gas consumption is challenging to assess. Our forecast considers the power sector as the sole consumer of gas up to 2030. It is based on the planned expansion of power capacities (6 GW in 2030 compared to 2.5 GW in 2013) and the switch of

exports. This figure will be revised in case of future discoveries.

current oil fired power plants to gas (estimated gas capacities of 5.2 GW in 2030) [7]. The estimated gas consumption is therefore quite optimistic as projects might encounter delays given the political situation and demand might be unmet.

Of the countries examined, only Israel is producing gas today. Table 2 shows our estimates of future gas production levels under a central scenario. It assumes that Israel will maintain the announced production timeline, and that production from Cyprus will come solely from the Aphrodite field, which is quite a conservative approach for 2030. Despite the government desire to see production starting in 2020, it is unlikely to see gas flowing out of Lebanese gas fields before 2025 as a result of significant delays in the tendering process, and a troubled political situation. Additional production will only occur if more fields are discovered and investments secured.

Our figures may be subject to delays as a result of regulatory issues and lower oil prices. The timeline for the Israeli production may well be delayed by at least two to three years given the immaturity of the country's legal framework for upstream investments. In Cyprus too, the slowdown and failures of the drilling process may push production from additional fields further back in time.

Table 2: Estimated Future Gas Production levels in bcm/year

	2013	2020	2025	2030
Cyprus	0	1.0	2.8	3.9
Israel*	6.4	20.9	36.7	36.7
Lebanon	0	0	0.2	1.1

Sources: Enerdata's POLES model and author estimates based on Noble Energy projections [2], [11].

⁴ This represents 210 bcm for Israel and 22 bcm for Cyprus, i.e. 232 bcm in total, out of a 530 bcm potential presented by Noble [2], [11].

Opportunities: Prospective exports volumes

Under a scenario which does not account for any significant new discoveries but takes into account the implementation of current government consumption plans and companies' field development projects, most of the region's gas exports by 2030 will come from Israel. Lebanon, with its ambitious domestic gas development plan, would remain a net importer of gas.

Table 3: Consumption and available gas for exports (bcm/year)

	2013	2020	2025	2030
Cyprus [8]	0	0.0	1.1	1.1
Available for exports	0	1.0	1.7	2.7
Israel [9]	5.7	12.1	14.7	17.9
Available for exports	0.7	8.7	22	18.8
Lebanon	0	1.5	3.2	4.5
Available for exports	0	-1.5	-3	-3.4

Sources: Country government demand forecasts, expert estimates and Enerdata's POLES model

In total, the export potential of the region would represent 1.7% of the EU's total natural gas consumption by 2020 and 3.7% by 2030 [12]. By 2030, about 44% of the total regional potential estimated by Noble will have been exported⁴.

Potential gas export projects

A number of projects of varying capacity are currently being promoted by national governments and companies in the region to capitalize on reserves (Appendix B). These aim at exporting gas either in liquefied form or via gas pipelines.

New gas pipelines projects have been proposed. In terms of breakeven cost, some argue that the cheapest, but not necessarily the

most profitable, is the pipeline linking the Cyprus Aphrodite field to Turkey [13], unlikely to happen due to the Turkish military occupation of areas of Cyprus. Second in line ranks the pipeline linking Israel to Turkey. This project first proposed in 2009 was cancelled following the Gaza flotilla incident. The project is promoted by Turcas Holding, among other companies. The project would have the advantage of targeting Turkey's rapidly growing gas market, which disposes of high domestic gas prices. Geopolitical issues, and in particular the resurgence of the conflict between Israel and the Palestinian Territories, as well as the divergence of Israeli and Turkish national interests, cast doubt on its possible achievement. Although partners offered to build the pipe at their own cost, such a project would still require the backing of the governments, while insurance costs may be high [14].

Due to the depth and gradient changes in its offshore section [13], the East-Med pipeline is quite costly. Its capacity of at least 7 bcm represents almost twice the size of the Greek domestic gas market; i.e. current annual consumption of 4 bcm. This means it will have to reach other countries. On the list are Italy, through either TAP (\$1.5bn Capex) or ITGI (\$1bn Capex), a 70 bcm gas market in 2014 and possible transit country to other European countries; and Bulgaria, a smaller gas market of 3 bcm, through the IGB interconnector (€150m). In sum this means, the overall breakeven costs will be higher than \$10.3/Mbtu while transiting countries may face difficulties to secure credits.

It has been argued by Noble Energy that LNG from East-Mediterranean is more competitive than West-Australian and East African LNG [2].

⁵The Vasilikos LNG terminal has been given the status of a PCI [15], at a first phase will have a capacity of 5 MTPA (~6.72 bcm/yr), and requires an investment cost of \$6 billion. Assuming a feed gas price of \$2.5/MMBtu, an MIT study has estimated the LNG break-even price at \$9.75/MMBtu and \$10.25/MMBtu for the European and

Onshore LNG projects however face difficulties. The Cyprus Vasilikos LNG plant is not viable with only the current gas reserves from the Aphrodite field. As such, the financial viability of the project relies on additional volumes of gas either from future discoveries in Cyprus or on securing interest from Israel. The cost of the feedstock will need to average \$2.5/Mbtu, while Israel has put a floor price on gas export prices averaging its domestic gas prices (around \$6/Mbtu). Lebanon could be another source but delays in exploration would delay the project even further.⁵

The deployment of a floating LNG (FLNG) platform in Israel and Cyprus has also been brought up [2], but since this is an untested technology, it is uncertain what the expected investment requirements would be.

As a result, the use of existing LNG facilities in Egypt appears as the cheapest and most feasible option. The gas could serve the growing needs of Egyptian domestic market and be further exported on the world's LNG markets. Historically, both Idku and Damietta have sent gas to Spain, France and Italy as far as the EU is concerned [16], [17]. Recently exports have been reoriented towards Asia [18].

Currently both Israel and Cyprus are negotiating contracts with these LNG terminals. As they represent the entire export potential of the region by 2030, any other gas infrastructure project is difficult to forecast by that date. In the longer term however, both countries will be keen to exploit export facilities and operating companies to extend on the value chain so as to maximise profits. While sale contracts being negotiated run up to 15 years starting from 2018 onwards, interruption

Asian markets respectively [13]. However, using Enerdata's production projections for Cyprus based on current proven reserves, the terminal will only be able to work at about 40% of its capacity. In such a scenario, adopting assumptions from the MIT study, we estimate that the cost of production would rise by about \$5/MMBtu.

clauses may have an impact. This could help Israeli operators to cash-in shortly while promoting a stand-alone FLNG, and Egypt to make use of any potential future gas production to feed its LNG plants and domestic market.

In recent years the LNG market has grown in liquidity and exporters have a global reach. This is expected to be true for East-Med gas. However, given current and expected transport costs, the low gas prices in the US and the potential reduction in the gap between European and Asian gas market prices (Appendix C), the netback might not be sufficient for exports to make their way to the US and Asian markets. European, North African and Middle Eastern destinations are the most likely markets for East Med gas.

Barriers: Regulatory issues in the region

In Lebanon, the exploratory phase has not yet started despite the initial success of the call for tenders that followed the publication of encouraging 3D seismic data covering almost its entire offshore territory. Two key decrees of the 2010 Oil Law cannot be passed by the current temporary government. They define the blocks for exploration, the framework contract surrounding royalties and taxes on companies. While the basics of a legislative framework are lacking, political focus has also been given to the issue of maritime border delimitation with Israel and the setting of a sovereign fund [19]. Overall a clear and realistic strategy for the development of gas is missing.

In Israel, the regulatory framework is still in development. In the past two main changes were made to the initially investor-friendly concession framework with the introduction of an excess profit tax and a 40% export quota on proven reserves. This had the negative impact of Australian company Woodside dropping out of a US\$2.5bn deal in Leviathan, and

reoriented investors' plans towards regional exports. The changes also delayed plans for LNG projects. More serious issues however are the current actions undertaken by the Anti-Trust Authority. The agency, whose mandate is to promote competition in Israel, may decide to break up the main consortium led by Noble Energy, which currently holds 90% of the country's gas reserves. This decision if confirmed can only be challenged in court. The attractiveness of buying shares in two giant gas fields with no exploratory risk is certainly high for prospective investors. Investors' confidence however usually depends on the country's regulatory maturity and stability and overall political climate, in particular in such a politically volatile region. In any case they will wait for a decision to be taken on regulating gas prices domestically. Furthermore Noble Energy has already declared its will to take the issue to court. In concrete terms this means that if no agreement is found, Leviathan development will be delayed by at least 4 years (2 years for the jurisdiction and 2 years from investment to production from the FPSO – as an onshore gas facility has been ruled out and an FPSO takes more time). Current export sales agreements for Tamar are also being side-lined. The popularity of such measures has given a hard time to the design of a clear overarching strategy to the former heterogeneous governmental coalition. It seems that the outcome of the March legislative elections has reinforced political forces in favour of such regulations [20].

The impact of lower oil prices

Lower oil prices have a global negative impact on the oil and gas sector, and this will hit the shores of the Mediterranean as well. Firms drilling offshore Cyprus have just requested the government to grant them a delay so as to restart the drilling process further in the future [21]. In Israel, developing the Leviathan field will require additional investors which may be even harder to find in the current context and

despite the possibility to be confirmed of buying more shares from the field following the ruling of the anti-trust authority.

LNG markets have been harmed from an exporter perspective, with drops in gas prices reaching as much as 30%. In fact the majority of LNG contracts remain linked to oil price. This is particularly true for Asia, the most attractive market and from which future demand will be driven. This also affects two of the most attractive markets for east-Mediterranean gas: the European Mediterranean shore in which 85% of gas contracts are still linked to oil prices, and south-east European markets, which are 100% linked to oil [22].

Investments in new gas export projects are therefore negatively affected, and this has been confirmed by the recent move of both Israel and Cyprus producers to negotiate sales contracts with the existing Egyptian LNG facilities. Production will likely be impacted too, and any consumption switch from oil to gas (in the industry and transport), other things being equal, may take more time to materialize. Additionally this may affect government rents, mostly for Israel, as gas export contracts are being linked to the Brent yet with a floor price. This could fuel arguments in favour of more regulation so as to capture a higher rent elsewhere, which may in turn affect investors.

Oil prices will therefore negatively affect the development of the region's gas potential for the medium term. We assess that oil prices are likely to return to higher levels towards the end of the current decade, which will again change the situation and foster development over the 2020-2030 decade.

Conclusion

Analysis presented in this paper demonstrates that around 20 bcm may be available annually for exports by 2025. Both changes in legislation and the drop in oil prices are however delaying

gas exports projects. Previous exploratory successes in Cyprus' Aphrodite field have not continued, which undermine the possibility of a dedicated LNG terminal on the island. Exports at present will be directed to neighbouring markets, until production increases and investments in major infrastructure can occur. However, break-even needs of projects will be more demanding for projects targeting the European and Asian markets than those of regional markets, such as Egypt and Turkey. At the same time, the geopolitical environment is highly volatile in the region. The continued settlements in Israel threaten relations with its Arab neighbours and can put regional gas deals on hold, while the increasing isolation of Turkey may encourage the country to act more as a deterrent force if its gas transit role is diminished; as a consequence maritime military budgets can be expected to rise in the region.

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Additional Notice:

Post publication of this HET, the proposal of the Israeli anti-trust agency has been finally withdrawn and traded off for a softer proposal. It includes a loose control of gas prices likely to be based on the contract signed between the Israeli Electricity Company and Tamar and some arrangements on the ownership of Tamar, which still need to be disclosed. See for reference:

http://www.enerdata.net/enerdatauk/press-and-publication/energy-news-001/noble-and-delek-will-have-sell-offshore-assets-israel_31516.html.

Appendix A – Methodology

In order to understand the gas export potential from the region, Enerdata's POLES model was used to provide projections regarding fuel production, consumption and trade in different regions on a global level. Due to its lower spatial resolution, in order to provide more concrete values, outputs from the model were cross-checked and complemented with external sources, where this was necessary. The summarized points below clarify how the figures presented in the tables have been calculated or from where they have been derived.

Consumption figures

- Israel: the table shows government figures
- Cyprus: Based on a study made by KTH for IRENA
- Lebanon: modelling based on the government's planned gas fired power capacity up to 2030. Gas consumption figures are only based on consumption from power generation. Firstly because there is currently no gas distribution infrastructure to support consumption by households and industry and such a network is likely to take up to ten years from policy planning and investment phase up to the construction phase. This would require more visibility on households and industry consumption – a problematic issue given the high numbers of diesel generators used around the country and the well-spread practice of stealing off the grid. Secondly because industry currently represents 17% of the total energy consumption, of which 41% is in the form of electricity [7]. In this respect no big switch to gas from other sectors should be expected.

Production figures

- **Cyprus:** For Cyprus, POLES modelling forecast includes the production from the Aphrodite field. Production follows the appetite for domestic consumption and for exports, the latter making a large part of the destination of the gas produced. Given the Aphrodite resource volume, after a ramp-up in the early 2020s, production could reach a plateau for the next two to three decades – a faster production would result in a fast depletion.
- **Israel:** the figure assumes that by 2020 expected sales and contracts under negotiation will materialize and production will reach the associated levels at Tamar and Leviathan. For 2030, it is assumed that production will reach 100% of the quoted capacity for the fields of Tamar and Leviathan [2], [11]. This figure does not include production from smaller gas fields like Karish and Tanin. As they represent only 84 bcm (3 Tcf) compared to 923 bcm (33 Tcf) of Tamar and Leviathan reserves combined, they will not dramatically affect the export potential by 2030. The planned development of Tamar and Leviathan by Noble Energy is also quite aggressive and may be

subject to delays if domestic consumption is lower than government forecasts and if the regulatory developments induces delays. This forecast is therefore not as conservative as it may seem.

- **Lebanon:** Based on expert view on the production potential given the resource and with a development path as aggressive as for Israeli gas fields but within the constraints of regulatory and infrastructure delivery delays, production could start and ramp up in the 2020s.

Gas Export Potential

- Cyprus: Gas export potential is assumed to be the result of an energy balance between production and domestic consumption.
- Lebanon: Gas export potential is assumed to be the result of an energy balance between production and domestic consumption.
- Israel: Gas export potential is assumed to be the result of an energy balance between production and domestic consumption. The figure abides with the set export quotas and takes into consideration signed and negotiated contracts.

Oil and gas prices are provided by the POLES model (EnerFuture update, February 2015).

- Brent prices are expected to reach \$115/bbl in 2020 and \$150/bbl in 2030.
- European gas market prices are expected to reach \$10/MMBtu in 2020 and \$13/MMBtu in 2030.

Appendix B – Proposed Infrastructure Projects

Table B1 – Proposed Project Details

*Estimates

Proposed Infrastructure	Capacity	Capital Investment requirements	Comments
Eastern Mediterranean pipeline [15]	7bcm/yr	5.4-billion US\$ (range of 4.3-7.3) [13]	Assuming a feed gas price of \$2.5/MMBtu, break-even cost is estimated at \$10.32/MBtu [13]. This cost does not include -the extension of the pipeline to Israel -the link to Italy-Greece (ITGI), 7bcm capacity, \$1bln proposed by DEPA and Edison[ENERDATA] -the link to Bulgaria through the Greece-Bulgaria (IGB) Interconnectors, €150 million [ENERDATA] -the link with TAP, \$1.5bln, capacity
Israel-Turkey pipeline (Turcas holding)	16 bcm/yr	2.5 billion US\$ [23]	Breakeven cost estimated at approximately \$7.5/Mbtu. This pipeline has the potential for exports to Turkey and Cyprus [23]. Other bids have been submitted for pipelines to Turkey from Leviathan with capacities in the range of 7-10 bcm/yr.
Cyprus- Turkey pipeline	7bcm/yr	0.6 billion US\$	Breakeven cost estimated at \$5.8/Mbtu
Mediterranean Gas Storage (Vasilikos LNG terminal) [15]	5 MTPA (7 bcm/yr) with possibility up to 12 MTPA	6 billion US\$ for 5 MTPA train (range of 5-8 billion US\$) [13]	Assuming a feed gas price of \$2.5/MMBtu, break-even price is estimated at \$9.75/MMBtu and \$10.25/MMBtu for the European and Asian markets respectively [13]. Current estimates give 2022 as a possible first production year.
Floating LNG in Leviathan	3 MTPA (4 bcm/yr)	5.7 billion US\$*	Noble is considering floating LNG as an option for the Aphrodite field in Cyprus as well [2]. Final investment cost is very difficult to estimate as no previous FLNG plant has been finished yet. Shell's Prelude will have a capacity of 5.3 MTPA and will constitute the first FLNG development [24]; analysts estimate the cost of this project at over \$10 billion [25]. For a similar cost structure the project in Israel would cost \$5.7 bln.

Proposed Infrastructure	Capacity	Capital Investment requirements	Comments
Onshore Israel LNG	5 MTPA (7 bcm/yr)	~6 billion US\$ [26]	
Pipelines to Egypt's Idku and Damietta	Likely 7-10 bcm/yr for each section (e.g. Aphrodite to Idku)	1.2-1.8 billion US\$*	This is considered as an option for both Israel and Cyprus at the moment. Once gas is in Egypt it can be taken up by the domestic market or converted to LNG for export to other markets. The two liquefaction facilities have a total capacity of 12.2 MTPA, but only exported 5.1 and 2.8 MTPA of LNG in 2012 and 2013 respectively, as gas was diverted to the local market to meet growing demand [27]. The breakeven cost would need to take into account the liquefaction cost (fee), the gas feedstock price, and the additional cost of linking the gas fields to their respective shores.
Israel-Egypt pipeline	7 bcm/yr	~1 billion US\$	Construction time is estimated to be 6-12 months.
Reverse flow EMG	4 bcm/yr	0.5 billion US\$*	Israel has been using this pipeline to import gas from the East Mediterranean Gas (EMG) company. This 100 km-long pipeline connects El-Arich in Egypt to the Israeli port of Ashkelon[23].

Source: MIT cost calculator[13], authors' estimates, sources mentioned in the table.

Appendix B1 – Potential Gas Infrastructure



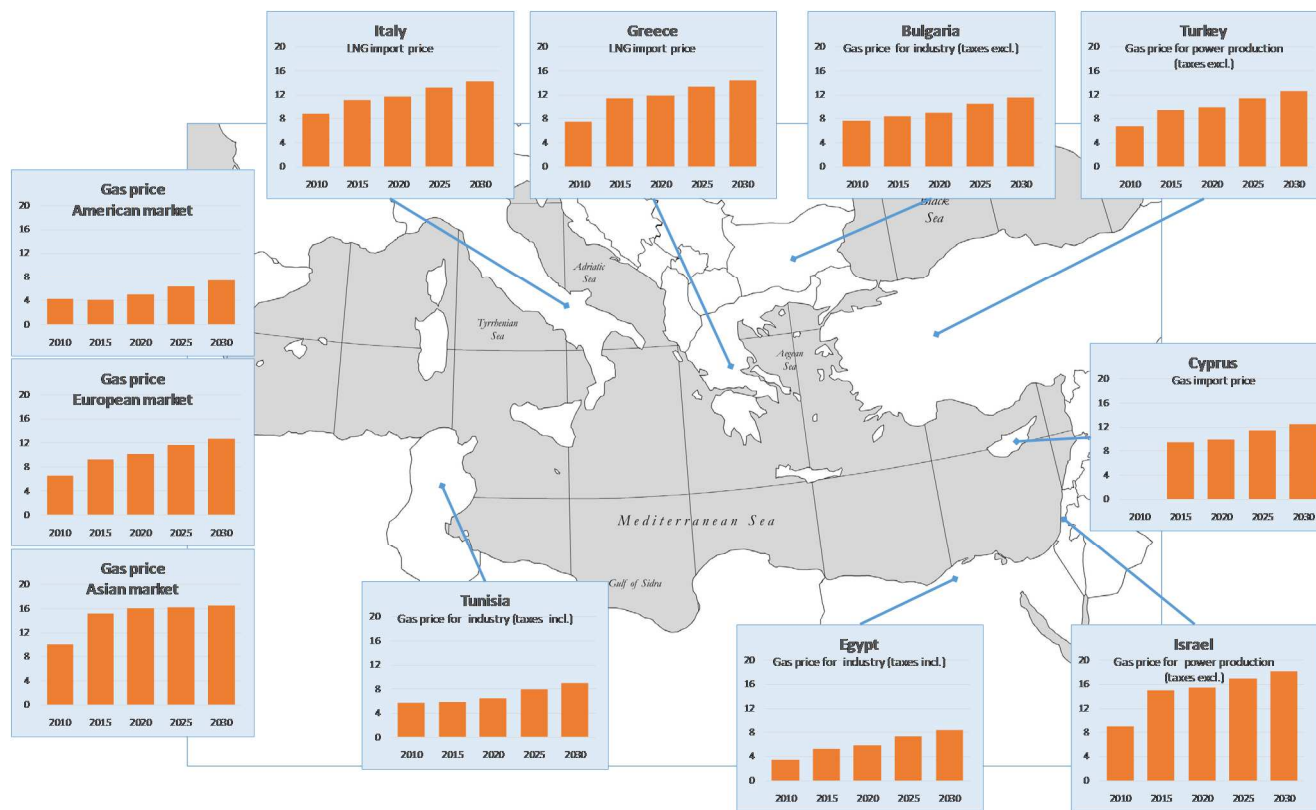
Source: adapted from Gas Infrastructure Europe [28]

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|--|---|
| 1 – Eastern Mediterranean pipeline | 7 – Pipelines to Egypt’s LNG facilities |
| 2 – Israel-Turkey pipeline | 8 – Egypt-Israel pipeline or reverse flow EMG |
| 3 – Pipelines to Israel | 9 – Italy-Greece Interconnector (ITGI) |
| 4 – Vasilikos onshore LNG facility | 10 – Interconnector Greece-Bulgaria (IGB) |
| 5 – Floating LNG facility (Leviathan or Aphrodite) | 11 – Existing regasification units in Greece and Turkey |
| 6 – Onshore LNG (Israel) | |

An Energy think tank informing the European Commission



Appendix C – Historical and projected natural gas prices in regional markets, \$(2013)/MMBtu (source: POLES-Enerdata)



For further reading or information, please visit www.insightenergy.org