PATHWAYS TO LNG IMPORTS

A working paper for the European Commission

TRAFIGURA

This working paper has been produced by Trafigura for the European Commission to help inform implementation of the EU's Energy Union strategy.

"We will explore the full potential of liquefied natural gas (LNG), including as a back-up in crisis situations when insufficient gas is coming into Europe through the existing pipeline system. Increases in LNG trade will help to bring world natural gas prices closer together. Currently, LNG prices are higher compared to pipeline gas due in particular to high liquefaction, regasification and transportation costs and demand in Asia.

In order to address these issues, the Commission will prepare a comprehensive LNG strategy, which will also look into the necessary transport infrastructure linking LNG access points with the internal market. The potential of gas storage in Europe and the regulatory framework needed to ensure sufficient gas in storage for winter will also be addressed in this context. The Commission will also work to remove obstacles to LNG imports from the US and other LNG producers."

From the European Commission proposal on an EU Energy Union Strategy
25 February, 2015

ABOUT TRAFIGURA

Trafigura is one of the world's leading commodity trading firms, moving large volumes of oil, petroleum products, metals and minerals from where they are produced to where they are needed, reliably efficiently and responsibly.

Established in 1993, the company generated revenue of $128 billion in 2014 and maintains offices in 36 countries. Physical trading and logistics are at the heart of the business, supported by targeted investments in infrastructure such as ports and transport systems. In LNG, one of the fastest growing energy markets, Trafigura is the largest independent trader, handling 33 cargoes in 2014 and with expected volume of 3 million tons in 2015.

Cover image: Hoegh LNG 'Independence' at LNG import terminal in Klaipeda, Lithuania.
Image courtesy of www.hoeghlng.com

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INTRODUCTION

In its proposal for an Energy Union strategy, launched in February 2015, the European Commission stressed the potentially important role that Liquefied Natural Gas (LNG) could play in diversifying the EU's energy supply and making it more resilient to disruptions. In particular, the Commission promised to prepare a "comprehensive LNG strategy, which will also look into the necessary transport infrastructure linking LNG access points with the internal market."

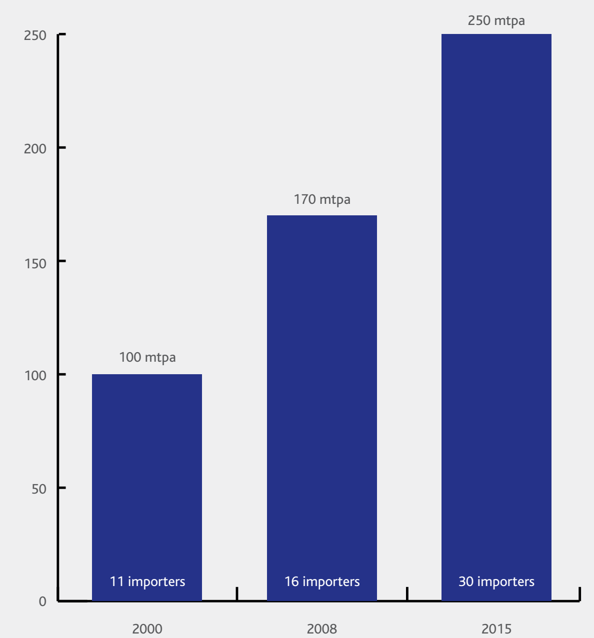
This working paper, produced by Trafigura following discussions with senior representatives of the European Commission, is designed to help inform preparations for this action plan. It focuses in particular on affordable ways of building the necessary infrastructure for importation of LNG. By extension, it suggests EU member states can use LNG to diversify from existing pipeline supplies of natural gas, notably from Russia, at a lower overall cost.

Global market conditions offer a propitious backdrop to consider such strategies. LNG supplies have been growing rapidly in recent years, a trend which is set to continue until 2020 and beyond, with total expected volumes of 250 mtpa this year compared to 170 mtpa in 2008 and only 100 mtpa in 2000. The number of importing countries has almost doubled to 30 in the past seven years 1.

More important still for future development is the radical shift we are witnessing in the structure of the market, from dominance by LNG producers to a leading role for independent traders. By 2020 we expect the proportion of global supplies controlled by producers to fall from 170 mtpa to 160 mtpa, while the share taken by companies able to trade rises three-fold to 180 mtpa 2. This means that surplus supplies will be readily available for purchase by an increasing number of gas importing countries, including EU member states currently over-reliant on Russia for their supplies. In other words, the spot LNG market now has the critical mass to offer security of supply.

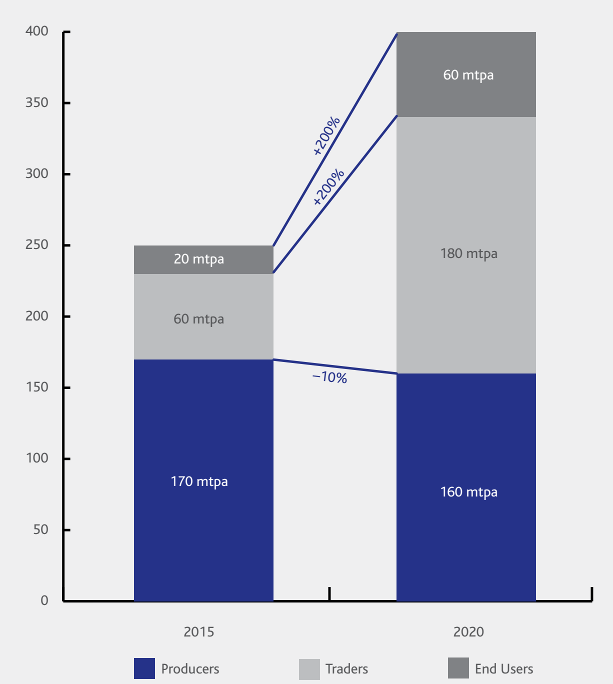
It is worth emphasising that securing adequately diversified supplies of natural gas is not a uniform challenge for EU member states. While Europe is already the third largest importer of LNG globally, those imports are overwhelmingly concentrated in the western European countries that have heavily invested in LNG regasification and storage facilities, namely the UK, Spain, France, the Netherlands and Belgium. See Figure 3 on the next page.

1 LNG MARKET GROWTH AND DIVERSITY



Source: Poten & Partners, Company Websites, Trafigura Research

2 WHO CONTROLS LNG MOLECULES



By contrast, the countries of south-eastern and north-eastern Europe do not have the infrastructure to import the required volumes of LNG and for this reason are largely still highly dependent on pipeline gas from Russia.

In consequence, we suggest that it is time for a renewed focus by policy-makers on building the basic infrastructure to support LNG imports in these vulnerable regions – essentially the Balkan states and the Baltic states. As this paper argues in more detail, this no longer means spending billions of euros and enduring the lead-times of several years required for the construction of major onshore regasification terminals, with all the financing and decision-making challenges they entail. Technological progress has created an altogether more flexible and affordable approach, through the use of specialised vessels known as Floating Storage and Regasification Units (FSRUs).

The remainder of this paper is devoted to a description of the benefits of this approach, and some case studies illustrating its application:

- The next article describes the approach in more detail.
- A third contribution outlines the experience of Lithuania in using an FSRU to build import capacity and explores the ramifications in the rest of the Baltic region.
- A fourth article frames a policy proposal for the Balkans, centred on Croatia.
- Finally, we provide case studies from Argentina and a number of other non-EU countries that have managed to make a rapid start in importing LNG through the use of FSRUs in recent years.

In summary, leasing an FSRU is the fastest and cheapest way for a country to start importing LNG. It is flexible - subject to periodic contract negotiations with specialist providers - and reliable, given the back-up the owners can provide. Even more important are the cost and time advantages. The initial investment required by way of capital expenditure to build basic jetty and pipeline facilities for an FSRU – typically between $50 and $150 million – is a fraction of the sums required to build an onshore terminal, and the lead-times involved are measured in months rather than years.

These factors make FSRUs an optimal solution for countries contemplating importing LNG, even on a modest scale. In nationally fragmented markets where gas demand needs to be built over time and future needs are not easily forecastable, an FSRU offers a modular approach to building import capacity. The low up-front capital expenditure radically simplifies and accelerates the task of securing an investment decision and in cases where government spending is involved minimises the call on the public purse. While operating costs are higher than for an onshore terminal, they can be funded entirely out of operating income.

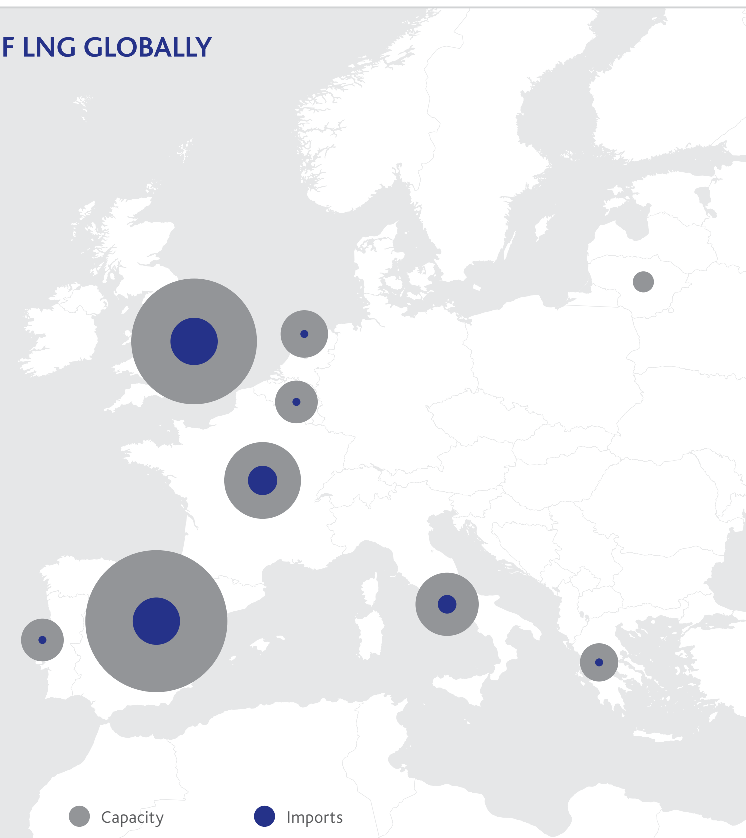
Finally, as the case of Lithuania demonstrates, the use of an FSRU offers gas importers a powerful instrument to negotiate and improve supply terms including pricing with their existing pipeline suppliers. So the upfront cost is more than defrayed by the overall saving on gas imports and the equally important improvement in security of supply.

3 EUROPE IS THE THIRD LARGEST IMPORTER OF LNG GLOBALLY

2014		
COUNTRY	CAPACITY*	IMPORTS*
Spain	60	11
United Kingdom	50	11
France	24	6
Italy	15	4
Netherlands	12	1
Belgium	9	1
Portugal	8	1
Greece	5	1
Lithuania	4	0

Source: GIIGNL, Trafigura Research

*Billion Cubic Meters /year



FSRUs AS A FAST TRACK TO LNG IMPORTS

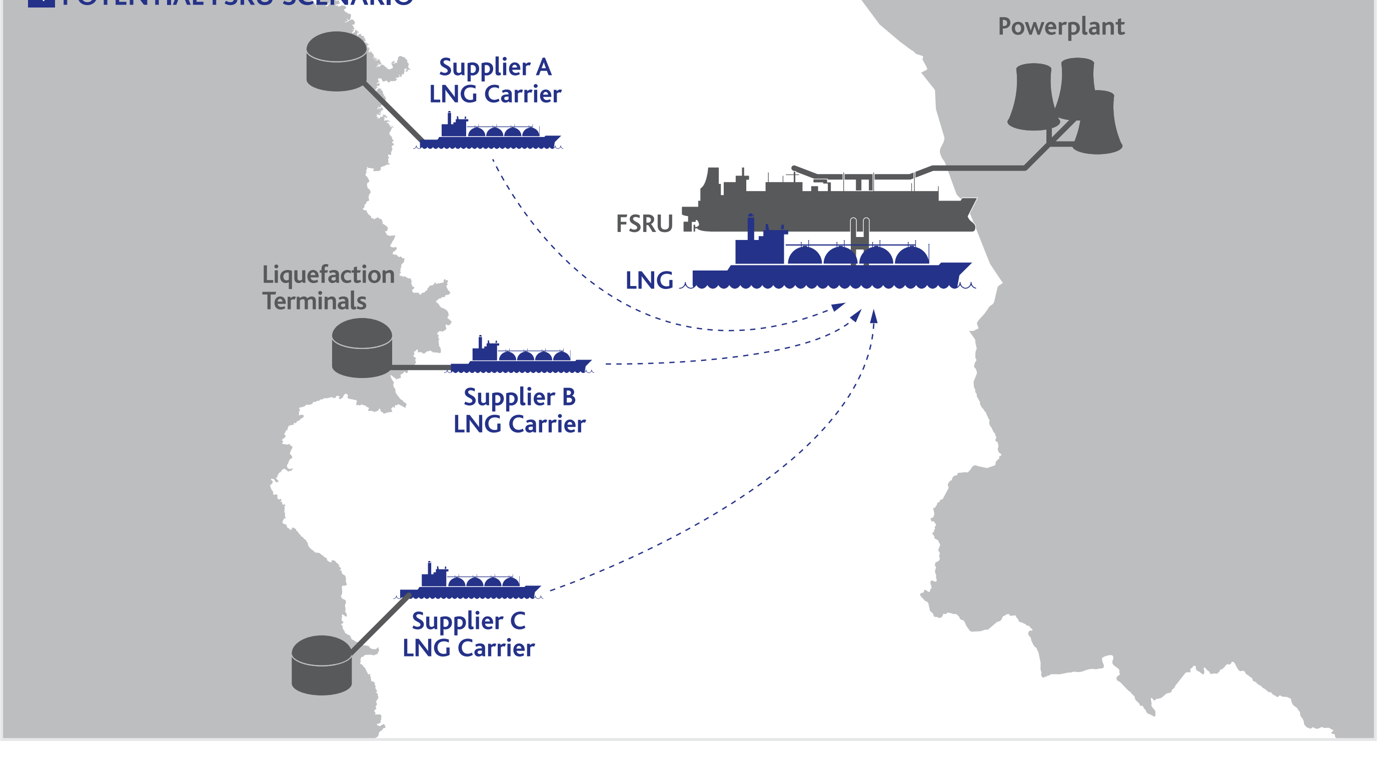
THE EVOLUTION OF IMPORT TERMINALS

For the 40 years following the first commercial delivery of LNG in 1964, onshore regasification terminals were the only method to import and regasify LNG. In the early 2000s, due to significant advances in regasification and vessel technology, it became possible to install an entire regasification unit onto a vessel. In 2005, Exmar delivered the first FSRU, the Excelerate Excelsior, to Excelerate Energy, with the idea being to quickly deliver LNG to new markets, which as of yet did not have regasification terminals. At the time, FSRUs conceptually functioned as a bridge for imports until an onshore terminal could be built. In 2007, Petrobras went a step further when it contracted Golar for an FSRU to serve as an import terminal for the next 10 years. This was a pivotal moment for the industry as it promoted FSRUs from a temporary bridging solution to a legitimate alternative to onshore regasification terminals. Since that project, many different countries have adopted LNG import solutions with offshore components. The vast range of projects, technologies and commercial arrangements currently in operation speak volumes to the versatility, efficacy and reliability of the floating regas concept. Over the last decade FSRUs have evolved into the optimal solution for a European country seeking to diversify natural gas supply with low upfront investment.

Potential FSRU Scenario

Country A needs to begin importing LNG quickly to cover growing power demand 4. Within a few months, it establishes a plan to lease an FSRU for 5 years with options to extend the contract or purchase the vessel every 5 years. Over the next 12 months, a jetty is built to receive the FSRU along with pipeline infrastructure connecting the jetty to the domestic gas grid. While construction is in progress, Country A finalises a 5-year contract to import LNG from a producer or an aggregator. Upon the charter commencing, the FSRU travels from its current location, loads a full LNG cargo, and arrives at the destination port. The vessel docks and connects to the newly constructed jetty and begins delivering natural gas onto the domestic gas grid. As the FSRU empties its initial cargo, an LNG carrier arrives from a producer or an aggregator and performs a ship-to-ship operation with the FSRU to resupply it. Natural gas send out is never interrupted during the resupply operation. This resupply process continues for 5 years. At the end of the initial charter period, Country A is very satisfied with the performance of the FSRU but domestic demand has increased beyond its capacity. A contract for a larger FSRU and increased supply are signed and LNG imports continue as per usual. This summarises the basics of an FSRU arrangement; however, every aspect of the above arrangement can be tailored to the requirements of the importing country.

4 POTENTIAL FSRU SCENARIO



FSRU Overview

In the most basic sense, LNG is imported for three major reasons: baseload supply, peak shaving, and security of supply. Egypt and Brazil import LNG for baseload supply: LNG imports are needed all year as both countries currently have insufficient domestic resources to fulfil demand. Baseload supply, by definition, cannot be interrupted, so FSRUs chartered for this purpose remain stationary at the port for the duration of the charter and are continuously supplied by LNG carriers through ship-to-ship (STS) transfers. These charters are usually for 5-20 years and with the FSRU only leaving the berth for maintenance purposes.

LNG can be imported for a country's baseload supply...

Dubai, Kuwait, the United States, and Israel import LNG for peak shaving: LNG imports are only necessary during annual periods of unusually high demand. As the FSRU is usually only needed for a particular season, it may be chartered for only a portion of the year. For example, Kuwait currently leases an FSRU for the warmest nine months of the year, leaving the vessel with the owners for the remaining three. In the case of the United States, whenever the weather is especially cold in Boston, Excelerate Energy brings in an FRSU to capture price spikes from domestic supply constraints.

... and for peak shaving during periods of high demand

Lithuania imports LNG for security of supply: LNG imports are essential to diversify and secure national energy supply. Before Lithuania acquired an FSRU it was completely dependent on Russia for all natural gas imports. The political and socioeconomic implications of this dependency placed the country in a vulnerable and potentially dangerous position every winter. Under these circumstances, LNG imports were necessary for national security.

LNG is imported for security of supply

Before an FSRU can begin operating, a jetty needs to be constructed to berth it and transfer natural gas onto the domestic grid. The total cost of this infrastructure is highly dependent on the existing facilities and local environmental conditions. If an existing jetty is available and can be repurposed to berth an FSRU, initial capex will be very low. Repurposing a jetty can be accomplished in 6 to 8 months for approximately $10-20 million. This includes all of the necessary equipment to deliver the natural gas onshore such as high-pressure receiving arms, piping, and measurement and testing systems. If a jetty needs to be constructed, there are three main preconditions. First, a minimum draft of 14-15 meters is typically required. Second, the port/berth needs to have sufficient space to bring in the FSRU and the LNG carrier, and safely perform an STS transfer between the two while complying with all relevant regulatory policies. Third, marine conditions at the berth need to be relatively calm. Assuming all of these pre-conditions are met, a single-sided jetty can be constructed in 9-15 months for approximately $50-75 million.

Capital expenditure is primarily driven by environmental conditions

If the draft is insufficient, there are two options: pursue an offshore mooring option or dredge the area under consideration to a sufficient depth. An option in this scenario is to use a special type of FSRU called a LNG Regasification Vessel (LNGRV). This vessel differs from a standard FSRU in one critical way: instead of discharging natural gas through high-pressure arms on the side of the vessel, it discharges into a subsea buoy. In its default state, the buoy rests on the seabed connected to a subsea pipeline that links to the domestic gas grid. Whenever the LNGRV approaches, the buoy rises from the seabed and mates with the vessel through a custom housing in the hull. This system typically requires a minimum water depth of 50m and costs at least $50 million excluding the costs of the subsea pipeline. Another possibility is to use a turret mooring system that is essentially a fixed column in the water that vessels can attach to and then discharge into. Dredging and offshore infrastructure are typically quite expensive and highly dependent on environmental conditions: thus a general cost estimate cannot reasonably be provided.

If marine conditions at the berth are not relatively calm, a STS operation may not be feasible. In this case, a double-sided jetty could help by allowing both vessels to moor to the jetty, rather than to each other, and transfer LNG in what is commonly known as an 'across the jetty' operation. Some importers take more conservative approach and build these as a base case. Double-sided jetties can be constructed in

12-18 months at a cost of $100-150 million. While the environmental requirements for an FSRU are more demanding than an onshore terminal, the cost of marine infrastructure for both is extremely dependent on local conditions. The following analysis assumes a construction time of 18 months at a cost of $75 million for a single -sided jetty and all relevant infrastructure. This is assumed to be the full capital expenditure for an FSRU-based import terminal to begin operating.

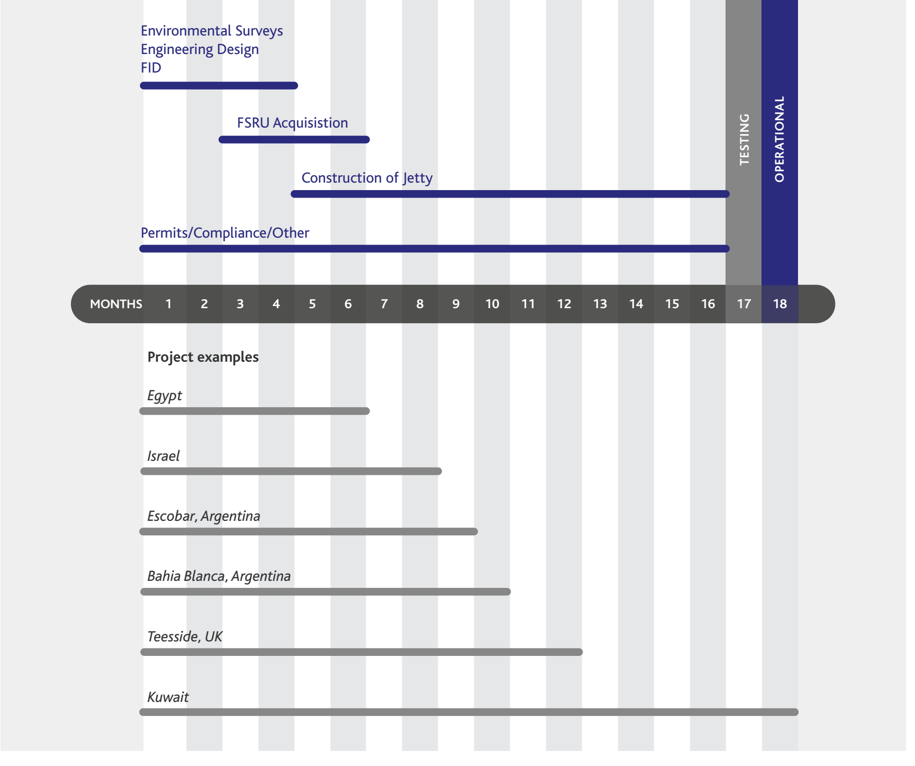
A development timeline, as seen in Figure 5, depicts the major milestones for an FSRU project. If the project is urgent, as is usually the case, development can be accelerated. Conversely, if environmental conditions are less than ideal, development will likely be delayed. To allow for comparison, the construction timelines of many of the projects mentioned in the text are displayed in grey. It is important to note that timelines shown for past projects are primarily time from final investment decision or contract award to operation. Time spent prior to final investment decision (FID) is highly dependent on the financial status and expertise of the developing party as well as the political and regulatory environment of the host country. Historically, this has ranged from a few months for countries that urgently needed to begin imports to a few years for countries that lacked the political will to proceed.

Political and financial conditions will affect FSRU timelines

Building a new FSRU takes around 24-36 months while converting an existing LNG carrier to an FSRU takes approximately 18-24 months. Notably, all of the projects in the timeline were able to become operational much sooner because they leased an existing, available FSRU rather than commissioning one to be built. Historically, uncommitted FSRUs have been available at relatively short notice for prospective projects, but this trend may not continue as the number of proposed FSRU projects begins to outnumber uncommitted FSRUs under construction. In a sub-optimal scenario, projects could be delayed by this time frame if no uncommitted vessels are available at the time of project inception. As all other steps in the timeline would be performed concurrently, the time to acquire an operational FSRU would become the limiting factor, lengthening the overall timeline to as much as 36 months.

Acquiring an operational FSRU on short notice may not always be feasible

5 FSRU DEVELOPMENT TIMELINE



THE COMPARISON

Capital Expenditure

The primary advantage of an FSRU-based import terminal is the very low initial capital expenditure (capex). The total capex for an FSRU-based import terminal is $75 million compared to $600 million for a similarly sized onshore terminal 6. Not only is the capex $525 million less, but the project financing requirements are much simpler, one of the largest hurdles for a prospective LNG terminal. To prove financial viability to potential investors and acquire financing, most onshore terminals pre-sell regasified LNG through long-term contracts. Long-term sales contracts inherently carry components of price and demand risk as these factors cannot be predicted or hedged, especially in less liquid European gas markets. If this risk cannot be passed downstream and remains with the terminal, financing costs increase. If the risk is passed downstream, the contractual LNG sale price will be decreased to compensate. Essentially, by the virtue of its long-term capex, the terminal creates risk that it will pay for in some fashion. Furthermore, final investment decision cannot be taken and construction cannot be started until the financing is fully secured easily causing significant delays to the timeline of any project. For example, Croatia's onshore terminal has been delayed for years due to financing difficulties. Conversely, an FSRU has minimal capex and can be leased for as little as five years, thus generating far less long-term risk and consequently lowering financing costs while accelerating the development timeline. Given the vast range of financing options, structures, and rates available to potential importers, we will avoid assumptions regarding the exact financing cost. However, it is very clear the onshore terminal will have a substantially higher direct financing cost as well the indirect opportunity cost of the capital deployed.

FSRU-based terminals have low initial capex and simpler financing

Construction Time

The time differential between constructing an onshore terminal and an FSRU is considerable 7. An FSRU can begin operation within 18 months, whereas an onshore terminal will take approximately 3-5 years. For the majority of FSRU projects referenced in the text, waiting an additional 3 years for LNG supply would have been untenable:

FRSUs can secure a country's energy future in a fraction of the time

6 ONSHORE TERMINAL VS FSRU COST COMPARISON (10 YEAR)

TOTAL COST	ONSHORE	FSRU	UNIT
Initial Capex	600	75	USD $MM
Opex: Charter Rate	0	49	USD $MM
Opex: Fuel Cost	11	21	USD $MM
Opex: Other	5	0.5	USD $MM
Total	693	675	USD $MM
Capacity	3	3	mtpa
Cost/Mmbtu	$0.88	$0.61	$/mmbtu
Operational Period	6	8.5	Years
Initial Cost (% of Total)	87%	11%	%

Onshore Terminals Assumptions: These terminals vary far more than FSRUs in terms of capacities, types, and technologies, making it difficult to assess the cost of a typical LNG regasification plant. Current market analysis shows that a 3 mtpa terminal will cost approximately $600 million to construct, 4 years to build, and $5 million a year to operate. Fuel usage is calculated by assuming 1% of total throughput will be consumed during operation. LNG import price is forecast using the NBP domestic gas marker. Additionally, we assume the terminal will be 85% utilised.

FSRU Assumptions: The capex of an FSRU has previously been explained to be $75 million. We assume a charter rate of $135,000/day and opex of $1,500/day. Fuel usage is calculated by assuming 2% of total throughput will be consumed during operation. LNG import price is forecast using the NBP domestic gas marker. Additionally, we assume the terminal will be 85% utilised.

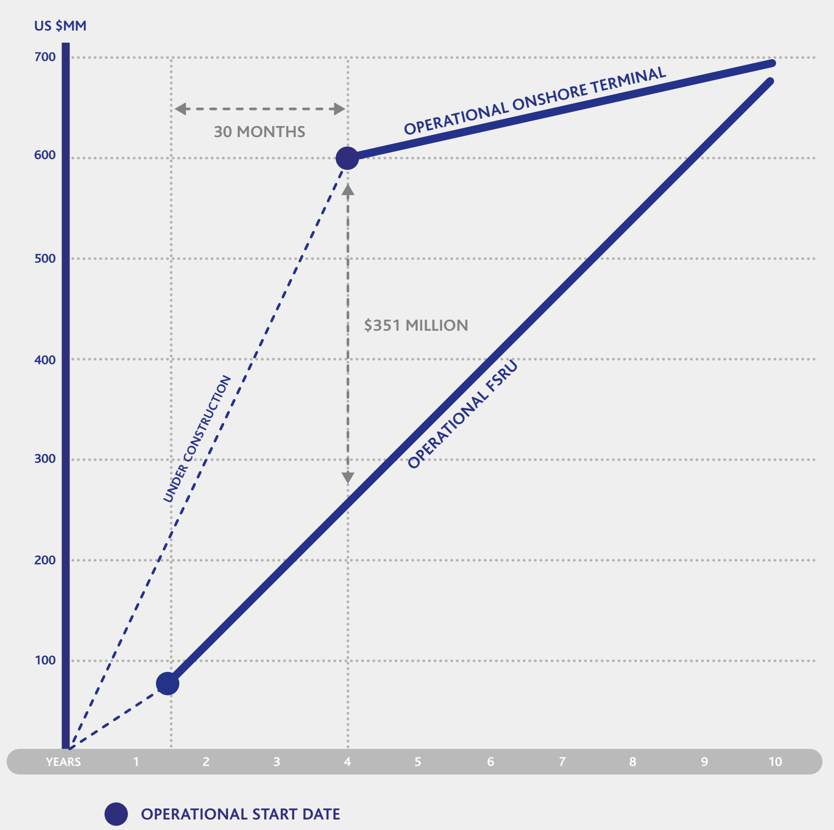
Egypt, Kuwait, and Argentina were facing rolling blackouts when they decided to import LNG. Even for European countries importing for security rather than scarcity of supply, every additional winter that the terminal is under construction could potentially prove to be disastrous. Furthermore, given the gross dependency of most European nations on Russia, especially in the Balkans and the Baltics, the ability to import LNG provides significant negotiating power, all but ensuring lower pipeline gas prices. In Lithuania's case, the threat of future contracted LNG supply provided sufficient leverage to secure a large reduction in the pipeline gas price from Russia, with the cost savings more than covering the total cost of the FSRU.

Operational Expenditure

The primary risk for an FSRU-based import terminal is the daily charter rate. Historically, FSRU charter rates have been very stable as they have primarily been a function of vessel cost. Since inception, they have shown little correlation with the LNG carrier market. Assuming this relationship continues, $135,000/day is a fair charter rate assumption. However, as interest in FSRUs continues to rise while supply remains low, rates could rise in the next few years. Our charter rate and fuel cost assumptions imply an annual operational expenditure (opex) of approximately $71 million/year. Comparatively, an onshore terminal requires a much lower opex of approximately $16 million/year. At first glance, this discrepancy of $45 million/year clearly favours the onshore terminal but the risk associated with these costs is highly dependent on either terminal's downstream commercial arrangement. If the regasified LNG from both terminal types has been presold, financial risk is minimal. However, if a large portion of the regasified LNG is being sold on a short-term basis and terminal utilisation is low, both terminals will face risks, albeit different ones, in recouping expenditures. The FSRU-based terminal will have difficulty covering its annual operational expenditure,

FSRUs provide additional methods of recouping expenditures

7 TIME AND COST COMPARISON: FSRU VS. ONSHORE TERMINAL



whereas the onshore terminal will have difficulty recouping its annual financing cost. In this situation, the risk from the FSRU is preferred because there are potentially exit options. The importing country, for a fee, could release the FSRU from its current contract or lease it to a third party, thus mitigating losses. An onshore terminal contains none of this flexibility and thus carries a much higher pressure to maintain high utilisation.

It must be noted that both the onshore terminal and the FSRU utilise a portion of the LNG imported each day as fuel to operate the regasification units. The exact percentage consumed depends on a variety of factors including but not limited to the efficiency of the regasification units. Additionally, for the FSRU, surrounding water temperature plays a significant role. The fuel cost will roughly equate to 1-2% of each cargo, with the onshore terminal providing slightly better efficiency. We assume 1% for an onshore regasification terminal and 2% for an FSRU in European waters.

Flexibility

Leasing provides flexibility to accommodate future demand scenarios

Onshore terminals are generally constructed on a significantly larger scale than FSRUs to ensure sufficient capacity to cover future demand increases. Additionally, they are usually paired with correspondingly large infrastructure projects to deliver gas to future customers, particularly in neighbouring countries. Given the number of governments, companies, and other entities involved, the development process can easily become a long and drawn out affair as various interests submit their needs and proposals. Even if the economics are favourable, it is important to account for the effect of inevitable political delays.

The smaller scale of FSRU projects, combined with their lower financing requirements, allows for a much greater chance of following the initial development timeline. Also, assuming a standard 5-10 year lease, host countries can begin importing LNG at current demand levels while continuing discussions on infrastructure projects. If domestic demand increases and/or if any associated infrastructure projects become viable, a larger or a second FSRU can be leased. Conversely, if a new fuel source pushes LNG out of the energy mix, the FSRU can be released. Furthermore, FSRUs offer additional flexibility in that they can be utilised variably throughout the year.

Currently FSRUs are leased in three different time charter arrangements. 1) The FSRU is permanently docked at the terminal and a STS transfer is performed with the LNG carrier. 2) The FSRU is leased for a fixed period of time each year. Kuwait currently leases an FSRU from Golar LNG for nine months out of the year, leaving the vessel in Golar's control for the other three. 3) The FSRU is brought in only when there is demand. Even within the first two arrangements, there is further flexibility. During the lease period, if the FSRU is experiencing a period of low utilisation, the vessel can be sub-leased to another terminal or used as a standard LNG carrier, thus recovering some of the operating costs. An onshore terminal provides none of this flexibility and essentially forces the host country to gamble hundreds of millions of dollars that its specific project design is the optimal solution to its energy needs for the next 20-30 years. The optionality offered by FSRUs lets policymakers continuously re-evaluate the situation, ensuring the best decision is always made.

Equity

FSRUs now allow importers to build equity as well

Onshore terminals are primarily favoured over FSRUs because they allow the importer to build equity in the asset. This argument is becoming increasingly weak as countries can usually purchase an FSRU for less than an onshore terminal and operate it at a similar cost. FSRU leases have recently begun to include purchase clauses. Furthermore, if the importer purchases the vessel and would like to sell it for any reason in the future, whether it be to purchase a larger one or import another fuel type, that can be easily accomplished. The advantage of an FSRU is the immense optionality embedded in the asset: for example, a country could lease an FSRU, leverage that capability to reduce the cost of their pipeline gas imports, and then purchase the vessel five years later to augment existing supply.

Additional Risks

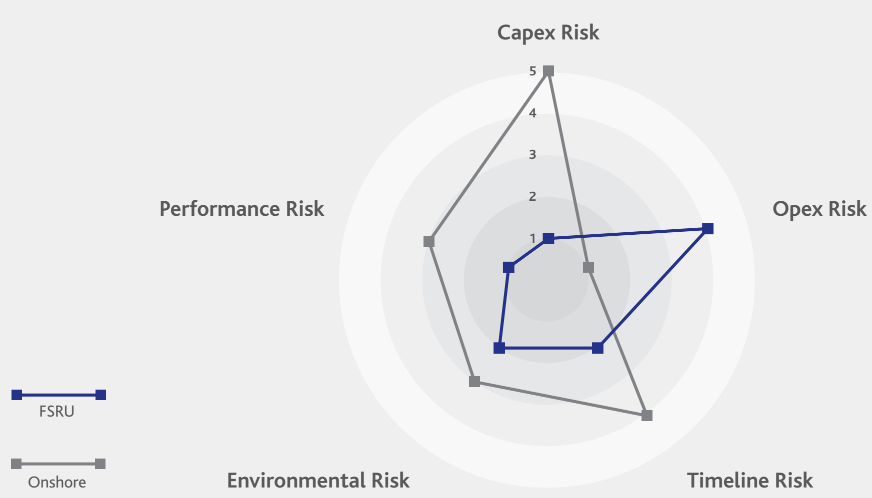
Figure 8 offers a visual summary and comparison of risks between FSRUs and onshore terminals. The chart offers a comparison within each category but does not imply the categories carry equivalent weight. CAPEX, OPEX, and Timeline Risk have been previously discussed at length. The category of Performance quantifies the operational risks taken on by the host country throughout the lifespan of the asset. For an onshore facility the host country is fully responsible for the terminal's design, engineering, and embedded technology. In the case of an FSRU, the host country pays the daily charter rate leaving the FSRU owner responsible for all issues. From this perspective, for the host country, there is far less performance risk when leasing an FSRU compared to an onshore terminal. Finally, in regards to environmental risk, onshore terminals have a much larger physical footprint and more regulatory guidelines to follow than an FSRU which operates as a self-contained offshore unit.

The host country has less performance risk leasing an FSRU

CONCLUSION

For European countries seeking to diversify, augment, and secure natural gas supplies, FSRUs offer the optimal blend of speed, cost, and flexibility. Low initial investment coupled with minimal construction requirements reduce financing needs and expedite development timelines. Typical FSRU lease structures allow countries to continuously adapt supply requirements to downstream demand through any type of market environment. Importers can purchase the asset and operate it long term if they are confident forecasting future demand. Opex tends to be the strongest argument against FSRUs, but this is defrayed by the immense optionality embedded in the asset. In sum, any coastal European country over-dependent on a single source of supply should look to FSRUs to tap into the resources of the global LNG market.

8 RISK COMPARISON: FSRU VS. ONSHORE TERMINAL



CASE STUDY: THE BALTIC STATES

Finland, Estonia and Latvia are dependent on a single supply source

Finland, Estonia, and Latvia are in quite a precarious position regarding diversity of supply as all three countries are completely dependent on Russia for their natural gas needs. Furthermore, neither the Baltic countries nor Finland are connected to any EU gas markets, Baltic interconnections notwithstanding[1]. According to the IEA, in 2013, regional demand totaled 8.6bcm, with Finland importing 3.5bcm, Lithuania importing 2.7bcm, Latvia importing 1.7bcm, and Estonia importing 0.7bcm. Of these four countries, Finland has the highest risk of a supply disruption as it does not have any gas connections to the Baltic States, relying solely on its direct link to Russia[2]. Supply risk in the Baltic States is slightly lower, primarily due to sizeable storage capacity in Latvia and the recently built LNG terminal in Lithuania. Stress tests have shown that these two assets would allow the Baltic region to function temporarily under emergency conditions and for possibly longer periods if additional connecting infrastructure is developed. However, these are extreme scenarios and all consumers in this region would suffer from any significant supply disruption. The European Commission has recognised the "energy isolation" of the Baltic region as a high priority issue and considered various solutions, including but not limited to onshore LNG terminals in Finland and Estonia, but no agreement has been reached on a "cost efficient solution"[1]. An FSRU located in Finland or Estonia, would qualify as a "cost efficient solution" that would quickly alleviate supply concerns in the region.

...and until recently, so was Lithuania

Until recently Lithuania was in a similar situation, completely reliant on Russia gas, piped through Belarus, for all of its natural gas needs. The country recognised the potential peril ahead and began to craft a solution to the issue. In 2010, the country established a plan to lease an FSRU and station it at the port of Klaipeda. This plan satisfied quite a few of Lithuania's energy objectives: 1) It eliminated the Lithuania's complete dependence on Russian Gas, 2) It allowed Lithuania to independently cover emergency gas demand, and 3) It gave the country access to international gas markets[3]. Following months of environmental, engineering, and feasibility studies, final investment decision was taken in 2012. The FSRU selected, the Independence, was a new build from Hoegh LNG with an annual capacity of approximately 4bcm/year. Given Lithuania's 2013 demand of 2.7bcm, the FSRU allows Lithuania to cover a large portion of its natural gas needs in an emergency.

A new FSRU has given Lithuania greater negotiating power and security of supply

A secondary benefit of the FSRU has been increased negotiating power with suppliers. As the project has progressed, especially after supply was secured from Statoil, Lithuania's negotiating power has been increasing[4]. The ability to import LNG essentially places a cap on the price that Russia can charge for natural gas. According to Mantas Bartuska, the chief executive of Klaipėdos Nafta, Lithuania will spend $568 million for the construction and operation of the terminal across the next 10 years[5]. The first cargo was delivered in October 2014, but what Lithuania was seeking, and ultimately achieved, was security of supply.

In light of the Lithuanian success story and recurring disputes between Ukraine and Russia over supply, the other Baltic States have likewise concluded that rapid diversification is essential. For the last few years, Finland and Estonia have proposed building LNG terminals. They recently agreed to pursue a joint venture; the project would involve both countries building onshore terminals on each side of the Gulf of Finland connected via pipeline, thus linking the gas markets and storage facilities of both countries. In 2013, Timo Kallio, the project director for Finland's terminal, said the total investment would exceed €500 million, with the Finnish terminal accounting for €380 million, and the connecting pipeline accounting for around €110 million[6]. In mid-2014, the European

Commission found the venture ineligible for investment aid. According to Gasum, Finland's sole natural gas importer, subsequent revisions have garnered some investment from the European Commission but not enough to make either project commercially viable. Both Finland and Estonia have announced their desire to proceed regardless but at the moment the future remains bleak[7]. The earliest either terminal could be operational would be 2019. In contrast, an FSRU-based import terminal could be constructed in less than 18 months for less than $100 million. In the case of Finland and Estonia, an FSRU project could probably be completed even faster on the back of design and feasibility studies already completed for the onshore projects. Furthermore, at these substantially reduced capex costs for each country, financing issues are far smaller, allowing both countries to lease an FSRU with capacity that easily surpasses their entire domestic consumption. For less than $200 million, Estonia, Latvia, and Finland could go from complete dependence on Russia for their gas needs, to complete independence with a far more reliable and secure supply source.

Onshore terminals in Finland and Estonia currently face financing hurdles

For less than $200 million, the Baltics could achieve energy independence

1 European Commission Report on the Findings of the Baltics and Finland Focus Group (2014).
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7 Gasum (2014) "Negotiations on Gulf of Finland LNG terminal end"

CASE STUDY: CROATIA

Croatia can become an important gas supplier to the Balkans...

When Russia abandoned the South Stream project to pipe natural gas to Eastern Europe, an opportunity was created for Croatia to become a regional hub for gas supplies to the Balkans. Many eastern European countries depend on Russia for a large portion of their natural gas imports and as political divisions render this dependency increasingly perilous, these countries are seeking to diversify and expand their supply base. To this end, Croatia is currently planning an onshore LNG import terminal on Krk Island to provide itself and the Balkan region with a source of secure, reliable, and competitively priced natural gas. An FSRU, on the other hand, would allow Croatia to achieve all these goals through an expedited process with much less expenditure.

Since 2007, the idea to build an onshore LNG terminal on Krk Island in Croatia has existed in several forms through various consortia[8]. Financing estimates in the subsequent period have ranged from €600 million for the terminal to in excess of €1 billion with associated infrastructure. According to the current plan, the facility will have an initial capacity of 4-6 bcm/year with the possibility for additional expansion[9]. The project is designed to cover Croatia's natural gas import needs, in slight excess of 1 bcm/year, while exporting the surplus to Slovenia and Hungary, among other countries. Slovenia's net imports are close to 1 bcm/year while Hungary's net imports are approximately 8 bcm/year[2]. The onshore terminal would not have the capacity to cover both countries initially, but further expansions would allow for that. Given the urgent need to diversify supply, the terminal has even been deemed a 'project of strategic importance' by the EU allowing it to be fast tracked for all permitting and regulatory approvals. However, despite the stated importance, seven years have gone by, several environmental and feasibility studies have been carried out, many companies have provided bids and proposals, but no consortium has been able to gather the necessary momentum to take the final investment. This is primarily due to its exorbitant initial capital expenditure and a best case operational date of early 2020. The LNG import concept is beneficial to the region, yet has proven unrealistic at the current price. We suggest it is time to consider an alternative solution.

... but financing for an LNG terminal has still not come to fruition

Similar to an onshore terminal, a normal FSRU with a capacity of 4bcm/year would fully cover Croatian imports while exporting excess gas to Slovenia and Hungary. This FSRU, as seen with Lithuania, would increase negotiating power with Russia for all three countries, thus generating cost savings that would consequently reduce the overall cost of the FSRU project. An onshore terminal would provide a similar benefit, albeit several years later. Additionally, in the event of a supply disruption in the region, LNG imports would be able to provide supply to any areas in need. The unique benefit of the FSRU over the onshore terminal would be flexibility in usage. If after a few years, demand for LNG increased and regional distribution infrastructure improved, a larger FSRU or a second FSRU could be brought in. Conversely, if domestic gas prices decreased enough to make LNG imports uneconomical and fears over security of supply subsided, the FSRU could be released at the end of the initial charter. Additionally, the initial contract could be structured to lease the FSRU only during the winter, specifically the months where the region is especially concerned about supply disruptions. Unlike an onshore terminal, an FSRU would be able to adapt to the continuously changing supply economics and geopolitics of the region.

An FSRU could provide emergency supply while increasing negotiating power for the region

Implementation of the FSRU would likely proceed faster than usual as the location has already been studied for LNG imports. The Krk island location was chosen for a variety of reasons, the foremost being its water depth, proximity to domestic gas infrastructure, and location within an active industrial zone, easing environmental concerns[10]. All of these factors suggest that the costs of implementing an FSRU project would be below the international average for projects of this kind. Assuming implementation costs of approximately $75 million, the FSRU would provide similar capabilities to the originally proposed onshore terminal with over $500 million less in upfront costs. As many of the initial studies, designs, and discussions have been completed, the timeline for the project likely be quicker than the usual 9-18 month timeframe. In view of the enormous cost savings, accelerated timeline, and inherent flexibility, the case for deploying an FSRU to Krk Island has never been stronger.

Implementation would be accelerated due to previous efforts to import LNG

8 Adria LNG: About the Company
9 LNG Croatia: About Us
10 Adria LNG Environmental Decision

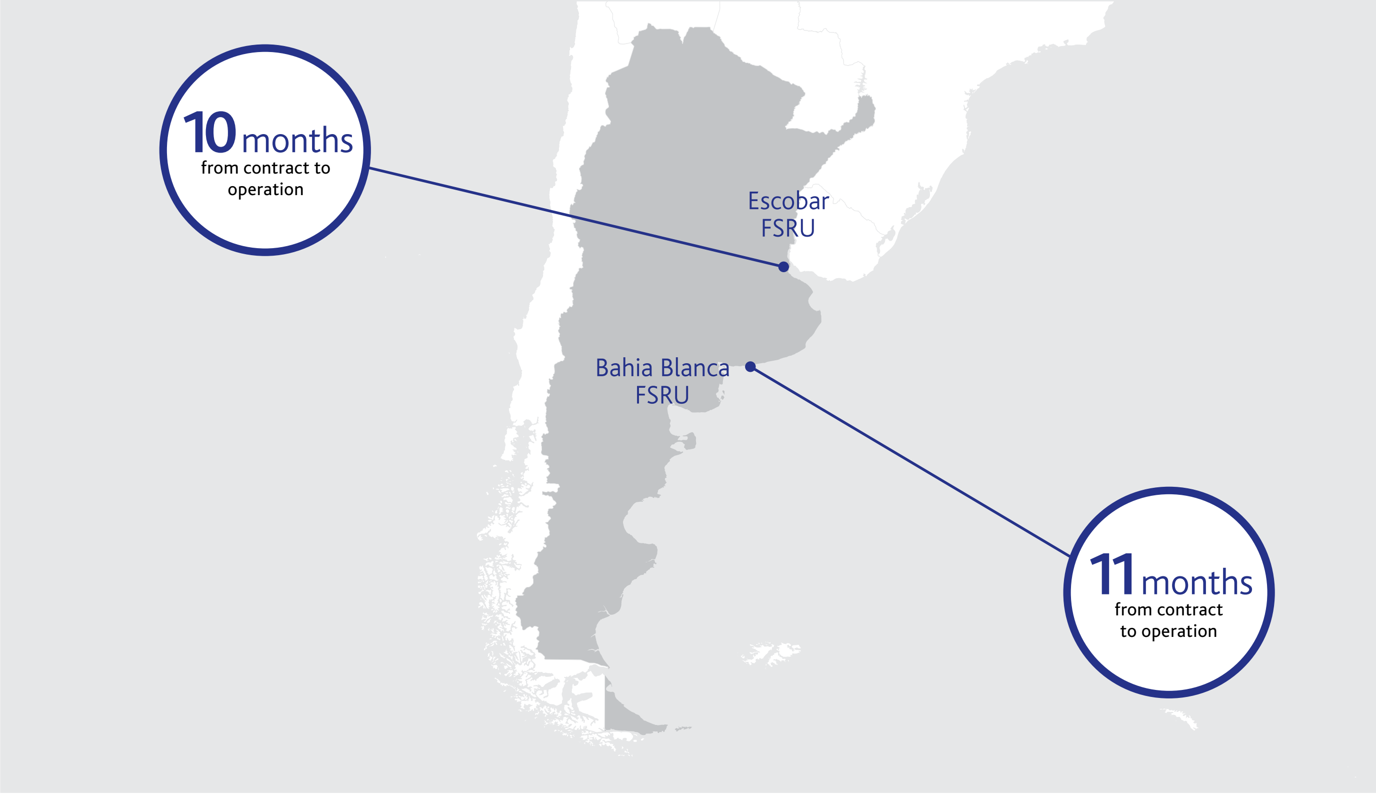
ADDITIONAL CASE STUDIES

ARGENTINA

In 2007, Argentina endured a severe winter and a simultaneous gas supply shortage. Supplies were diverted to households away from industrial consumers. The power grid began to collapse causing blackouts in Buenos Aires[11]. With domestic production continuing to fall, Argentina needed to quickly locate additional supplies. As Argentina is dependent on natural gas for over 50% of its energy needs across the residential, industrial, and transportation sectors, LNG was the obvious solution[12]. Due to the current and growing shortage, leasing an FSRU was the only realistic option. An agreement was signed with Excelerate Energy and an FSRU was in place at Bahia Blanca by May 2008, requiring only 11 months for design and construction[13]. Based on the success of the first project and increasing natural gas demand, Argentina contracted Excelerate to build a second FSRU at Escobar in 2010. This facility was developed even faster, taking 10 months from final investment decision (FID) to operation, just in time for the peak winter season[14]. The Escobar project cost approximately $180 million, in part due to necessary dredging and pipeline construction. Close to three million cubic meters of material had to be dredged to provide the facility with an adequately deep draft and a 31km pipeline was constructed to connect the facility to the domestic grid[15]. It is important to note that this investment is above normal but may be required for some FSRU locations. The reduced capex argument for FSRUs remains unaffected as similar costs would be incurred when constructing an onshore terminal.

Overall, this is an excellent example of the speed which FSRUs can be implemented and their inherent flexibility. Argentina was able to scale up floating regasification capacity to match the country's rising demand curve. When the country elected to begin importing LNG it did not have to forecast demand for the next 10-20 years and build capacity accordingly, like it would for an onshore terminal. It simply contracted the capacity that it needed, knowing that it could lease a larger FSRU or a second FSRU later on. Conversely, in the coming years, if more domestic gas resources are developed in the region and LNG imports decrease, the country can elect to release one or both of the FSRUs. Either way, Argentina's two FSRUs quickly saved the country from a supply crisis and will continue to provide a secure and stable source of energy for as long as necessary.

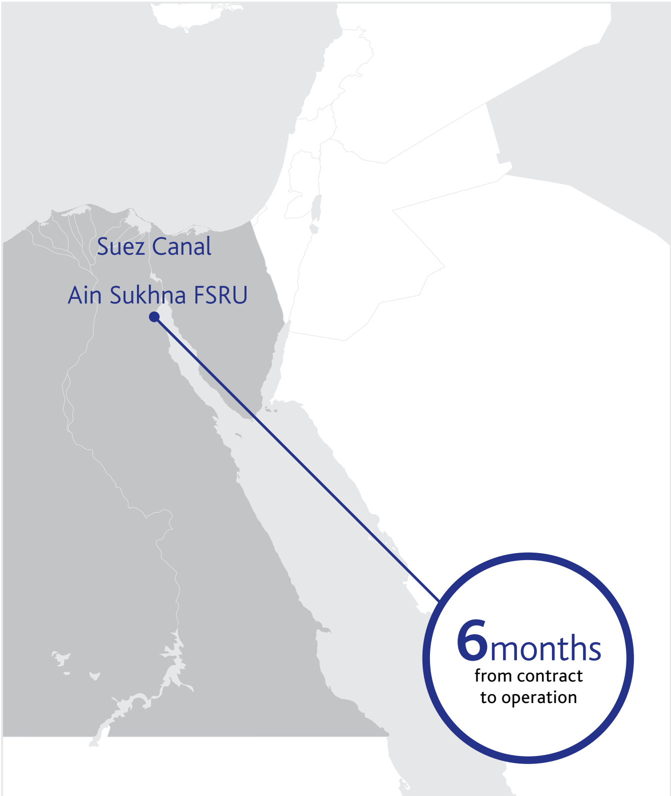
11 The Economist: Caught Short
12 EIA: Argentina Country Overview
13 Excelerate Energy: Bahia Blanca Gasport
14 Excelerate Energy: GNL Escobar
15 YPF Report: Escobar LNG



EGYPT

Prior to 2009, Egypt was exporting large volumes of natural gas and attracting foreign investment to increase domestic production and exports[16]. By 2014, Egypt was facing severe gas shortages, rolling blackouts, and serious economic challenges. This crisis had been years in the making, as consumption has grown steadily while production has remained relatively stagnant. Furthermore, a neglected and aging infrastructure base is struggling to support the increased power demand. Natural gas currently accounts for 53% of primary energy consumption and is growing as Egypt encourages switching from other fuels[17]. As power shortages worsened last year, Egypt entered talks to acquire an FSRU. In November 2014, Egypt finalised an agreement with Hoegh, one of the leading FSRU manufacturers, to lease the Gallant for 5 years at a cost of approximately $40 million/year[18]. Within six months an existing jetty was repurposed and Egypt received its first LNG cargo in April 2015. Despite the current FSRU's send out capacity of 5bcm/year, consumption will soon surpass it[19]. Egypt is currently searching for a second FSRU and will soon tender for additional supply. As seen in Argentina, FSRUs can be added as needed to ensure sufficient supply with minimal excess capacity, effectively maximising the value of capital deployed while retaining flexibility for future demand scenarios.

16 Foreign Policy Report: Sisi's Gas Pains
17 EIA Country Report: Egypt
18 ICIS: Hoegh and EGAS firm up FSRU time charter for Q1 2015 start
19 Hoegh LNG: Fleet



KUWAIT

In the early 2000s, Kuwait's demand for natural gas was increasing, primarily for use in electricity generation, while production struggled to keep pace. In 2007, consumption finally outstripped supply and the resulting shortages began to cause blackouts, especially in the scorching summer months. Kuwait began to divert gas from refinery and petrochemical operations while also boosting electricity generation from petroleum based fuels. However, this was a short-term solution to a growing long-term dilemma. Kuwait is one of the world's top ten producers of petroleum and other liquids. According to OPEC and IMF data, over 60% of its gross domestic product is derived from petroleum exports[20]. Using petroleum based fuels for electricity generation reduced national revenues while raising domestic electricity prices. Given that a large portion of Kuwait's generation capacity is gas-fired, the country made the easy choice to begin importing LNG. Building an onshore terminal was simply not an option given the immediate need for additional supply. In March 2008, Kuwait signed an agreement with Excelerate Energy to design and construct the Mina Al-Ahmadi Gas Port. Eighteen months later, in August 2009, Kuwait received its first LNG cargo. The facility cost approximately $200 million including extensive refurbishments and enhancements of existing jetty facilities[21]. The high cost was in part due to the unique mooring arrangement that was constructed. In most FSRU-based import terminals, the LNG carrier moors to the FSRU and transfers LNG through a STS operation. In Kuwait, both vessels moor to the jetty and all liquid and gas transfers are done through the jetty. The additional receiving and piping infrastructure significantly added to the cost.

After 5 years usage, Kuwait replaced the original FSRU from Excelerate with a larger vessel from Golar. Sendout capacity was relatively similar, but less fuel was consumed when regasifying each cargo, saving a considerable sum each day. Kuwait currently leases the FSRU for nine months out of year, leaving the vessel in Golar's control for the remaining three[22]. As demand continues to rise, Kuwait will likely lease the FSRU for the full year soon to provide constant baseload supply.

20 EIA: Kuwait, a leading oil exporter, relies on imports of liquefied natural gas
21 Excelerate Energy Report: Partnering with Kuwait
22 Golar LNG. (n.d) "Golar LNG Awarded Kuwait FSRU Contract."

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This document is a high level summary of internal institutional knowledge and numerous conversations with invested industry players including LNG suppliers, FSRU owners, EPC contractors, and terminal operators. The ideas presented within are a general consensus of best practices and estimates between all relevant parties.

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