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# Exporting the American Renaissance
# Global impacts of LNG exports from the United States

**A report by the Deloitte Center for Energy Solutions and Deloitte MarketPoint LLC**

**Deloitte Center for Energy Solutions**

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# Executive summary

In a startling about-face, natural gas market forces reversed course over the past several years. Expectations that the U.S. would become a major importer of liquefied natural gas ("LNG") have been replaced by the possibility of the U.S. becoming a major LNG exporter. As a result of a largely unforeseen surge in shale gas production, North American natural gas prices collapsed from over $10 per million British thermal units (MMBtu) in 2008, to under $3/MMBtu at various times during 2012. However, gas prices in Asia and Europe remain strong, creating huge spreads above U.S. prices.

Large price spreads between the U.S. and other regions have enticed foreign buyers seeking lower cost gas to consider U.S. supplies, while U.S. producers yearn for higher prices seen in foreign markets. As a result, U.S. LNG project developers seeking to arbitrage the large price spreads have submitted about 20 LNG export projects to the U.S. Department of Energy (DOE) for approval. The proposed projects represent approximately 27 billion cubic feet per day ("Bcfd") of LNG export capacity.[1]

Each world-scale LNG plant requires a multi-billion dollar investment to build, and given the enormity of the capital needed for development of U.S. LNG export facilities, project developers, regulators, and natural gas producers are keenly interested in understanding the potential impact of LNG exports on U.S. and worldwide natural gas markets. Clearly, not all or perhaps even a majority of the proposed projects are likely to come to fruition. But what would the impact be if the U.S. exported a significant volume of LNG?

To provide insight to this and other questions posed below, Cheniere Energy, Incorporated ("Cheniere") funded a study by Deloitte MarketPoint ("DMP") to conduct an objective, economic model based analysis of the potential impacts of LNG exports from the U.S. on domestic and global markets and prepare a report discussing the results of the analysis. Cheniere specifically requested that Deloitte MarketPoint make the report publicly available to inform interested parties. Cheniere provided no data or assumptions for inclusion in the report and did not request DMP to provide any viewpoint other than DMP's objective assessment of the potential market consequences.

While much attention has focused on the impact of U.S. LNG exports on the U.S. market, this study also specifically analyzes the potential economic consequences of those exports on global markets. It attempts to estimate the potential price impacts, gas supply changes, and flow displacements if the U.S. exported a given volume of LNG to either Asia or Europe. Key questions addressed in this report include:

- How could U.S. LNG exports affect prices in the U.S. and global markets?
- How much could price spreads narrow as a result of U.S. LNG exports and other market developments?
- Which countries might benefit from U.S. LNG exports and which ones might be disadvantaged?
- What future natural gas projects might be displaced?
- How could a more competitive global LNG market that is less dependent on oil-indexed gas prices affect projected results?

Although these highly speculative questions depend in part on actions of parties that do not always act according to free market principles, we developed market scenarios and tested alternative market behaviors to understand key drivers and obtain a sense of the magnitude of potential outcomes. We do not present our results as predictions of market outcomes or actions of particular parties, but rather as a study of how exports might alter the economic balance in global natural gas markets.

### World Gas Model and assumptions

Deloitte MarketPoint utilized its World Gas Model to analyze prices and quantities in global markets under alternative market assumptions. The World Gas Model (WGM) includes disaggregated representations of supply and demand in North America, Europe, Asia, and other major global markets and their linkages through global LNG trade or export pipelines. It computes prices and quantities simultaneously across multiple markets on a monthly basis over a 30-year time horizon based on rigorous adherence to established microeconomic theories. Unlike many other models that assume all parties work together to achieve a single global objective, the WGM represents self-interested decisions made by each market "agent" along each stage of the supply chain. (More information about the World Gas Model is included in the Analytical Approach and Market Scenarios section and further detail can be obtained from DMP).

[1] http://www.fe.doe.gov/programs/gasregulation/reports/Long_Term_LNG_Export_10-12-12.pdf

Using the WGM, we analyzed the impact of a fixed volume of U.S. LNG exports on U.S. and global gas markets for two alternative hypothetical market scenarios. The first market scenario, "Business-as-usual," contemplates that global LNG markets will support prolonged oil-price indexation. The second scenario, "Competitive Response," assumes increased competition resulting from the influence of some newer sources of supply that will be coming on-line over the next decade.

For each market scenario, we specifically analyzed the impact of 6 Bcfd of U.S. LNG exports shipped to either Asia (2 Bcfd each to Japan, South Korea, and India) or Europe (3 Bcfd each to UK and Spain). The 6 Bcfd of exports is not a projection of the volumes that might be economic to export, but rather an assumption to enable evaluation of what impacts might arise. We compared the results of each export case to a reference case with no U.S. LNG exports to determine potential price impacts and supply displacements. Figure 1.1 summarizes the cases and scenarios we considered and present in this study.

Figure 1.1: Market scenarios and export cases

| | Business-as-usual scenario | Competitive response scenario |
|---|---|---|
| **No export case** | • No LNG exports from U.S.<br>• Prolonged oil-price indexation | • No LNG exports from U.S.<br>• More competitively priced supplies |
| **Asia export case (6 Bcfd)** | • 2 Bcfd each to Japan, Korea, and India<br>• Prolonged oil-price indexation | • 2 Bcfd each to Japan, Korea, and India<br>• More competitively priced supplies |
| **Europe export case (6 Bcfd)** | • 3 Bcfd each to UK and Spain<br>• Prolonged oil-price indexation | • 3 Bcfd each to UK and Spain<br>• More competitively priced supplies |

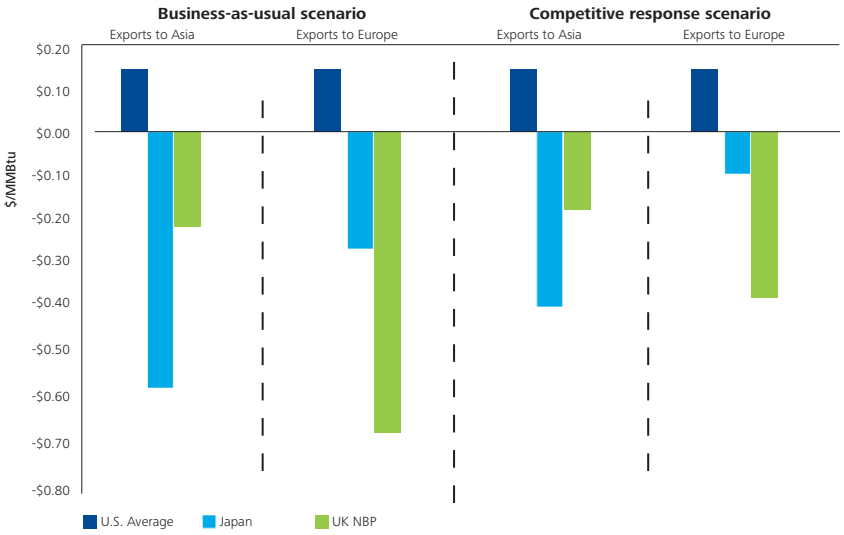
## Key findings

The study reveals complex market dynamics, but under close examination, clear economic impacts with potential geopolitical implications become evident. Below are highlighted major findings resulting from 6 Bcfd of LNG being exported from the U.S.

- **U.S. LNG exports could hasten the transition away from oil price indexation of gas supply contracts.** Decoupling from oil-indexed prices is already occurring in some European markets and might happen in Asian markets, especially with the projected growth in Australian LNG. If Asian markets decouple from oil-indexed prices, their prices could drop sharply over the next several years. Since supplies for U.S. LNG exports are expected to be pegged to U.S. gas prices (e.g. Henry Hub), rather than oil prices, the incremental volumes could result in global gas markets transitioning more rapidly to prices set by "gas-on-gas" market competition.
- **Prices are projected to decrease fairly significantly in regions importing U.S. LNG, but only marginally increase in the U.S.** The projected increase of average U.S. prices from 2016 to 2030 is about $0.15/MMBtu, while the corresponding price decrease in importing countries could be several times higher (see Figure 1.2). Furthermore, the interconnectivity of gas markets causes price impacts to be felt globally, not just in the countries importing U.S. LNG.
- **U.S. LNG exports are projected to narrow the price difference between the U.S. and export markets and hence, the market will likely limit the volume of economically viable U.S. LNG exports**. As prices in the U.S. firm and prices in export markets soften, the margins between the U.S. and global markets will narrow and limit the LNG export volumes even without government intervention. For example, the spread is projected to be reduced by $0.84/MMBtu if 6 Bcfd of exports are sent to Europe under the Business-as-usual scenario ($0.15/MMBtu average increase in U.S. price and $0.69/MMBtu decrease in Europe).

- **U.S. LNG exports are projected to provide an economic benefit to gas importing countries.** While the price impact in the U.S. is projected to be fairly minimal because of the large size of the North American resource base and responsiveness of the U.S. gas market to price signals, the global impact could be more than what the relative size of 6 Bcfd of exports might indicate. Because of the embedded take-or-pay volumes in long-term gas supply contracts and limited regional production in many parts of the world, U.S. LNG exports could reduce global prices and cost of supplies for gas importers.
- **Gas exporting countries could suffer a decline in trade revenue due to price erosion and/or supply displacement.** Entry of new supply clearly benefits consumers, but negatively impacts suppliers through price reductions and/or direct displacement of their export volumes. Even if gas supply in a region is not directly displaced by U.S. LNG exports, its producers might suffer decline in revenues due to lower prices affecting the region. Furthermore, gas exporting countries could face increased pressure to adopt market-based gas prices in lieu of oil-indexed prices. As the world's largest gas exporter by both volume and revenue and a high cost gas provider into Europe, Russia appears to be particularly vulnerable, especially if U.S. LNG exports are sent to Europe.
- **U.S. LNG exports could also displace some oil consumption through increased gas-fired electric power generation.** The ultimate potential for oil displacement in electric generation may be as high as 5 million barrels per day globally. The availability of competitively priced gas could incentivize displacement of oil-fired power generation, which would also provide environmental benefits through lower carbon emissions.

**Figure 1.2: Projected price impact from 2016 to 2030 by scenario ($/MMBtu, real 2012 $)**




Source: DMP World Gas Model projection (October 2012).

Which countries are likely to benefit from U.S. LNG exports and which countries are disadvantaged? Figure 1.3 displays the top gas importing and exporting countries by volume in 2011. To highlight the dramatic changes that are occurring in the global natural gas market, it is interesting to note that although Australia appears well down the list of gas exporters in Figure 1.3, it is projected to become the global leader in LNG exports over the coming decade.

In Figure 1.4 we have listed the members of the Gas Exporting Countries Forum (GECF),[2] which cumulatively account for about half of the world's export volumes. GECF members include some of the world's largest gas exporting nations, as well as Iran and Venezuela, which could potentially be major future gas exporters if various political obstacles can be overcome. The GECF member countries are listed separately because its purpose is to promote collaboration among its members, and working together could wield particular influence on the dynamics of the global natural gas market.

As can be seen in Figure 1.3, the leading importing countries are generally stable, OECD member countries with longstanding trade relationships with the U.S. Most are also members of NATO and tend to have strong defense ties to the U.S. On the other hand, many current and potential gas exporting countries shown in Figures 1.3 and 1.4 are non-OECD members, including a few that have more challenged relationships with the U.S. This study examines the complex market dynamics and the possible economic impact of U.S. LNG exports to the global natural gas market, including those with important potential geopolitical implications.

**Figure 1.3: Top gas importing and exporting countries**

| Top Gas Importers in 2011 | | Top Gas Exporters in 2011 | |
|---|---|---|---|
| Country | Net Imports (Bcfd) | Country | Net Exports (Bcfd) |
| Japan | 10.3 | Russia | 18.5 |
| Germany | 7.0 | Qatar | 11.8 |
| Italy | 6.7 | Norway | 9.4 |
| US | 5.4 | Canada | 5.6 |
| South Korea | 4.8 | Algeria | 5.0 |
| France | 4.3 | Other Africa | 4.1 |
| Turkey | 4.0 | Indonesia | 3.7 |
| Ukraine | 3.9 | Netherlands | 3.5 |
| United Kingdom | 3.6 | Australia | 2.5 |
| Spain | 3.4 | Trinidad and Tobago | 1.8 |

Source: BP Statistical Review (2012)

**Figure 1.4: Gas Exporting Countries Forum members**

| Gas Exporting Countries Forum | |
|---|---|
| Algeria | Nigeria |
| Bolivia | Oman |
| Egypt | Qatar |
| Equatorial Guinea | Russia |
| Iran | Trinidad and Tobago |
| Libya | Venezuela |

Source: GECF website

[2] According to their website: "The Gas Exporting Countries Forum (GECF) is a gathering of the world's leading gas producers and was set up as international governmental organization with the objective to increase the level of coordination and strengthen the collaboration among Member countries." http://www.gecf.org/

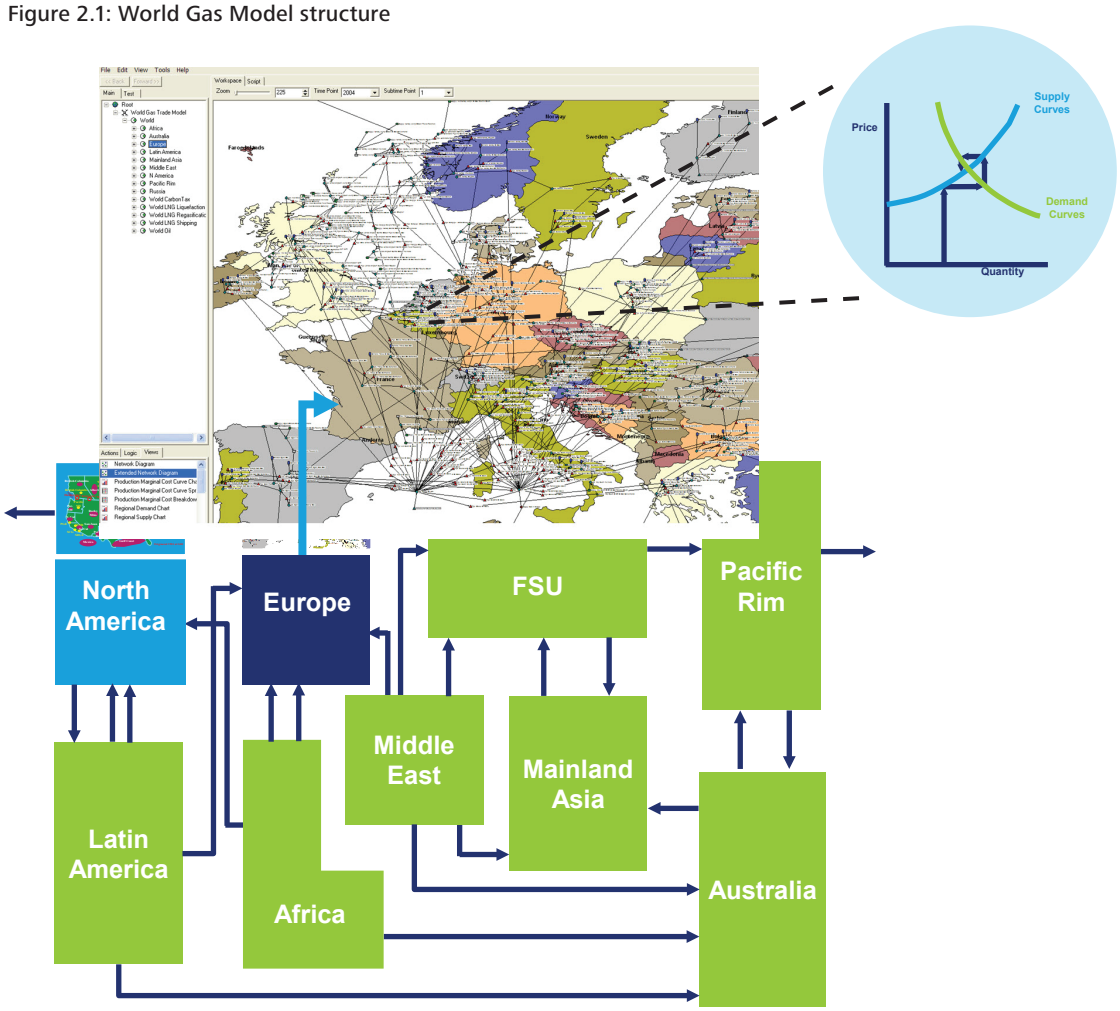
# Analytical approach and market scenarios

## Analytical approach

Deloitte MarketPoint applied its World Gas Model (WGM) to analyze the impact of U.S. LNG exports given alternative market scenarios. The WGM, an economic model of long-term global natural gas markets, projects gas prices, production volumes, and flows through 2046. The projected prices in the WGM reflect the economic value of gas, as opposed to contract or regulated prices.

The WGM includes disaggregated representations of supply and demand in global markets, including North America, Europe, and Asia, and their linkages through global LNG shipments or pipeline exports. Figure 2.1 illustrates the regional structure of the model including a screenshot of the WGM's high-level nodal detail for Europe. Each region (e.g., Europe) includes a detailed representation of the major countries within the region with inbound and outbound flows to other regions. Within each country are representations of its gas supply basins, pipeline and LNG infrastructure, storage facilities, and demand regions. In each market area, all sources compete against each other to serve demand downstream of the market. Market clearing prices and quantities are computed by solving for supply and demand equilibrium, as depicted in the supply-demand chart, simultaneously across all markets and over all time points. Unlike many other models which assume that all parties work together to achieve a single global objective, the WGM represents self-interested decisions made by each market "agent" along every stage of the supply chain.

Figure 2.1: World Gas Model structure



Exactly how much prices will change really depends on market dynamics including how the LNG export volumes affect the marginal source in each market. That is, price impact will depend on the elasticity of supply and, to a lesser degree, elasticity of demand. Rather than estimate supply response through a statistical function and estimated supply elasticity terms, the WGM represents gas supplier decisions given the various supplies competing in each market, including estimates of delivered costs for each supply into a market. With entry of new supply (e.g., U.S. LNG exports) into a market, the model computes what sources will be displaced and how that affects the price. The displaced supplies, in turn, seek other markets so there is a recalculation of supply demand balance throughout the world.

Furthermore, natural gas is a depletable resource, meaning that there is a fixed volume that cannot be replenished over time. What is produced in one period is not available for production in future periods. Unlike most models, which require assumptions on productive capacity over time, the WGM computes productive capacity over time by representing producer decisions given their resource endowments and anticipated forward prices. The resources are characterized by supply curves estimating the capital and operating costs to find and develop gas volumes. The model uses discounted cash flow to compute the value of reserve additions and production given the supply curves and projected wellhead prices. Through an iterative algorithm, the WGM computes the optimal timing of reserve additions and production that maximizes net present value to producers.

Vital to this analysis, WGM represents capital decisions regarding capacity additions for infrastructure such as LNG terminals and gas pipelines. These decisions require up-front capital expenditures plus finance charges, ongoing variable costs, and required rates of return. The model computes when and how much to build based on future margins that could be captured if capacity were added. Since we are analyzing long-term markets, we need to consider potential future market developments, not just against what currently exists. The WGM enables us to analyze how U.S. LNG exports might impact possible future projects.

### Oil-price indexed contracts

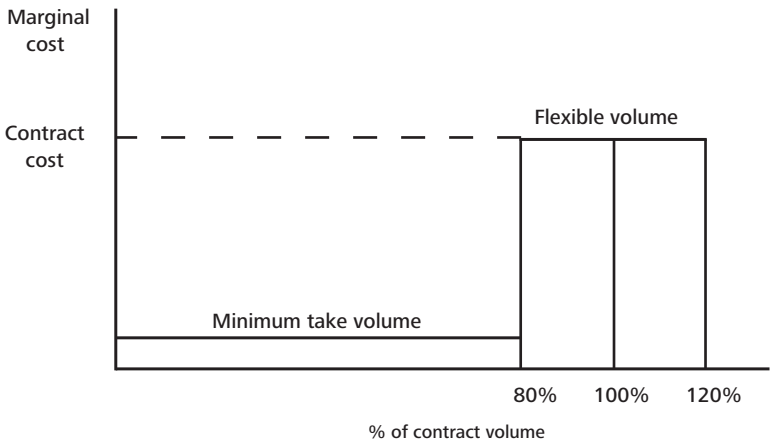
Crucial to any global gas market analysis is a proper representation of long-term gas supply contracts, which in many parts of the world are indexed to the price of oil (e.g., Japan Customs-cleared Crude (JCC)). When oil price indexation was first adopted in markets, natural gas markets were thinly traded so it made economic sense to index price of natural gas to oil, which to a degree was a fuel substitute with similar delivered costs. However, over the years, oil prices have risen to the point where it trades at a premium over gas. For example, an oil price of $90 per barrel, which contains about 6 MMBtu, would be equivalent to about $15/MMBtu. Not coincidentally, $15/MMBtu is close to the current price[3] in Japan, which is dependent on oil-price indexed LNG supplies. Gas exporters would obviously like to maintain high prices afforded by oil-price indexation. However, gas exporters are facing increased challenges from new supplies trying to enter the market and buyers seeking better terms.

A major uncertainty facing global gas markets is how long gas prices will be tied to oil-indexed prices. U.S. LNG exports could have a significant impact in determining the outcome. One of the attractions of U.S. LNG to buyers, particularly in Asia, is that it is generally available under terms not indexed to oil prices. As such, U.S. LNG may help erode the hold of oil-price indexation and transition markets to more competitively set prices, which are likely to be significantly lower. One of the key results of our analysis is how U.S. LNG exports affect the ability of exporters to maintain oil-price indexation of gas prices in various regions.

[3] Federal Energy Regulatory Commission estimate for December 2012, http://www.ferc.gov/market-oversight/mkt-gas/overview/ngas-ovr-lng-wld-pr-est.pdf

In Figure 2.2, oil-price indexed contracts typically have a fixed volume that must be purchased by the buyer regardless of whether delivery is taken (i.e., minimum take volume) and a flexible volume, which a buyer can purchase at their own volition. The minimum take volume typically comprises the majority, around 80% to 90% of the contracted volume, and can be considered sunk cost since it must be paid regardless of whether volumes are actually taken. The flexible portion is crucially important to markets since it could be the marginal source that sets the market price. Historical prices at UK's National Balancing Point (NBP) can be explained by this structure. During peak periods, prices gravitate near oil-indexed price since flexible contracted volumes are required. However, during non-peak periods, prices fall well below contracted prices since the flexible volumes are not required and other competitively price supplies set the price.

Figure 2.2: Representation of oil-price indexed contracts




The structure of oil-indexed price contracts leads to an important realization that the entire volume of contracted supply need not be displaced in order for markets to deviate from oil-price indexation. Since the marginal supply sets the market price, minimum take volumes, which only require incremental variable costs, would not likely be the marginal source setting market prices. Either the flexible volumes of contracts, pegged to oil price, or some uncontracted supply will set the market price, which we take to mean the spot price.

The implications of the contractual structure are profound. Since the bulk of supplies are contracted minimum take volumes, the transition to competitive prices, set by gas-on-gas competition, could be rapid once significant non-oil indexed supplies enter the market.

Figure 2.3: Aggregate supply and demand curves

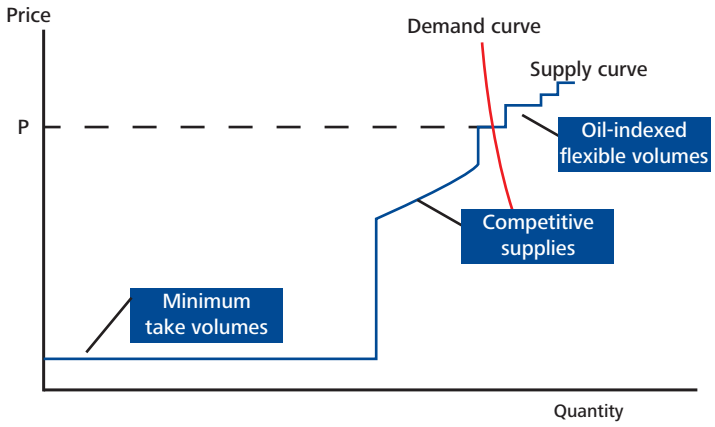
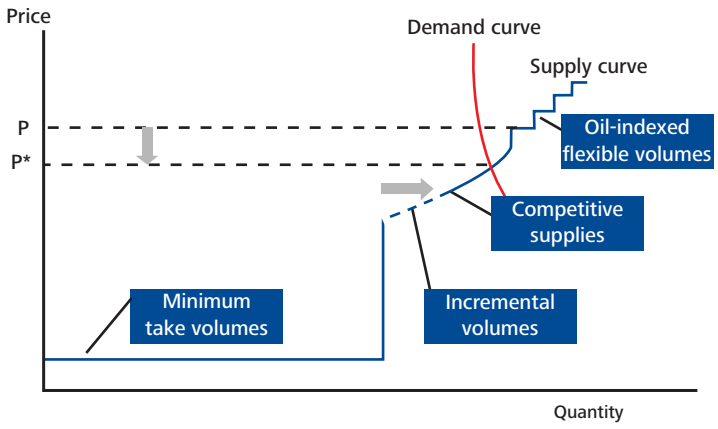



Figure 2.3 shows how an aggregate supply curve, including contracted minimum take volumes, competitively priced supplies, and flexible contract volumes available at oil-indexed, might look when stacked according to their marginal cost to market. The lowest cost section is comprised of minimum take volumes of long-term gas supply contracts. The volumes might have been contracted at high oil-indexed prices, but since the costs are sunk, the marginal costs are low. The next highest cost section is comprised of competitive supplies, which we have defined as non-contracted supplies that are priced according to market forces. The highest cost section of the supply curve is comprised of flexible oil-indexed contract volumes, which are volumes above minimum take contractual volumes that can be had at an oil-indexed price. The market clearing price is set by the intersection of the supply and demand curves. In this example, the demand curve intersects the supply curve at the least cost oil-indexed make up volume and its cost sets the market price, P. Notice that there are higher cost oil-indexed contract volumes that are not utilized because they are out of the money. Sellers of these high cost gas suppliers would just be selling their minimum take volumes.

Let us now examine what happens when we introduce additional volumes. Figure 2.4 illustrates what happens to price with the addition of competitively priced gas volumes to the supply curve. The section of supply curve that is available at higher cost than the incremental supply is shifted to the right by the incremental volumes. If demand is unchanged, the new market clearing price, P*, will then be set by the cost of a different marginal supply. In the figure, a competitive supply, rather than an oil-indexed supply, is now the marginal supply and its cost sets the market clearing price. As the diagram shows, the price drop could be significant since price is set by competitively priced supplies, which are estimated to be far lower cost than oil-indexed gas supply contracts in most markets. These charts indicate how sensitive gas prices could be to supply volumes. Competitively priced supplies do not need to displace all of the contracted volumes in a market, but just the flexible volumes indexed to oil prices to decouple markets away from oil-indexed gas prices. Furthermore, as gas suppliers see their volumes reduced to just minimum take volumes with the entry of increased competitive supplies, they might be willing to make more of their contracted volumes available at spot prices, further accelerating the transition.

There is widespread expectation that European and possibly Asian markets will eventually delink from oil-indexed prices, but the real question is how quickly this transition will occur. U.S. LNG exports might hasten this transition by applying competitive pressures on all gas suppliers. The timing of transition will depend partially on how gas exporters price their supplies to markets, which is difficult to gauge, so we developed alternative market scenarios.

**Figure 2.4: Supply curve with incremental supply**



## Market scenarios and cases

While there are many market scenarios and assumptions that could be made, we felt that a key issue in global gas markets is how quickly markets will transition from gas prices set by oil-price indexation to competitively set prices based on gas-on-gas competition. Of course, there are a multitude of factors, such as demand growth, new pipeline and LNG projects, and gas supply development, that will help determine the timing of this transition, but we simply postulated two market scenarios based on how major exporters would react to supply competition:

1. **Business-as-usual (BAU) scenario:** Some major current gas exporters, such as Russia, Qatar, Algeria, and Indonesia, are assumed to maintain oil-price indexation of their gas supplies. As existing contracts expire, they are assumed to require oil-indexed prices for future volumes. Other producers, such as Australia, Nigeria, and Turkmenistan, are assumed to be more opportunistic and price their gas according to what the market will bear (e.g., price takers). That is, they are assumed to make production decisions that maximize profits given projected prices at their wellhead and their resource endowments.

2. **Competitive Response scenario:** Major gas exporters using oil-price indexation are assumed to respond to growing market competition by gradually increasing the volume of their supplies available on a competitive basis, as opposed to rigidly holding to oil-indexed prices. This scenario does not change the available supply volumes, but only the pricing of those volumes.

The goal in defining the scenarios was not to specify a reasonable range of market outcomes, but to test how different pricing behaviors might affect the impact of U.S. LNG exports. We do not view the two scenarios as extreme market scenarios that bound the range of potential outcomes. Moreover, one does not reflect continuation of oil-indexed prices and the other competitive markets. Rather, they both reflect a continuation of current market trends and an eventual transition to competitive markets. The difference between the two scenarios is the assumption of how current major gas exporters will react to increasing competitive pressures. The BAU scenario assumes strict adherence to oil-indexed pricing while the Competitive Response scenario reflects gradual adoption of competitive pricing by major exporters as a result of competitive pressures. In both scenarios, existing supply contracts are represented and hold strong influence over projected market prices. In both scenarios, producers are assumed to be able to develop as much supply as is economic for domestic markets (e.g., China, India) and some gas exporters, such as Australia and West African countries are assumed to be able to export as much LNG as is economic. Of course, one could argue that recent Australian contracts have been signed at oil-indexed prices by Asian buyers and future contracts will continue to do so. However, these contracts were signed when global LNG supplies were tight. With buyers having few options, LNG sellers were able to extract favorable terms. Our assumption is that future contracts will not need to strictly adhere to oil-indexed prices, but rather reflect competitive prices set by gas-on-gas competition. European contracts are already starting to reflect competitive prices as portions of contractual volumes are indexed to hub prices. Alternatively, contracts might still be indexed to oil prices, but instead of a coefficient that reflects oil price parity, the coefficient might be lower to build in a "discount" factor which reflects competitive gas prices. European supply contracts reflect a built-in discount due to the more competitive nature of its gas market than Asian LNG contracts, which are more closely pegged to oil-parity pricing.

Under each market scenario, we ran two cases, one without and one with U.S. LNG exports. For the purpose of this study, we have assumed no exports from Canada so that we can isolate the impact of U.S. LNG exports. In reality, U.S. and Canadian LNG exports will likely compete against each other to some degree, and the impact of U.S. LNG export would be partially mitigated by offsetting actions from Canadian exporters (e.g., increasing U.S. LNG exports would tend to decrease Canadian exports and vice versa). The market scenarios and export cases are summarized in Figure 2.5.

**Figure 2.5: Market scenarios and export cases**

| | Business-as-usual scenario | Competitive response scenario |
|---|---|---|
| **No export case** | • No LNG exports from U.S.<br>• Prolonged oil-price indexation | • No LNG exports from U.S.<br>• More competitively priced supplies |
| **Asia export case (6 Bcfd)** | • 2 Bcfd each to Japan, Korea, and India<br>• Prolonged oil-price indexation | • 2 Bcfd each to Japan, Korea, and India<br>• More competitively priced supplies |
| **Europe export case (6 Bcfd)** | • 3 Bcfd each to UK and Spain<br>• Prolonged oil-price indexation | • 3 Bcfd each to UK and Spain<br>• More competitively priced supplies |

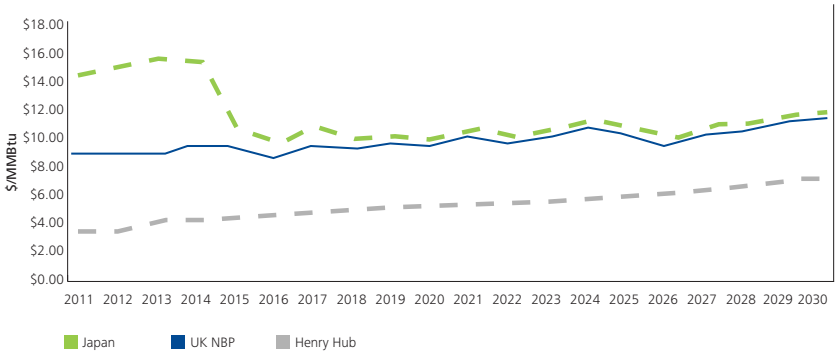
## Market projections

Figure 2.6 shows projected prices in the BAU scenario, for three major gas markets: Henry Hub (Louisiana, U.S.), which is the world's most liquid market; UK NBP, a virtual hub reflecting prices in the UK; and Japan, which is marked by the delivered price of LNG. Japan prices are projected to remain high in the near term, as the shut-down of Japanese nuclear power plants and rapidly growing Asian gas demand maintains tight Asian LNG supply balance. However, Japanese prices are projected to fall sharply within several years, primarily due to an increase in Australian LNG exports, which are assumed to be priced competitively. With decline in European production, primarily from the North Sea, the UK is projected to rely more on LNG imports in the future. As global LNG supplies increase, UK NBP and Japan prices are projected to track each other closely starting around 2015.

The projected prices suggest that some regional markets will become more highly correlated with growth in global LNG and pipeline trans-shipments. However, evolution to a global gas price is highly unlikely because the transportation cost for gas, unlike for oil, is just too high for this convergence to occur. For example, a barrel of oil costs just a few dollars per barrel to transport around the world which means that at $100/barrel, the transportation costs are only a few percent of the commodity value. In contrast, the cost of liquefaction and shipping natural gas from the U.S. to Asia or Europe would exceed 100% of the supply price, currently in the mid-$3 range. Hence, the development of a global gas price is highly unlikely even with a large expansion of global LNG capacities. Nevertheless, there are likely to be greater linkages between markets as LNG supplies increase and more international pipelines are built. U.S. exports to one market (e.g., Japan) could have significant consequences to a distant, noncontiguous market (e.g., UK) and vice versa.

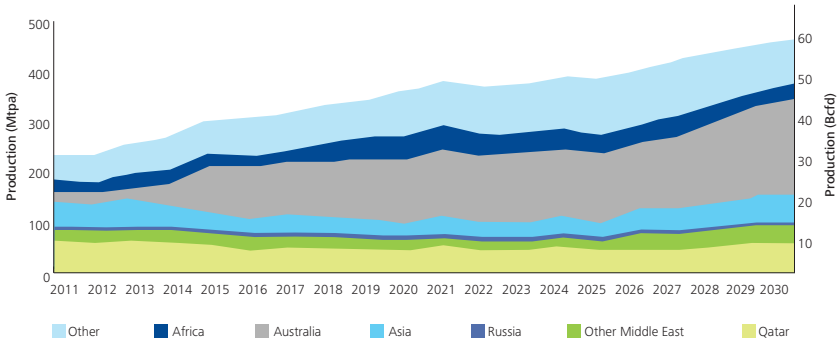
Figure 2.7 shows the projected LNG production assuming no U.S. LNG exports under the BAU scenario. Most prominent is the growth in Australian LNG, which is projected in this scenario to easily surpass Qatar as the world's largest LNG producer and dominate the Asia LNG market. In this scenario, Qatar LNG volumes are projected to decline over time as it loses market share to Australia and other suppliers. However, bear in mind that the BAU scenario assumes that Qatar holds to oil-indexed pricing while Australia is able to competitively price its supply and effectively undercut Qatar and other oil-indexed suppliers to capture greater market share.

**Figure 2.6: Projected prices in key markets (BAU scenario with no U.S. Exports)**




Source: DMP World Gas Model projection (October 2012).

**Figure 2.7: Projected LNG production (BAU scenario assuming no U.S. exports)**




Source: DMP World Gas Model projection (October 2012).

Whether Qatar and other suppliers will allow their multi-billion dollar supply infrastructures to suffer low utilization and see their market shares captured by competitive suppliers is questionable. That is why we created the Competitive Response scenario in which suppliers such as Qatar respond to market competition by making more of their supplies available at competitive prices that fall below oil-indexed prices. In the Competitive Response scenario, the projected LNG volumes from Qatar remain fairly constant over time as Qatar is assumed to price more of its supplies based on competitive prices to maintain high utilization of their plants. However, Qatar's market share is projected to decline since the global LNG market is increasing, but its liquefaction capacity is assumed to remain constant. Of course, since Qatar possesses such low-cost gas resources, it could lift its current moratorium on new builds and expand capacity to capture greater market share. We do not present either market scenario as more likely than the other, but rather to assess how U.S. LNG exports will affect global markets under each market scenario. However, the results strongly suggest that gas exporters will likely be forced to competitively price their supply in the future in order to maintain their volumes.

Currently, the highest natural gas prices are in Asia where major LNG importers, such as Japan, South Korea, and Taiwan, pay a premium in order to ensure peak month deliverability. Prices for spot LNG cargos sometimes shoot up in the winter months primarily because these Asian countries, with almost no other natural gas alternatives, vie against each other for the scarce available LNG cargos and bid up prices. For much of 2012, the landed price of LNG in Japan hovered around $15/MMBtu, or about five times higher than Henry Hub prices in the U.S. With growth in global LNG supplies, the highest priced markets will not be setting the price, since their demand will be the first to be satisfied and other, lower price markets will likely provide the marginal demand and set the price. Hence, the WGM projects a sharply decline in Japan prices coinciding with growth in Australian LNG exports.

In both the BAU and Competitive Response market scenarios, the price spreads between U.S. and foreign markets, especially in Asia, are projected to shrink from their current levels even without U.S. LNG exports. Increased global gas supplies, made accessible to markets by continued growth in global LNG liquefaction capacities and new international pipelines, are projected to apply competitive pressures on major producers supplying Asia and Europe. In both market scenarios, the current high prices in Asia were found to be unsustainable in the face of growing global gas supplies. Simply put, there is too much supply that can be brought to market at lower prices to sustain prices at current levels over the long run. Of course, with rapidly growing markets in China and India, Asian demand growth might stay ahead of supply growth and prolong high prices for some time.

Under assumptions in the Competitive Response scenario, projected prices for UK NBP and Japan each fall by about $0.70/MMBtu on average from 2016 to 2030 relative to the BAU scenario. The decline represents about 7-8% drop in projected prices. The impact might seem rather modest, but we remind the reader that the Competitive Response scenario does not introduce incremental supplies but rather enables current major exporters to respond to competitive pressures by pricing their supplies to reflect market conditions, instead of sticking to an oil-indexed price that the market might not be able to support. The market is projected to become more competitive over time even in the BAU case. The Competitive Response scenario is just a faster transition.

# Impact of U.S. LNG exports

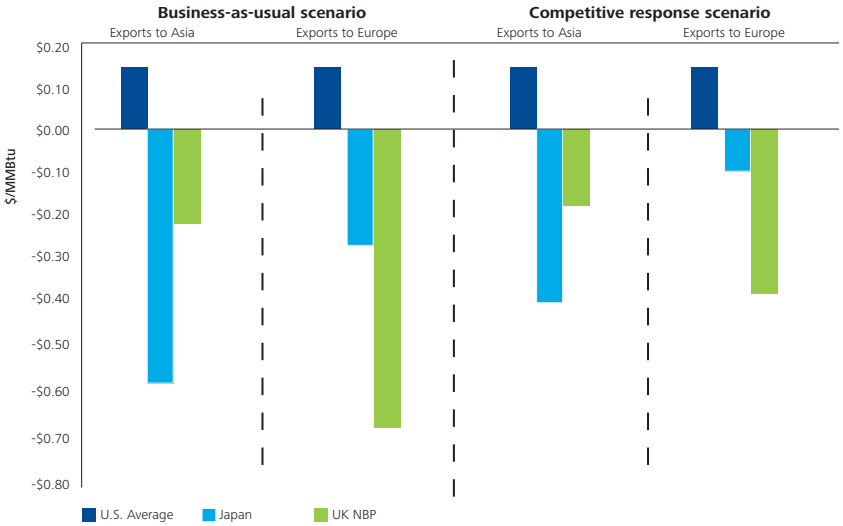
Based on the embodied economic logic and data assumptions, the World Gas Model (WGM) projected the price and quantity impacts of 6 Bcfd of LNG exports from the U.S. to either Asia (2 Bcfd each to Japan, South Korea, and India) or Europe (3 Bcfd each to UK and Spain) under two different market scenarios representing speed of transition to competitively set gas prices. The results show complex market dynamics with widespread impacts, but close examination reveals clear economic implications. U.S. LNG exports are projected to have global impacts, generally reducing costs for gas importers and reducing revenues for gas exporters.

### Price impact due to U.S. LNG exports

U.S. LNG exports are projected to impact prices globally, not just in the countries importing U.S. LNG. While the U.S. export volumes considered in this analysis represent only a small fraction of the total global gas supply, their price impact might be much higher than their relative volume might indicate. The structure of long-term gas supply contracts, as discussed in the previous section, and available regional supplies are important factors in determining the price impact. Figure 3.1 shows the projected price impacts of 6 Bcfd of U.S. LNG exports to either Asia or Europe under the Business-as-usual or Competitive Response market scenarios. The figure shows impacts on average U.S. citygate, Japan, and UK National Balancing Point (NBP) prices. Japan and UK NBP serve as proxies for Asia and Europe since there is widespread price impacts, not just in those countries assumed to receive U.S. LNG exports.

The impact of U.S. LNG exports on U.S. citygate prices is projected to be minimal, only an average $0.15/MMBtu from 2016 through 2030. Abundant North American gas resources mitigate the impact of demand changes, including exports. Vast shale gas resources, that are now economically viable due to technological advancements in recent years, have effectively caused the aggregate U.S. supply curve to flatten, representing greater supply elasticity. Coupled with the market's demonstrated ability to respond to market changes, the availability of large North American supplies mitigates the price impact of exports. If sufficient reserves can be added by the time export terminals come into operations, then the price impact will be determined by how the increase in demand changes the cost of the marginal field produced. Given the abundance of U.S. gas supplies available at similar cost levels, the change in the cost of the marginal supply is estimated to be minimal, as described in our previous paper, *Made in America: The Economic Impact on LNG Exports from the United States*.[4]

**Figure 3.1: Projected price impact from 2016 to 2030 by scenario ($/MMBtu, real 2012 $)**




Source: DMP World Gas Model projection (October 2012).

The price impact of U.S. LNG exports is projected to be much higher in the import markets than in the U.S. For example, with U.S. LNG exports to Asia the price impact in Japan is projected to be several times higher than the impact in the U.S.under both market scenarios. Similarly, with U.S. LNG exports to Europe the price impact in the UK is projected to be several times higher than the impact in the U.S. under both market scenarios. The magnitude of price impact varies by market scenario, but under both scenarios, the impacts are significant. The relative price impacts underscore the size of the U.S. gas market (about 65 Bcfd in 2011), which is far larger than that of Japan (about 11 Bcfd in 2011), the UK (about 9 Bcfd in 2011), or any other country. In fact, the U.S. market is larger than the entire European or Asian market. Additionally, the North American market is highly integrated, unlike European and especially Asian markets, so the continent-wide market can help mitigate the price impacts. Finally, markets in Europe and Asia rely on imports that have varying delivered costs. For example, Russian pipeline imports are more costly than Algerian pipeline imports in Europe. Nigerian LNG imports to Japan are more costly than the delivered cost of LNG from Qatar. In essence, the supply curves are steeper (i.e., less elastic) in European and Asian markets and therefore the price impact is greater than in the U.S.

[4] Deloitte MarketPoint LLC, *Made in America: The Economic Impact of LNG Exports from the United States* (2011). www.deloitte.com/us/lngexports.

As the price spreads between the U.S. and other markets narrow, the favorable economics of U.S. LNG exports diminish. How much U.S. LNG ultimately could be exported is not the focus of this study, but clearly price feedback from export volumes and other market developments will limit how much is economic. Even without government intervention, market forces can determine the desired level of U.S. LNG exports. It is an obvious point, but worth stating, that the price spread between U.S. and global markets will shrink as U.S. prices rise and prices in importing countries decline. The spread will shrink by the sum of the absolute values of change in both markets.

Notice in Figure 3.1 that whether U.S. LNG exports are sent to Europe or Asia, both markets are projected to be impacted due to the interconnectivity of global markets. The markets in Japan and the UK are projected to become particularly interconnected over time. The projected decline in North Sea production and increase in global LNG supplies results in the UK market becoming increasingly dependent on LNG imports. With increasing LNG supplies that have destination flexibility in contracts or are available on a spot basis, global LNG prices are expected to move in close sympathy, although significant price spreads could persist between regions due to large differences in shipping costs.

Furthermore, the price impact is diminished under the Competitive Response scenario, which assumes that current major gas exporters gradually price more of their supplies on a competitive basis. With more competitively priced gas supplies available in the Competitive Response scenario, the price impact of U.S. LNG exports is less than in the BAU scenario. In the BAU scenario, oil-indexed contracts have a more prolonged influence over prices. U.S. LNG exports, which likely will be indexed to U.S. gas price (e.g., Henry Hub) rather than an oil-indexed price, could apply pressure on exporters to more competitively price their gas. While gas exporters would prefer an oil-linked price, such attempts likely will be met by diminished volume of sales as buyers have more alternatives. Given the high capital cost of LNG terminal and long-distance pipeline projects, there will be pressure to price supplies to ensure high levels of utilization. As global gas supplies increase, exporters likely will need to accept realities of a more competitive market or else see diminishing market shares.

### Supply displacement due to U.S. LNG exports

This study assumes 6 Bcfd of U.S. LNG exports will be contracted (i.e., forced) into either Asian or European markets, causing displacement of a similar volume of supplies. (The volumes will not be exactly the same because of demand elasticity and transportation fuel use.) The supplies displaced in the LNG import markets will in turn seek other markets to find a home. Hence, there likely will be global impacts, not just impacts in the importing countries. The displaced volumes in each market will be the marginal sources, which likely will be high-cost supplies that are either not contracted or contracted, but above required minimum-take volumes specified in contracts. Due to their high cost, the first volumes displaced will likely be the contracted volumes above required minimum-take volumes which typically are pegged to an oil-indexed price.

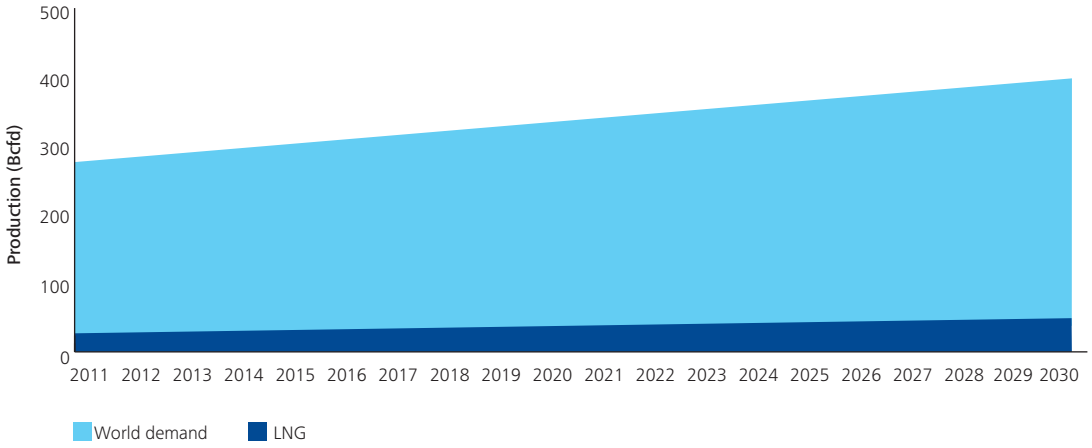
It is important to realize that not all gas exporters will be affected to the same degree by U.S. LNG exports. Finding which supplies will be displaced within each region is tantamount to finding the marginal source, which by definition is the first to exit the market when demand falls or some other source enters the market. The marginal sources will vary by region and over time, but likely will be the high-cost source that is uncontracted for firm delivery into a market. The analysis needs to take into account long-term gas supply contracts because they affect both the displaced volumes and price impacts of U.S. LNG exports.

Marginal sources in the future could include prospective new projects whose success hinges upon market conditions. A prime case in point is the vast, but high-cost Shtokman field in the Barents Sea which was planned to be developed and gas sent to Europe through a subsea pipeline, or liquefied and shipped to the U.S. When European and U.S. prices fell due to emergence of other supplies, Shtokman gas was economically displaced because it was no longer deemed economic. Other high-cost existing supplies or potential new projects could experience a similar result if the U.S. were to export LNG.

In Europe, which already imports large volumes of gas from Russia, North Africa, and LNG suppliers, the next big wave of supply could be from the Middle East or Caspian regions. Pipeline projects such as Nabucco and South Stream are designed to make these supply regions accessible to Europe. However, these prospective projects are high cost and fraught with political challenges. In Asia, major incremental supplies could come from Russia or the Middle East, as well as growth in domestic production in China and India. Again, prospective projects face formidable economic and political challenges. We analyzed which future supplies might be displaced by U.S. LNG exports. Furthermore, a project or supply from a politically problematic country, such as Iran or Venezuela, could have high implied costs because non-economic factors prevent or drive up the cost of entry into the market. They are more likely when prices are high, since economic incentives will help override political obstacles. High prices create incentives to overcome political obstacles. U.S. LNG exports could help keep these supplies from entering the market.

Furthermore, the LNG market is not a separate, niche market but rather a segment of a broader natural gas market. Even with strong growth in global LNG supplies over the past few years, LNG still comprised only about 9% of the total global gas supply in 2010.[5] In Figure 3.2, the WGM projects global LNG supplies to grow at a faster rate than global gas demand so that by 2030, LNG's share grows to about 15%, much larger than it is currently but still a relatively small percentage of the total gas market. Gas is gas, whether it is delivered through a pipeline or by a LNG tanker, and in the long term all gas supplies entering a market will compete for market share. Of course, there are short-term contractual rigidities and infrastructure constraints in some markets which will help determine how quickly competition will occur.

**Figure 3.2: World gas demand and LNG production**




Source: DMP World Gas Model projection (October 2012).

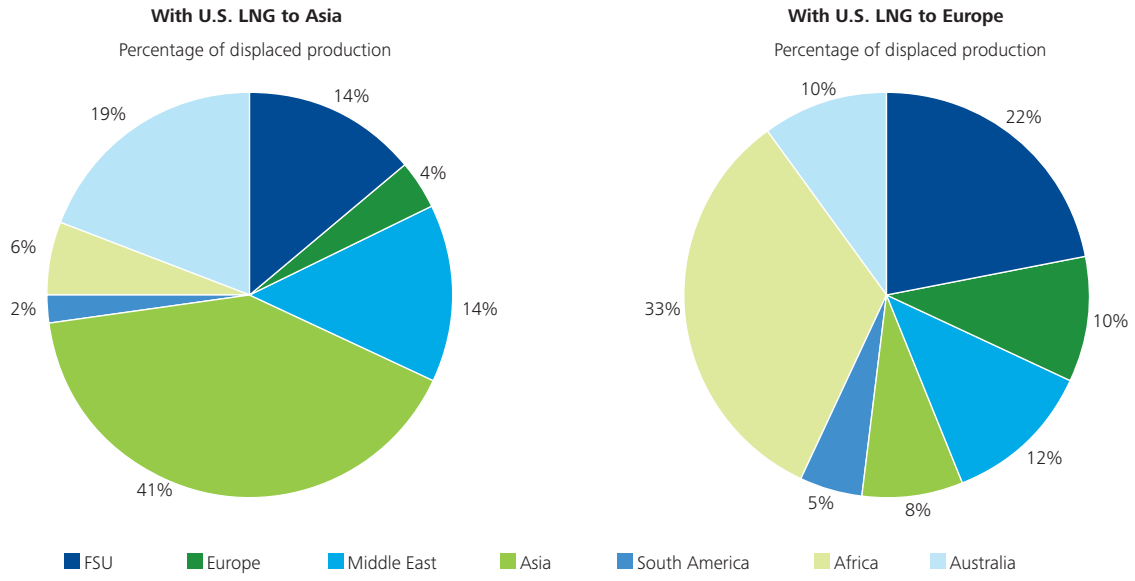
[5] International Energy Agency (http://www.iea.org/aboutus/faqs/gas/).

Given the relatively small size of the LNG market, the WGM projections show more displacement of non-LNG supplies than of LNG supplies due to U.S. LNG exports. Furthermore, most LNG supplies are tied up under long-term contracts with minimum-take volumes. If U.S. LNG is exported to Asia, the displaced volumes that are LNG supplies are about 30% of the total displaced supply. If U.S. LNG is exported to Europe, the displaced volumes that are LNG supplies is a little less, about 25% of the total displacement. The results make sense given the higher portion of Asian supply portfolio captured by LNG.

Figure 3.3 shows the displaced global volumes as a result of U.S. LNG exports sent to either Asia, shown in the chart on the left, or Europe, chart on the right, assuming the BAU scenario. The U.S. LNG export impacts under the Competitive Response scenario produce similar results. These charts show displaced production, rather than just volumes displaced out of the region in which U.S. LNG is exported. They represent the difference in total production by region between the cases with and without U.S. LNG exports. The displaced supplies will be the high cost non-committed supplies into each market. The non-committed volumes would include uncontracted supplies or the flexible volumes of contracted supplies. Contract minimum-take volumes, even if contracts were signed at high cost, would not be displaced since their costs would be considered sunk by buyers. Australian LNG exports to Asia and Russian exports to Europe look particularly vulnerable given their projected large volume of exports and high cost to markets they serve.

The largest LNG source that is displaced is Australian LNG. This result follows the rapid growth of Australian LNG projected by WGM, particularly in the BAU scenario in which Australian LNG grows from its current level of about 20 MTPA (3 Bcfd) to 130 MTPA (17 Bcfd) by 2030. By comparison, Qatar, currently the world's largest LNG producer, has 77 MTPA (10 Bcfd) of LNG production capacity. Due to its high supply costs, particularly from coal-bed methane sourced projects, and its distance from market, Australian LNG is partially displaced by U.S. LNG exports and comprises almost 20% of the total displaced volumes by U.S. LNG exports to Asia and 10% with exports to Europe. However, bear in mind that Australian LNG is still projected to grow rapidly and become the global leader in LNG production even with U.S. LNG exports. Australian LNG production is projected to grow, but just not quite as

**Figure 3.3: Supplies displaced by U.S. LNG exports 2016-30 under BAU scenario**




Source: DMP World Gas Model projection (October 2012).

high with U.S. LNG exports. Even in the case with U.S. LNG exports to Asia, Australia's projected LNG volumes are just reduced by a little over 10%. Asian LNG is little affected because it has a transportation cost advantage over other LNG sources and the fact that most Asian LNG supplies are already under contract for firm delivery.

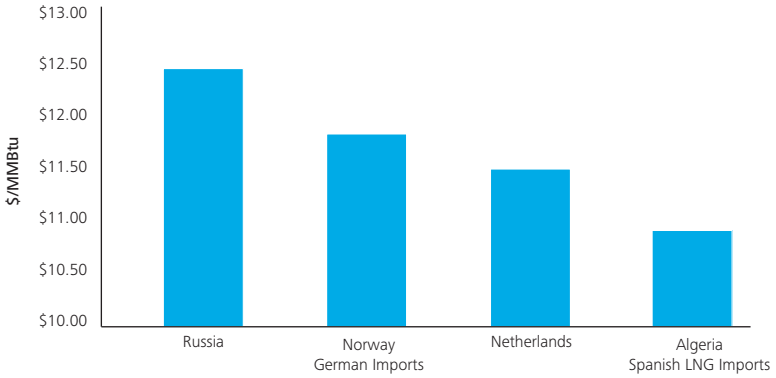
Asian sources are projected to bear about 40% of the total volume displaced by U.S. LNG exports to Asia. The displaced Asian sources are comprised primarily of indigenous production in China and India, as well as some Asian LNG supplies in Indonesia, Malaysia, and Brunei. Both China and India have significant gas resources including both conventional and unconventional, such as shale gas and coalbed methane, supplies, but their production costs are estimated to be quite high. China is estimated to possess 1,275 Tcf of technically recoverable shale gas, according to the EIA.[6] Some of their investments in North American upstream projects in recent years are thought to be at least partially motivated by a desire to learn U.S. shale gas production technology and processes so that they can develop their domestic resources. The Chinese government has announced aggressive goals for shale gas development. U.S. LNG exports will lower the cost of imported gas, thereby reducing the economic incentive for countries to develop their domestic supplies.

Notice also that even with U.S. LNG exports assumed to be shipped to Asia, projected supplies from the Former Soviet Union (FSU), including Russia and gas-rich Caspian republics such as Turkmenistan and Azerbaijan, and Middle East are displaced. The reductions in volumes are not a result of direct displacement by U.S. LNG exports but rather due to global rebalancing of gas supplies. Some of the supplies displaced out of Asia by U.S. LNG are diverted to European markets. For example, some of the Middle East LNG projected to be displaced in Asia are redirected to Europe and displace European sources, such as Russian gas imports. The interconnectivity and dynamics of global markets imply U.S. LNG exports will have global impacts.

If U.S. LNG exports are sent to Europe, the impacts are quite different. The WGM projects there to be less displacement of LNG supplies and more displacement of domestic and pipeline imports. The reason is simple: Europe imports far less LNG to meet its demand than does Asia. If U.S. LNG exports are sent to Europe instead of Asia, there is less displacement of Australian LNG and more displacement of African LNG, which includes supplies from Algeria, Egypt, Nigeria, Equatorial Guinea, and new supplies from Mozambique and Tanzania. Other displaced supplies include European sources, primarily contracted flexible supplies from Norway and the Netherlands, and FSU sources, including Russia and Caspian republics. Notice that Asian supplies are still affected by U.S. exports to Europe because of global gas supply displacement and lower prices.

Russia, the leading gas exporter to Europe, appears to be especially hard hit by U.S. LNG exports. Because of its huge volumes of gas exports, primarily to Europe, and their high cost to markets, Russia is vulnerable to supply competition. In Figure 3.4, Russian supplies are estimated to be the high-cost source into European markets and therefore Russian contract supplies above the minimum-take volumes would be the first to be displaced by incremental lower cost supply. With current slack European demand, there is already some displacement of Russian imports, as flexible volumes indexed to oil price have not been utilized by European buyers. U.S. LNG exports to Europe are projected to obviate the need for Russian and some other oil-indexed flexible supplies.

**Figure 3.4: European gas supply contract prices for October 2012**




Source: ICIS Heren European Gas Markets, October 31, 2012.

[6] EIA, http://www.eia.gov/countries/cab.cfm?fips=CH

Maintaining market share and oil-indexed prices are major concerns for Russia. Russia holds the world's largest natural gas reserves and was the largest producer until the U.S. overtook it in 2011 with the growth in U.S. shale gas production. Gas export is vital to the Russian economy, contributing about $64 billion in revenues in 2011.[7] Russia has jealously guarded its European market share through control of its pipeline transit capacities. By restricting access to its transit pipelines, Russia is able to prevent supplies from other countries, such as Turkmenistan which holds an estimated 500 Tcf of proved reserves, from reaching lucrative European markets and competing with Russian supplies. The strategy was working well until several years ago when economic recession caused European gas demand to stagnate and at the same time more LNG supplies, particularly from Qatar, became available. Qatar had increased its LNG liquefaction capacity in anticipation of exports to the U.S., but its plans were stymied by U.S. shale gas production which eliminated the need for imports. As a consequence, European prices fell and Russians were pressured to offer more competitive prices than the contractual oil-indexed prices. During the past year, several European companies successfully renegotiated their contracts and extracted discounts from Russia. U.S. LNG exports will likely apply greater pressure on Russia and other gas exporters to transition to competitively set prices.

Based on WGM projections using the two market scenarios, Russian revenues from exports to Europe are estimated to be significantly impacted by U.S. LNG exports, which will both displace some amount of Russian exports to Europe and reduce the price Russians receive in Europe. The table in Figure 3.5 shows the projected impact of U.S. LNG exports on Russian revenues (in 2012 U.S. dollars) from exports to Europe. Of course, the impact is higher when U.S. LNG exports are sent to Europe instead of Asia since there is direct competition with Russian supply and greater European price impact. Perhaps a bit surprisingly, the impact is higher under the Competitive Response case than in the BAU scenario. The reason is that under the BAU scenario, in which Russia and other major current gas exporters adhere to oil-price indexation, Russian exports to Europe are reduced down to the minimum take volumes as competitively priced supplies displace the oil-indexed flexible volumes. Hence, U.S. LNG exports have little impact on Russian volumes and most of the impact is through lower prices it receives in European markets for their exports. In the Competitive Response scenario, Russia is assumed to price more of its supplies on a competitive basis and therefore more Russian volumes are exported to Europe than under the BAU market scenario. With U.S. LNG exports, some of these non-minimum take volumes are displaced. Therefore, Russia is hit by both loss of volume and erosion of price under the Competitive Response scenario. These scenarios indicate that U.S. LNG exports may lead Russia to price its supplies on a competitive basis or be relegated to just selling its minimum take contracted volumes.

**Figure 3.5: Impact of U.S. LNG exports on Russian revenues from exports to Europe**

| | Business-as-usual | | Competitive response | |
|---|---|---|---|---|
| | Asia exports | Europe exports | Asia exports | Europe exports |
| Annual revenue impact ($ Billions) | $(2.1) | $(3.0) | $(2.2) | $(4.0) |
| % change | -3.4% | -5.0% | -4.0% | -7.2% |

[7] The Central Bank of the Russian Federation (http://www.cbr.ru/eng/statistics/print.aspx?file=credit_statistics/gas_e.htm ).

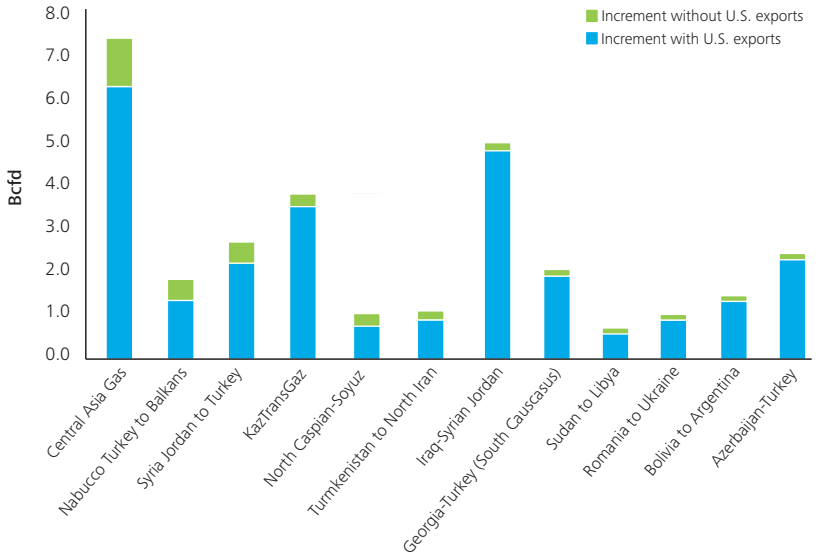
## Displaced future projects

Since we are analyzing a long time horizon, we need to consider potential new projects that might be impacted by U.S. LNG exports. The WGM projects new infrastructure, including pipelines and LNG terminals, that would be economic to build based on financial considerations, such as capital and variable costs, discount rate, required rate of return, and projected future prices. The WGM projects potential future margins that could be captured if capacity were built to compute the optimal timing and size of capacity expansions for existing or prospective assets. U.S. LNG exports diminish the need for capacity expansions by depressing prices and margins that could be captured by expanding capacity.

Figure 3.6 shows the largest projected impacts on capacity expansions under the Business-as-usual market scenario out to year 2030. The expansions are ordered from left to right by impact due to U.S. LNG exports. The height of the bars represents total capacity expansion assuming no U.S. LNG exports. The bottom blue portion of the bars represents the expansion that is projected to occur with U.S. LNG exports. Therefore, the green bars (i.e., the difference) represent how much less expansion there would be with U.S. LNG exports.

An examination of the projected expansions that are impacted reveals that they are primarily projects designed to bring Central Asian or Middle Eastern supplies to Europe and Central Asian supplies to Asia. Potential displayed future projects could also include supplies from Mozambique and Tanzania, depending on their production and infrastructure development costs. These supplies are abundant and low cost, but remote and therefore seeking pathways to markets. For example, the Central Asia Gas Pipeline, which is a recent pipeline bringing gas from Turkmenistan and potentially other Central Asian countries to China, is projected to expand by 7.4 Bcfd without U.S. LNG exports. With U.S. LNG exports to Europe, the projected expansion reduces by 1.0 Bcfd to 6.4 Bcfd. If U.S. LNG exports are assumed to go to Asia, the projected expansion falls an additional 0.7 Bcfd to 5.7 Bcfd, relative to the case with no U.S. LNG exports. Once again, we see the global impacts of U.S. LNG exports. Another impacted project is projected to be the Nabucco pipeline, which has engendered much politically charged controversy. Nabucco is designed to transport gas supplies to Europe from either the Middle East or Caspian region. Some want the pipeline to access low cost resources and diversify European gas supply, but others have opposed it for economic and political reasons. Russians have proposed the South Stream pipeline as an alternative so that they can protect their dominant position in the European market. The WGM projects that Nabucco, or some form of it, will eventually be built, but U.S. LNG exports diminish the need for it.

**Figure 3.6: Projected capacity expansions to 2030 (U.S. exports to Europe in BAU scenario)**




Source: DMP World Gas Model projection (October 2012).

### Impact on oil markets

U.S. LNG exports might also impact global oil markets, although obviously to a lesser degree than gas markets. LNG could displace oil in markets in which oil is burned for electricity generation. In some regions, oil-fired electricity generation is utilized because of lack of natural gas supply. In Figure 3.7, OECD countries consumed 1.6 million barrels of oil per day for oil-fired generation in 2008. Using estimated heat content in oil (40.4 trillion Btu per ton of oil) and average heat rates for oil- (11,100 Btu/kWh) and gas-fired (9,900 Btu/kWh) power plants, we estimate that about 8.2 Bcfd of gas would have been consumed if oil-fired generation were displaced by gas-fired generation. Non-OECD Asia consumed about 0.9 million barrels of oil per day, which would convert to about 4.8 Bcfd of gas consumption. Because gas has lower environmental emissions relative to oil, gas-fired generation would be preferred from an environmental perspective if gas supplies and generating capacities were available. For example, due primarily to increase in gas-fired generation, carbon-dioxide emissions in the U.S. in 2012 have dropped to their lowest level in 20 years.[8] Other countries could also realize substantial environmental benefits by shifting from oil to natural gas-fired generation. Potentially, there could be almost 5 million barrels of oil per day displaced if gas supply were more available.

**Figure 3.7: Fuel burn for oil-fired power generation in 2008**

| Region | Oil-fired generation (Million barrels/day) | Gas equivalent (Billion cubic feet/day) |
|---|---|---|
| OECD | 1.6 | 8.2 |
| Middle East | 1.3 | 6.9 |
| Asia (Non-OCED) | 0.9 | 4.8 |
| Latin America | 0.6 | 3.2 |
| Africa | 0.4 | 1.9 |
| **Total** | **4.8** | **25.0** |

Source: IEA World Energy Outlook 2010 and Deloitte MarketPoint

If U.S. LNG exports contribute to the decoupling of global gas prices from oil prices, it will increase the incentive to use gas-fired generation instead of oil-fired generation and global oil consumption might decrease. For example, in the aftermath of the devastating earthquake and tsunami that hit Japan in 2009, Japan shut down its nuclear power plants. To replace the lost power generation, Japan has increased both gas and oil imports to fuel gas- and oil-fired generation plants. In fact, Japan imports oil from Iran, after the U.S. exempted Japan from its financial sanctions against Iran.[9] At the current high, oil-indexed prices that Japan is paying for LNG, it does not have much incentive to switch to natural gas. However, if prices fall as projected by the WGM, the incentive will be much greater to switch to gas-fired generation and reduce oil consumption. Reduced oil demand would help reduce global oil prices. Greater global LNG supply might even help reduce oil price volatility since more substitutable fuel would be available and thereby increase supply elasticity.

### Key findings

- U.S. LNG exports are projected to have a greater gas price impact in importing regions than in the U.S.
  - Gas importing countries benefit from gas supply cost savings.
  - U.S. LNG exports will narrow the price spread from the U.S. to export markets and hence limit the volume of U.S. LNG exports that will be economic.
  - Global gas markets are likely to transition away from oil-indexed prices to competitively set prices and U.S. LNG exports will hasten that transition.
- Gas exporting countries could suffer decline in revenues due to price erosion and/or supply displacement.
- U.S. LNG exports could also affect global oil markets by allowing displacement of oil-fired electric power generation.

[8] EIA, http://www.eia.gov/totalenergy/data/monthly/archive/00351206.pdf#page=171
[9] Reuters, October 23, 2012. http://www.reuters.com/article/2012/10/23/us-japan-meti-lng-idUSBRE89M08720121023

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# About Deloitte MarketPoint

Deloitte MarketPoint is a decision support solutions company focused on fundamental market analysis and price forecasting. We provide software and models with consulting services to help energy companies make informed decisions. Our solutions are comprised of our software applications, such as MarketBuilder, our models, our market data, and consulting services.

Deloitte MarketPoint LLC, the result of Deloitte's acquisition of substantially all the assets of MarketPoint Incorporated and Altos Management Partners (MarketPoint/Altos) in 2011, combines the global strength and quantitative experience of Deloitte and the member firm network of Deloitte Touche Tohmatsu Limited with the market-leading software and time-tested energy market success of MarketPoint/Altos. Deloitte MarketPoint is located within the Deloitte Center for Energy Solutions.

**www.deloittemarketpoint.com**

# Contact us

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