U.S. Natural Gas Exports: New Opportunities, Uncertain Outcomes

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Summary

As estimates for the amount of U.S. natural gas resources have grown, so have the prospects of rising U.S. natural gas exports. Projects to export liquefied natural gas (LNG) have been proposed—cumulatively accounting for about 12.5% of current U.S. natural gas production—and are at varying stages of regulatory approval. Projects require federal approval according to Section 3 of the Natural Gas Act (15 U.S.C. §717b) with the U.S. Department of Energy's Office of Fossil Energy and the Federal Energy Regulatory Commission being the lead authorizing agencies. Pipeline exports, which accounted for 94% of all exports of U.S. produced natural gas in 2010, are also likely to rise.

What effect exporting natural gas will have on U.S. prices is the central question in the debate of whether to export or not to export. A significant rise in U.S. natural gas exports would likely put upwards pressure on domestic prices, but the magnitude of any rise is currently unclear. There are numerous factors that will affect prices: export volumes, economic growth, differences in local markets, and government regulations, among others. With today's natural gas prices relatively low compared to global prices and historically low for the United States, producers are looking for new markets for their natural gas. Producers contend that increased exports will not raise prices significantly as there is ample supply to meet domestic demand, and there will be the added benefits of increased revenues, trade, and jobs, and less flaring. Consumers of natural gas, who are being helped by the low prices, fear prices will rise if natural gas is exported.

Electric power generation represents potentially the greatest increase in natural gas consumption in the U.S. economy, primarily for environmental reasons. Natural gas emits much less carbon dioxide and other pollutants than coal when combusted. Other types of consumption are not likely to increase natural gas demand domestically for a long time. Use in the transportation sector to displace oil is likely to be small because expensive new infrastructure and technologies would be required. There is discussion of a possible revival of the U.S. petrochemicals sector, but the potential extent of a change is unclear.

Getting natural gas to markets where it can be consumed, whether domestically or internationally, is the industry's biggest challenge. Infrastructure constraints, environmental regulations, and other factors will influence how the market adjusts to balance supply and demand.

Environmental groups are split regarding natural gas use, with some favoring increased use to curb emissions of certain pollutants, while others oppose expanded use of natural gas because it is not as clean as renewable forms of energy, such as wind or solar. The use of hydraulic fracturing to produce shale gas has also raised concerns among environmental groups particularly concerned with its possible impacts on water quality.

The possibility of a significant increase in U.S. natural gas exports will factor into ongoing debates on the economy, energy independence, climate change, and energy security. As the proposed projects continue to develop, policymakers are likely to receive more inquiries about these projects.

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Introduction: Things Have Changed

Within the next five years, the United States may become a large exporter of natural gas for the first time in decades. Increased development of U.S. natural gas resources—particularly shale gas—along with low domestic prices in recent years and idle liquefied natural gas (LNG) infrastructure, have driven the change in the U.S. position. The United States has exported some amounts of natural gas for close to 100 years, but has generally imported more than it has exported. However, imports have been declining since 2005, while exports have been climbing.

Historically, U.S. natural gas exports—which require federal approval pursuant to Section 3 of the Natural Gas Act (NGA) (15 U.S.C. §717b), with the U.S. Department of Energy's (DOE) Office of Fossil Energy and the Federal Energy Regulatory Commission (FERC) being the lead authorizing agencies—have been primarily via pipeline to Mexico and eastern Canada, but natural gas companies are now considering exporting greater quantities of U.S. LNG to a number of countries. Since 1969, the United States has exported Alaskan LNG almost exclusively to Japan, but the volumes of those shipments have been relatively small and Alaska's natural gas market has been isolated from the rest of the United States. The prospect of the United States supplying a global market with large quantities of LNG from the lower 48 raises concerns in Congress, particularly about a potential rise in what U.S. consumers pay for natural gas.

Developers of natural gas export projects and natural gas producers argue that domestic gas prices will not rise a lot if U.S. natural gas exports increase because the United States now has ample gas resources to meet domestic demand. Other stakeholders disagree, fearing that such exports could cause domestic natural gas prices to rise. There is no consensus about how large the impact might be and there is little publicly available analysis of this issue. As one Member of Congress stated in the press, "I think it's premature to conclude that the United States now has so much natural gas that it can afford to export it overseas."[1]

U.S. natural gas prices are lower than the those in other international markets, partly because of the competitive nature of the U.S. market. Nevertheless, natural gas prices within the United States differ by regional market because of transportation limitations, access to supplies, and differences in demand. As new volumes of shale gas are developed, these supplies will seek markets where little or no natural gas production has existed in the past. Over time, the U.S. natural gas market will reconfigure itself to balance supply and demand regionally and nationally. But getting new natural gas supplies to market will be an ongoing challenge for the industry, whether within the United States or abroad. Infrastructure constraints, such as the availability of pipelines and environmental regulations, will play a part in how the natural gas market adjusts. Exports of natural gas either by pipeline or as LNG will be a factor as the market balances, especially on a regional basis. Hence the potential export of more U.S. natural gas may have economic impacts that differ significantly from region to region, and regional impacts may diverge from impacts on the nation as a whole.

Other issues have also been raised regarding natural gas exports. Environmental groups are split on the desirability of greater use of natural gas at home and abroad. Advocates see it as decreasing emissions compared to other hydrocarbons, whereas opponents point out that natural

[1] U.S. Senator Ron Wyden, "Backers of Coos Bay LNG Site to Apply for Federal Export License," *The Oregonian,* September 22, 2011.

gas still emits carbon dioxide and other pollutants. Concerns about contamination of water supplies during gas production have been raised because of the use of hydraulic fracturing ("fracking"), the technique for extracting shale gas which uses water, sand, and chemicals to create fissures in shale, allowing the trapped natural gas to be cost-effectively extracted.[2] Other groups want to see greater use of natural gas in the U.S. economy before it is exported overseas for economic and national security concerns.

As the debates over the economy, energy independence, climate change, and energy security continue, Congress is beginning to face important questions regarding a potential increase in U.S natural gas exports. This report examines what has changed in the U.S. natural gas market and the prospects and implications of the United States becoming a significant net natural gas exporter.

Background: Natural Gas Exports Are Not New

Heading into the 2000s, the United States was expected to be a growing importer of natural gas because domestic production was declining and demand was rising (see **Figure 1**). The U.S. Energy Information Administration (EIA) in its 1999 Annual Energy Outlook forecasts that net natural gas imports would grow between 1997 and 2020 from 12.9% of consumption to 15.5%, based on consumption growing faster than production.[3] To accommodate the potential increase in imports, five new LNG import terminals were built by industry in the latter half of the 2000s and some existing facilities were re-commissioned and expanded (see **Figure 5**). The United States currently has LNG import capacity of almost 14 billion cubic feet per day (bcf/d) or over five trillion cubic feet (tcf) per year. However, higher domestic production—mainly from shale gas development—has made imports less necessary, leaving the use of existing import capacity at about 10%. (See **Table A-1** for the U.S. supply and demand balance.) In its most recent Annual Energy Outlook 2011, EIA projects U.S. net natural gas imports to decline to under 1% of consumption by 2035 as domestic production outpaces demand.[4]

The abundance of new domestic natural gas supplies shifted industry interest from building LNG import terminals to constructing LNG export terminals. As of October 2011, four companies have applied for permits to construct liquefaction facilities at existing LNG import terminals (also know as regasification facilities) and a fifth company has applied to construct a new LNG export facility in order to export domestically produced natural gas as LNG. A sixth company has applied to export U.S.-produced LNG, but would use existing LNG produced through other industrial processes in small quantities. (See **Table 1**.) Additionally, seven companies received authorization to re-export LNG cargos (take in foreign cargos, hold in storage, and then reload onto LNG tankers to go to foreign markets) from import terminals with one additional company application pending. Increased pipeline exports to Canada[5] and Mexico may also rise if their domestic production continues to decline and their demand continues to increase.

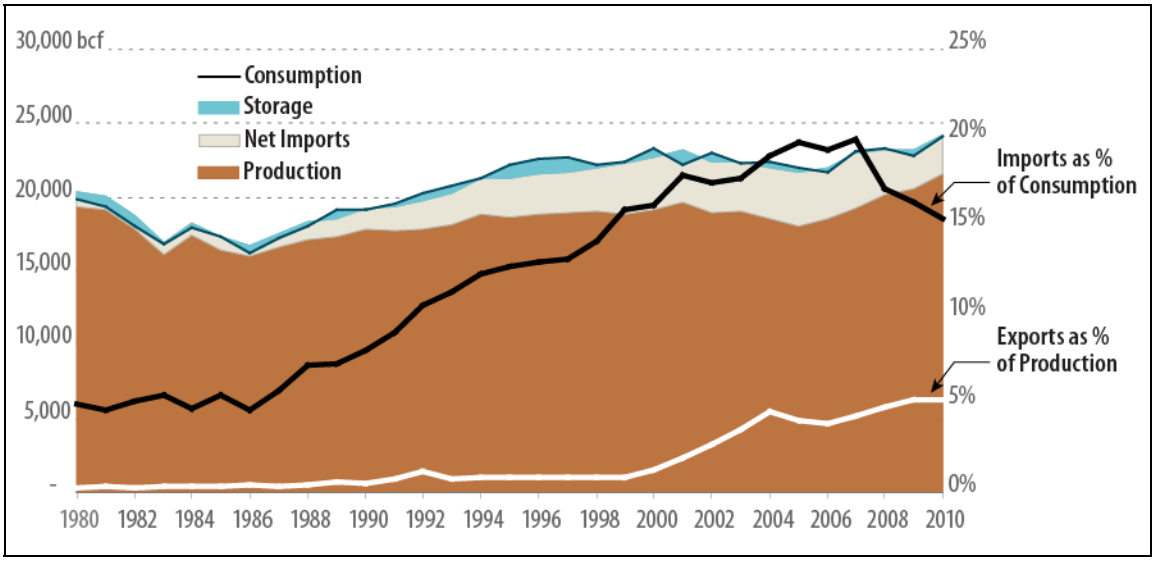
[2] For additional information and analysis of shale gas and fracking see CRS Report R40894, *Unconventional Gas Shales: Development, Technology, and Policy Issues*, coordinated by Anthony Andrews, and CRS Report R41760, *Hydraulic Fracturing and Safe Drinking Water Act Issues*, by Mary Tiemann and Adam Vann.

[3] U.S. Energy Information Administration (EIA), *Annual Energy Outlook 1999 with Projections to 2020*, DOE/EIA-0383(99), Washington, DC, December 1998, p. 71, http://www.eia.gov/oiaf/archive/aeo99/pdf/0383(99).pdf.

[4] EIA, *Annual Energy Outlook 2011 with Projections to 2035*, DOE/EIA-0383(2011), Washington, DC, April 2011, p. 80, http://www.eia.gov/forecasts/aeo/pdf/0383(2011).pdf.

[5] For additional information on the U.S.-Canada energy relationship see CRS Report R41875, *The U.S.-Canada Energy* (continued...)

Figure 1. U.S. Natural Gas Production, Consumption, and Trade



Source: EIA natural gas databases, http://www.eia.doe.gov/naturalgas/data.cfm.

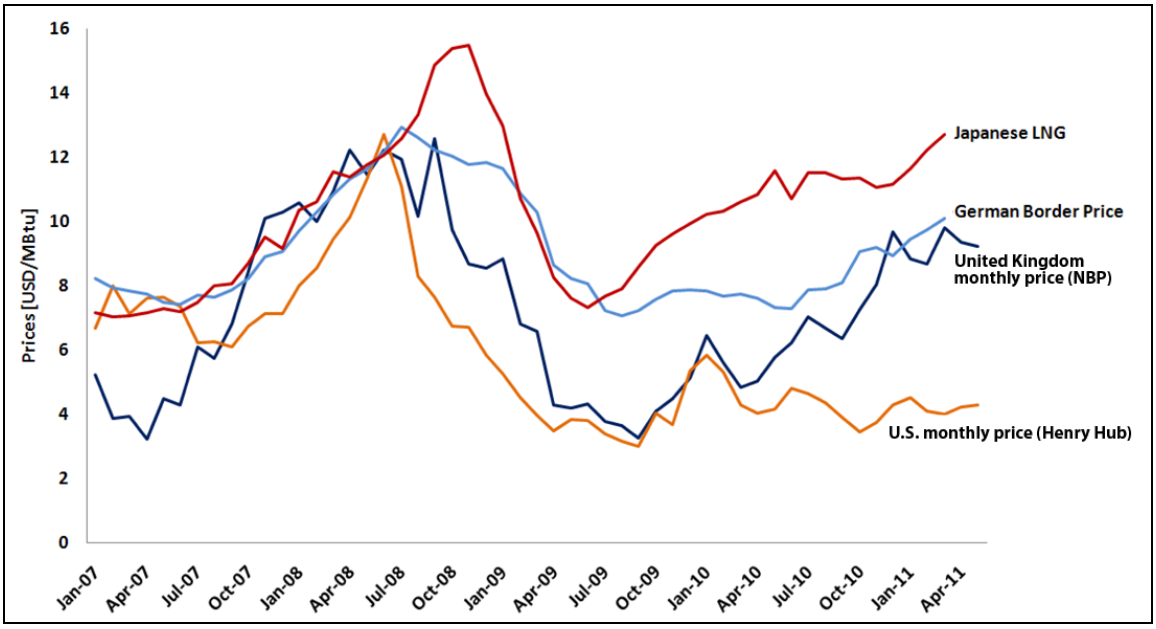
Notes: Consumption equals Production, Net Imports, and Storage, but because of negative storage numbers for injection of natural gas into facilities the Consumption line in the graph does not exactly align with the sum of its parts. Exports of natural gas include the re-export of LNG cargos that comprise third-country natural gas supplies. Units are billion cubic feet (bcf) per year.

Low U.S. natural gas prices relative to other international markets has spurred interest in exporting U.S. produced natural gas (see **Figure 2**). What effect exporting natural gas will have on U.S. prices is the central question in the debate of whether to export or not to export.

(...continued)

Relationship: Joined at the Well, by Paul W. Parfomak and Michael Ratner.

Figure 2. Select Global Natural Gas Prices



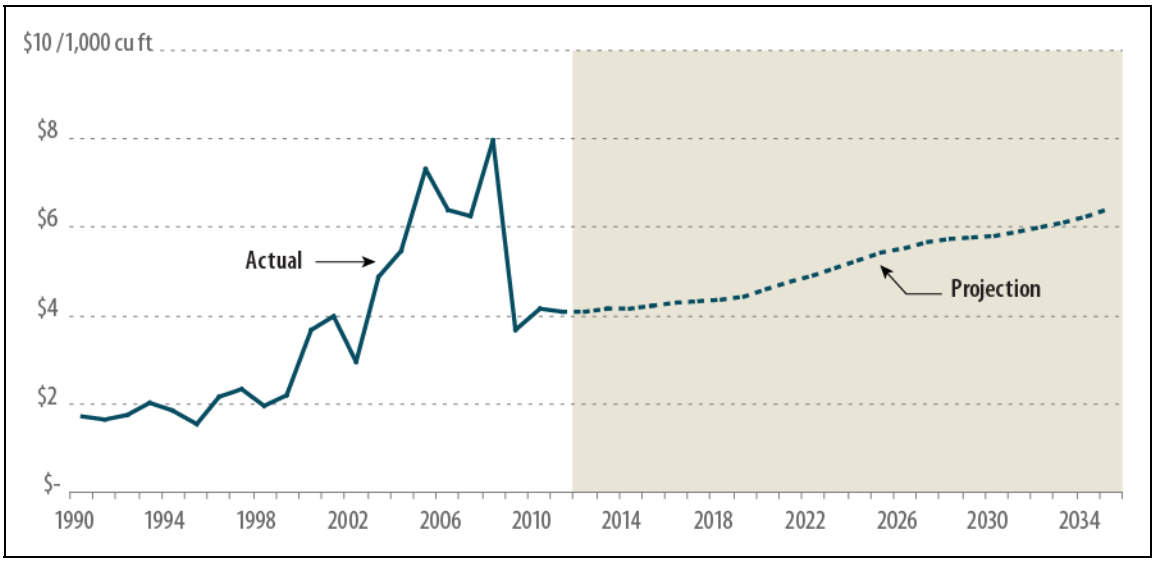
Source: International Energy Agency, Medium-Term Oil & Gas Markets 2011 presentation by Anne-Sophie Corbeau, June 21, 2011.

Notes: Henry Hub is the benchmark U.S. natural gas price. Henry Hub and the United Kingdom's NBP (National Balancing Point) reflect spot natural gas prices, while the German Border Price and Japanese LNG are long-term contract prices linked to oil prices. Units are U.S. dollars per million British Thermal Unit (USD/MBtu).

The most recent EIA projections, which do not assume construction of any new U.S. LNG export terminals, show prices rising in the future. The projections, which extend to 2035, never reach the annual average high reached in 2008 (see **Figure 3**).

Lower natural gas prices since 2008 along with a large and growing resource base have prompted calls for greater use of natural gas in the U.S. fuel mix. This is one of the key arguments against exporting U.S. natural gas. Natural gas comprised about 27% of U.S. primary energy consumption last year and has averaged 24% per year since 1973. Instead of exporting U.S. natural gas, some have called for increased use of natural gas in the electric power sector to displace coal, as an alternative transportation fuel to displace oil, and to provide fuel and feedstock to domestic industries such as petrochemicals.

Figure 3. Annual U.S. Natural Gas Prices, 1990-2035



Source: EIA's natural gas price database, http://www.eia.gov/dnav/ng/hist/n9190us3a.htm and EIA's Annual Energy Outlook 2011, Natural Gas Section, reference case, http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=3-AEO2011&table=13-AEO2011&region=0-0&cases=ref2011-d020911a.

Notes: Prices reflect the average price at the wellhead in the lower 48. Projections are for 2011 forward. Units are dollars per thousand cubic feet ($/1,000 cu ft) in 2009 dollars.

U.S. Natural Gas Exports to Date

Total U.S. natural gas exports are currently relatively small but have grown tremendously since 1999, increasing sevenfold through 2010. The United States has been exporting natural gas since at least the 1930s, primarily to Canada and Mexico.[6] In 2010, 94% of exports were by pipeline to Canada and Mexico. Starting in 1969, a small amount of natural gas was also exported as LNG via the Kenai LNG terminal (Kenai LNG) in Nikiski, Alaska. Kenai LNG has been operating continuously since its opening and remains the only LNG export facility in North America, but is scheduled to close by the end of 2011. Production of natural gas in the Cook Inlet of Alaska that supplies natural gas to Kenai LNG has declined too much to keep the facility operating.[7]

In 2010, the United States, through DOE's Office of Fossil Energy, allowed LNG import terminals to receive cargos of LNG, store the LNG, and to re-export the LNG to international markets—seven companies have received permits to re-export LNG with one pending. This explains the "Other LNG" category that emerged in 2010 (see **Figure 4**). Prior to 2010, LNG exports had declined steadily since 2005. Growing U.S. natural gas production, primarily from shale gas, has decreased the demand for both pipeline imports and LNG imports, leaving the import terminals mostly idle. Additionally, five import terminals have applied for licenses to

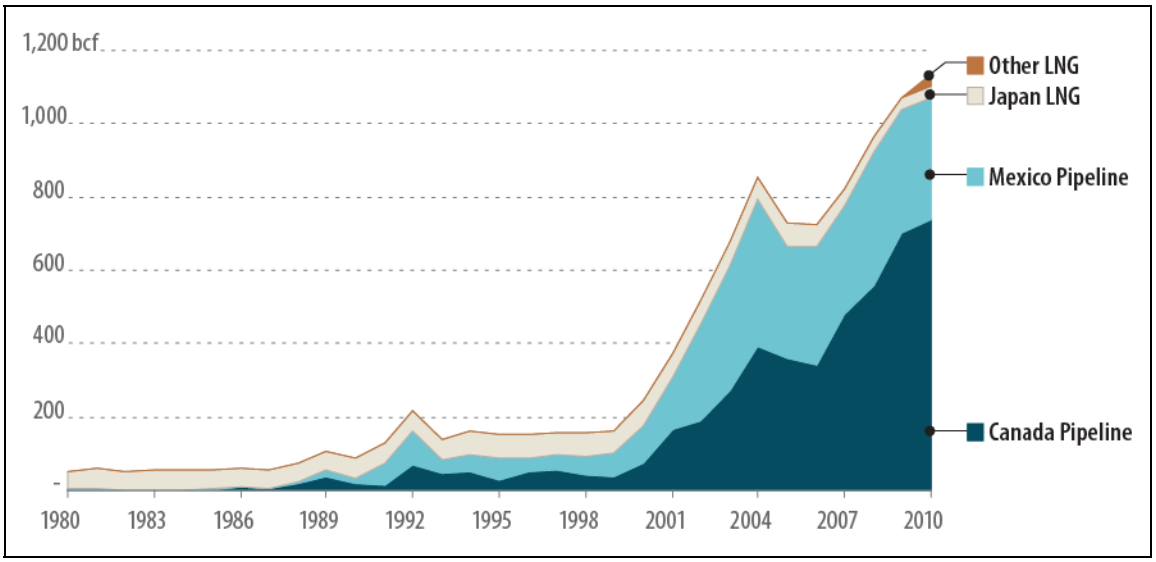
[6] Data are unavailable earlier than the 1930s and distinguished by country since the 1950s.

[7] The facility will be mothballed, not dismantled. It is possible that the facility could reopen if Alaskan natural gas production increases in the future, especially if there continues to be no pipeline to carry Alaskan natural gas to market.

construct liquefaction facilities to export domestically produced LNG using existing LNG facilities in small amounts. These applications are pending with various regulatory agencies (see **Table 1**).

Figure 4. U.S. Natural Gas Exports

1980-2010



Source: EIA natural gas exports database, http://www.eia.doe.gov/dnav/ng/ng_move_expc_s1_a.htm.

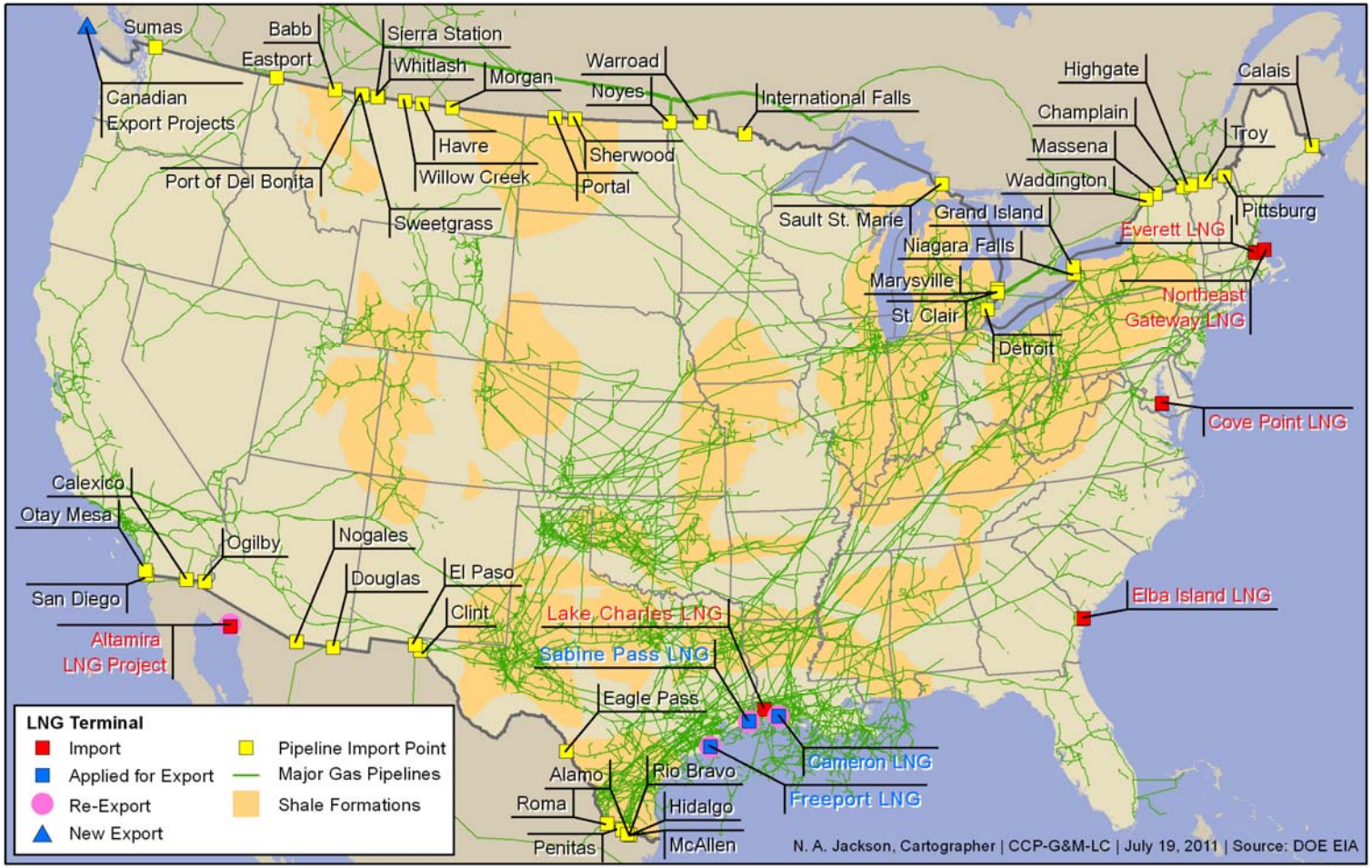
Notes: LNG exports by volume are negligible to other countries besides Japan are negligible. Units are billion cubic feet (bcf) per year.

Pipeline Exports Increase

Natural gas exports by pipeline have risen greatly since 1999, increasing almost 11 times through 2010 and accounting for about 94% of total natural gas exports last year. Canada and Mexico, both free trade partners, are the only recipients of U.S. natural gas exports by pipeline. As countries with which the United States has free trade agreements (FTAs), exports of natural gas to both is assumed to be in the national interest by statute, thereby expediting the approval process for projects. The St. Clair, MI, transit point to Canada and the Ogilby, CA, transit point to Mexico are the busiest for U.S. natural gas exports (see **Figure 5**).

Gross exports to Canada and Mexico have both increased enormously since 1999, growing 19-fold and 5.5-fold, respectively. Facilitated by the 1994 North American Free Trade Agreement, new cross border natural gas pipelines have expedited the trade. Canadian natural gas production has declined almost 15% since peaking in 2002, but still remains above the level of Canadian consumption. Some of Canada's imports of natural gas from the United States are from gas produced in Canada's western provinces, imported into the United States, and re-exported to Canada's eastern provinces. This is a cost-effective way to transport the natural gas given pipeline constraints within Canada. Mexican natural gas consumption has increased about 70% since 1999, growing much greater than its production.

Figure 5. U.S. Export and Import Points



Source: Compiled by Library of Congress cartography from EIA sources.

Notes: The blue squares with red outlines are operating regasification terminals for import that have applied for export licenses so that they may convert to liquefaction for export.

LNG Activity on the Move

U.S. LNG exports started in 1969 with the opening of the Kenai LNG export terminal in Nikiski, Alaska. Japan, the world's largest LNG importer in 2010, received almost 100% of U.S. LNG exports until recent years. Starting in 1998 Mexico began receiving small amounts of U.S. LNG from other industries that liquefy natural gas in cross-border arrangements, not from Kenai LNG.[8] In 2007, the United States exported LNG also to Canada and Russia.[9] In 2009, an LNG cargo from Kenai LNG went to South Korea.

Since its inception, the Kenai LNG facility has been owned by ConocoPhillips, which was formed by the 2002 merger of one of the original owners Phillips Petroleum Company and Conoco Inc., and Marathon Oil Company.[10] The project has not been expanded from its inception and remains the only U.S. LNG export facility. From 2005 to 2010, exports from Kenai LNG declined almost 50% due to depletion of its natural gas supply, which will ultimately lead to closure of the facility at the end of 2011.

LNG Re-Exports: The Latest Thing

Starting in 2010, DOE's Office of Fossil Energy, according to provisions in the NGA, authorized LNG import terminals to receive LNG cargos from foreign countries and then re-export the LNG to other countries. Some LNG exporters try to take advantage of the idle U.S. import terminals and storage to wait for higher world prices. This trend almost doubled U.S. LNG exports to other countries, including new recipients Brazil, India, Spain, and the United Kingdom. This trend is likely to continue, particularly as natural gas prices in the United States remain lower than elsewhere and U.S. production remains adequate for domestic consumption. Using the facilities for re-export will help maintain their operating capabilities in light of the significantly decreased use to import LNG. Currently, seven companies have received permission to re-export LNG cargos from foreign countries with one application pending.[11]

In order to re-export LNG minimal or no additional equipment may need to be added to an import terminal. As mentioned above, DOE's Office of Fossil Energy must approve the change as does FERC.

Exports of Domestically Produced Natural Gas as LNG

Six companies have applied for permits to export domestically produced natural gas as LNG, with a cumulative capacity of almost 2,900 billion cubic feet (bcf) per year or just over 12.5% of current U.S. production.[12] Four of these liquefaction projects plan to adapt an existing LNG

[8] LNG is produced at various locations around the United States, mainly for local use, but only Kenai LNG is exclusively for export.

[9] The cargo to Russia was to facilitate the commissioning of that country's first LNG export terminal in Sakhalin. The Canadian LNG imports from the United States are minor in comparison to pipeline imports and only happened in 2007.

[10] ConocoPhillips agreed to purchase Marathon Oil's 30% interest in Kenai LNG in October 2011.

[11] Department of Energy (DOE), Office of Fossil Energy, *Authorizations Database*, Washington, DC, 2011, http://www.fossil.energy.gov/programs/gasregulation/authorizations/Orders-2011.html.

[12] DOE, Office of Fossil Energy, *Authorizations Database*, Washington, DC, 2011, http://www.fossil.energy.gov/programs/gasregulation/authorizations/Orders-2011.html.

import terminal for export, which would require construction of liquefaction facilities at the import terminals, a major financial investment, with preliminary estimates ranging from $2 billion to $8 billion mostly depending primarily on capacity size. A fifth project would construct a new LNG import and export terminal, while the sixth is a small project—expected exports of less than 12 bcf per year—that will use cryogenic containers by rail or ship to export to South American, Central America, or the Caribbean countries. As of October 2011, Cheniere Energy's Sabine Pass LNG project, ConocoPhillip's Freeport LNG project, Southern Union's Lake Charles LNG, and Carib Energy have received approval from DOE's Office of Fossil Energy to construct the facilities and export U.S.-produced natural gas as LNG to free trade countries. Only Cheniere Energy's project received DOE approval to export U.S. produced natural gas to non-free-trade countries.[13] Of the FTA countries, only Canada, Chile, Dominican Republic, and Mexico have existing LNG import terminals.

Table 1. Proposed North American LNG Export Projects

Project	Owner(s)	Location	Terminal	Volume (bcf/y)	Status
Sabine Pass Liquefaction	Cheniere Energy	Louisiana	Sabine Pass LNG	803	Received conditional DOE approval to export to both Free Trade Agreement (FTA) and non-FTA countries. Application is pending with FERC.
Freeport LNG Expansion	ConocoPhillips, others	Texas	Freeport LNG	511	Received conditional DOE approval to export to FTA countries, but approval pending to non-FTA countries.
Lake Charles Exports	Southern Union	Louisiana	Lake Charles	730	Received conditional DOE approval to export to FTA countries, but approval pending to non-FTA countries.
Carib Energya	Carib Energy	Not Applicable	Not Applicable	12	Received conditional DOE approval to export to FTA countries in South America, Central America, and the Caribbean.
Dominion Cove Point LNG	Dominion Resources	Maryland	Dominion Cove Point LNG	365	Application to export to FTA countries is pending with DOE.
Jordan Cove Energy	Fort Chicago and Energy Projects Development	Oregon	Jordan Cove (not yet built)	438	Application to export to FTA countries is pending with DOE.

[13] Free Trade Agreement countries that require national treatment include Australia, Bahrain, Canada, Chile, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Jordan, Mexico, Morocco, Nicaragua, Oman, Peru, and Singapore.

Project	Owner(s)	Location	Terminal	Volume (bcf/y)	Status
Kitimat LNG	Apache, EOG Resources, Encana	British Columbia, Canada	Kitimat	468	Approved by Canada's National Energy Board.
BC LNG	LNG Partners, HN DC LNG	British Columbia, Canada	New Construction	86	Applied to Canada's National Energy Board (pending)

Source: Department of Energy, Office of Fossil Energy, Natural Gas Regulatory Responsibilities databases, http://www.fossil.energy.gov/programs/gasregulation/ and Canada's National Energy Board LNG projects databases, http://www.neb-one.gc.ca/clf-nsi/rthnb/pplctnsbfrthnb/kmlnggh_l_2011/kmlnggh_l_2011-eng.html and https://www.neb-one.gc.ca/ll-eng/livelink.exe/fetch/2000/90466/94153/552726/674445/674203/674343/A1Y0J3_-_BC_LNG_Export_Co-operative_LLC_Application.pdf?nodeid=674344&vernum=0.

Notes: For comparison, the United States produced over 22,000 bcf in 2010 compared with the 2,900 bcf of proposed U.S. LNG export projects. In October 2011, Shell Canada announced the purchase of a marine terminal in British Columbia, Canada to build an LNG export terminal with its partners—Korea Gas, Mitsubishi Corp., and China National Petroleum Corp.—three key importing countries, but no applications have been filed.

a. Carib Energy will use cryogenic containers to export LNG in small amounts on cargo ships and does not need a specialized export terminal like the other projects.

Adding liquefaction capacity will require new equipment to be added to the existing import terminals. The modification or expansion of existing facilities, including liquefaction trains, storage tanks, compressors, piping, and other equipment, will require authorization from FERC. Depending on the nature of individual facility modifications, compliance with additional state or federal statutory or regulatory requirements may also be required. For example, facility modifications would be subject to some level of environmental review pursuant to the National Environmental Policy Act (NEPA). Potential regulatory requirements are discussed in below (see "Regulatory Approvals to Export LNG").

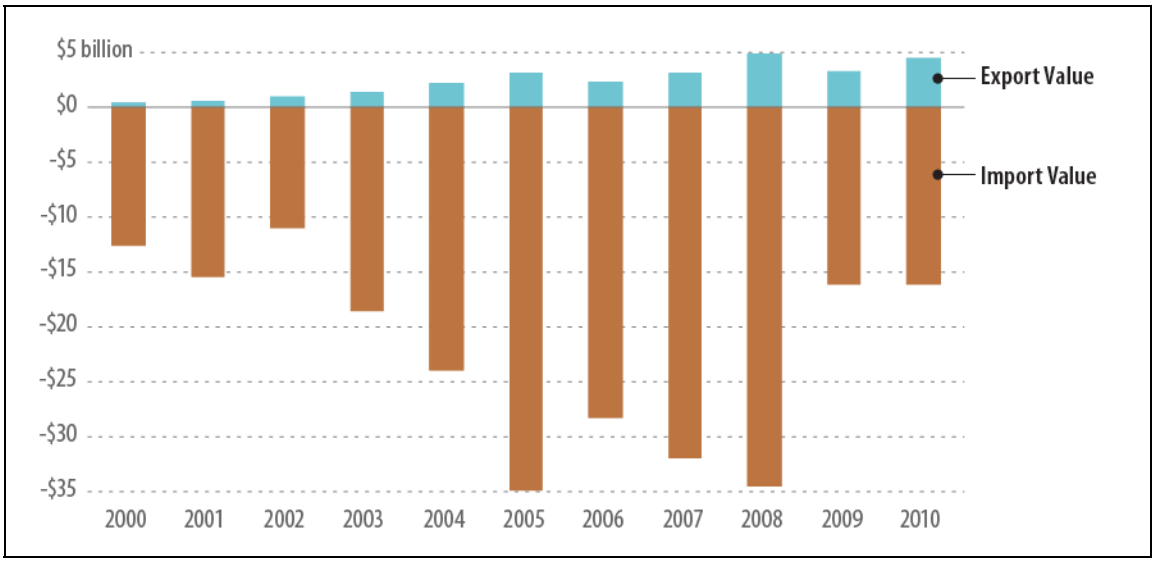
Trade Data

Natural gas imports and exports comprise a small fraction of overall U.S. international trade, totaling about $21 billion in 2010, with most of the value coming from imports (see **Figure 6**).[14] Since 2000, the value of exports has averaged almost $2.5 billion per year while imports averaged over $22 billion.[15] Should all the proposed LNG export capacity be constructed and maximally utilized, with U.S. natural gas prices of $4.00 per million British thermal unit, this would correspond to over $11.6 billion in exports. As there is no single world price for natural gas, this will vary depending on the market the LNG is exported to and the actual price companies receive, which is likely to be higher than the U.S. natural gas price in order to warrant the export.

[14] Bureau of Economic Analysis, Department of Commerce, *Trade in Goods Databases*, June 14, 2010, http://www.bea.gov/agency/uguide1.htm#_1_19.

[15] Ibid.

Figure 6. Value of U.S. Natural Gas Trade



Source: Department of Commerce, Bureau of Economic Analysis, export and import databases, http://www.bea.gov/agency/uguide1.htm#_1_19.

Note: Negative values show outflow of dollars from the United States.

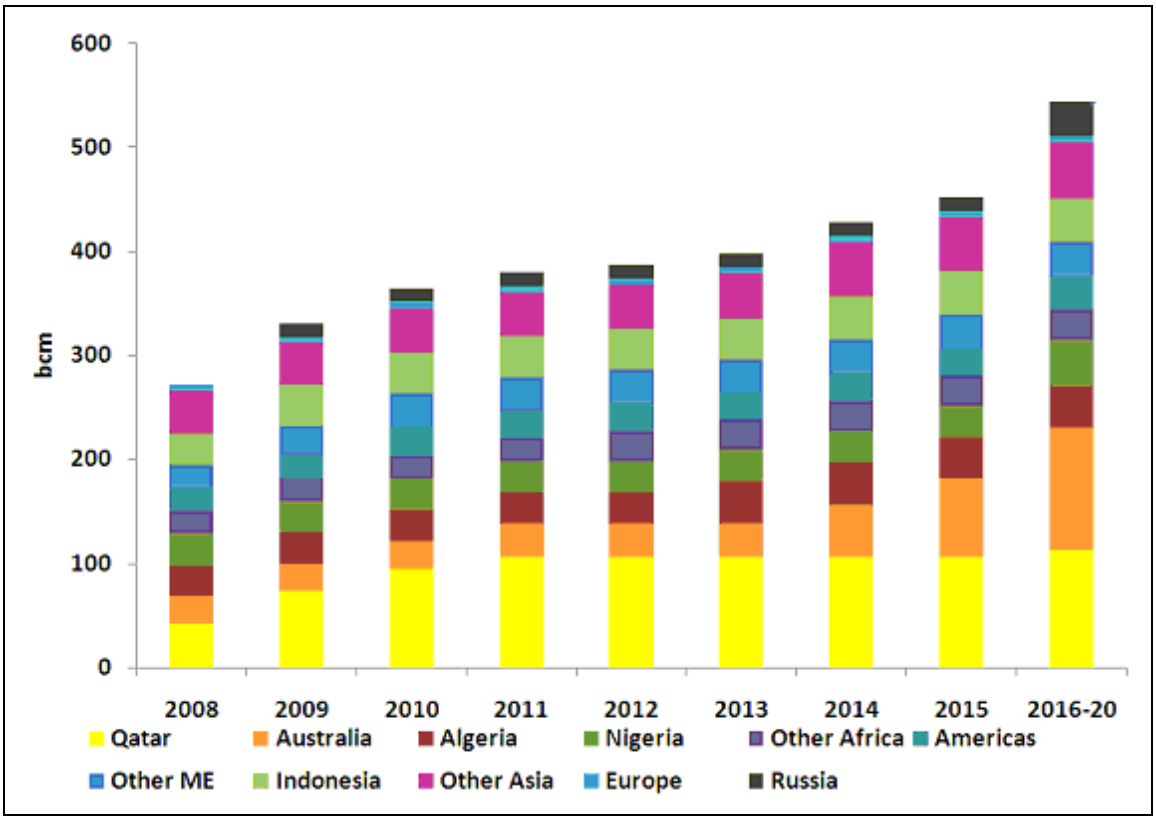
The Global LNG Market

If all the proposed U.S. LNG export projects were operational today, the United States would rank second behind Qatar in global export capacity. However, U.S. LNG exports will face competition in the global LNG market. Global liquefaction capacity is projected to almost double by 2020 (see **Figure 7**), with many projects much further along than the U.S. projects.[16] LNG trade was up over 20% year-on-year in 2010, accounting for 30% of all natural gas traded internationally.[17] Most LNG sold in the world is under long-term contracts, indexed to oil prices. The long-term contracts are needed to finance the liquefaction facilities, usually the most expensive part of the LNG supply chain, which includes LNG tankers, storage, and LNG import terminals. U.S. natural gas prices are market-based, which should give U.S. LNG export projects an advantage as the differential with oil-indexed priced natural gas can be more than double the U.S. price (see **Figure 2**). U.S. LNG exports could add to the pressure for other countries to delink their natural gas exports—either as LNG or by pipeline—from oil-indexed prices. However, U.S. LNG export projects will still need to enter into long-term supply contracts, usually 20 to 30 years, to obtain financing, which may be a difficult hurdle to get over given existing market and financial conditions. Providing LNG to countries that use oil for heating or industrial processes could also decrease demand for petroleum products, putting downward pressure on oil prices.

[16] Anne-Sophie Corbeau, "Medium-Term Oil & Gas Markets 2011," CSIS presentation, Washington, DC, June 21, 2011, p. 16, http://csis.org/files/attachments/110621_Energy_Corbeau.pdf.

[17] BP, *BP Statistical Review of World Energy*, London, June 2011, p. 28, http://www.bp.com/assets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/statistical_review_of_world_energy_full_report_2011.pdf.

Figure 7. Actual and Projected LNG Production Capacity



Source: International Energy Agency, Medium-Term Oil & Gas Markets 2011 presentation by Anne-Sophie Corbeau, June 21, 2011.

Notes: Units for this chart are billion cubic meters (bcm) per year, instead of billion cubic feet like the other data used in this report. One cubic meter equals 35.3147 cubic feet. Some potential U.S. LNG export terminals are included in the time period of 2016-2020 on the bar chart.

Given the location of most of the proposed export terminals on the U.S. Gulf Coast and the East Coast, most LNG exports will likely go to Europe, which has a lot of import capacity and growing demand. Russia, the main supplier of natural gas to Europe, may be put under increasing pressure by U.S. export projects to further delink its natural gas prices from oil. U.S. LNG exports could also provide options for some countries that are highly dependent on one supplier. Widening the Panama Canal, a project scheduled to be completed in 2014, would open up Asia for additional U.S. natural gas exports. The Jordan Cove project in Oregon and the western Canada projects are targeting the Asian natural gas market.

Regulatory Approvals to Export LNG

Pursuant to provisions included under Section 3 of the NGA (15 U.S.C. §717b), both the export of LNG and the construction or expansion of LNG terminals require authorization from DOE's Office of Fossil Energy and from FERC. With regard to exports, any person seeking authorization to export LNG from the United States, or to amend an existing import or export authorization,

must file an application with DOE's Office of Fossil Energy.[18] Issuance of an authorization is dependent upon the export being deemed consistent with the public interest.[19] If the United States has an FTA in effect with the nation to which the LNG would be exported, that application will be deemed consistent with the public interest.[20] LNG exports to non-FTA countries may also be authorized, but require the Office of Fossil Energy to publish a notice of the application in the *Federal Register* and seek public comments, protests, and notices of intervention in order to make the public interest determination. DOE also can limit the amount of cumulative LNG exports, so each successive project may be contingent upon the volumes of previously approved projects.

Also under the NGA, any person proposing to site, construct, or operate facilities to be used for the export of natural gas from the United States to a foreign country or to amend an existing FERC authorization, including the modification of existing authorized facilities, must file an application for authorization with FERC.[21] In addition to FERC, the Department of Homeland Security's U.S. Coast Guard and the Department of Transportation's Office of Pipeline Safety (OPS), under the Pipeline and Hazardous Materials Safety Administration (PHMSA), may also be responsible for exercising some level of regulatory authority over the siting, design, construction, expansion, and operation of LNG facilities, and related land and marine safety and security issues. If an application is approved, FERC will issue of a Certificate of Public Convenience and Necessity.

Both an LNG export authorization from the Office of Fossil Energy and a FERC authorization regarding facility siting, construction, or expansion are required to evaluate a proposed project's anticipated impact on the public and the environment in compliance with the National Environmental Policy Act (NEPA, 42 U.S.C. 4321 *et seq*.). Broadly, NEPA requires federal agencies to consider the environmental impacts of their actions before proceeding with them and to inform the public of those potential impacts.[22] To ensure that environmental impacts are considered, regulations implementing NEPA require all federal agencies to provide an Environmental Impact Statement (EIS) for every proposed major federal action *significantly* affecting the quality of the environment.[23] When an EIS is approved, a final Record of Decision (ROD) is issued.

Projects with less than significant impacts require a certain level of documentation under NEPA as well. Actions for which environmental impacts are uncertain require the preparation of an Environmental Assessment (EA) to determine if an EIS is necessary. If no EIS is required, a

[18] Requirements applicable to LNG exports are specified under Section 3 of the NGA (15 U.S.C. §717b). Regulations implementing requirements applicable to the export authorization application process were established under 10 C.F.R. Part 590, the "Administrative Procedures with Respect to the Import and Export of Natural Gas."

[19] Applicants seeking authorization to export LNG may seek either a blanket or a long-term authorization. The blanket authorization enables the applicant to export on a short-term or spot market basis for up to two years. The long-term authorization is used when an applicant has, or intends to have, a signed gas purchase or sales agreement/contract for a period of time longer than two years.

[20] See 15 U.S.C.§717b(c). Regulations implementing this section of the NGA were promulgated under 18 C.F.R. Part 153, "Applications For Authorization to Construct, Operate, or Modify Facilities Used For the Export or Import of Natural Gas."

[21] Pursuant to 15 U.S.C. §717b(e)(1).

[22] 42 U.S.C. §4332(2)(C).

[23] Regulations implementing NEPA's requirements, broadly applicable to all federal agencies, were promulgated by the Council of Environmental Quality (CEQ) under 40 C.F.R. §§1500-1508. NEPA regulations that supplement the CEQ regulations as well address issues specific to actions implemented by or that are the responsibility of DOE were promulgated at 10 C.F.R. Part 1021. FERC's NEPA regulations are found at 18 C.F.R. Part 380.

Finding of No Significant Impact (FONSI) may be issued. Projects that do not individually or cumulatively have significant environmental impacts are processed as Categorical Exclusions (CEs). That is, they are categorically excluded from the requirement to prepare an EA or EIS.[24]

The level of environmental review required under NEPA (i.e., the preparation of an EIS or EA or a categorical exclusion determination) is entirely project specific. For example, an LNG export-related authorization that would involve an existing LNG import terminal, that would require no modification or expansion of facilities to begin operations, may be deemed a categorical exclusion, under NEPA. However, LNG exports that involve the construction of new facilities or the expansion or modification of existing facilities may require an EIS or an EA.

In preparing the appropriate NEPA documentation for an LNG export-related authorization, the Office of Fossil Energy or FERC would be required to identify any other compliance requirements applicable to the authorization.[25] For example, for a project involving the construction, modification, or expansion of an LNG export facility, FERC would be required to identify all applicable environmental compliance requirements, in addition to NEPA. Applicable requirements may involve some level of input, analysis, or approval from another federal agency, or possibly a tribal or state agency. For example, the following selected federal statutes, including agencies that may have some jurisdiction over those requirements, may apply to the construction of a new LNG export terminal or the expansion of an existing LNG import facility to include export operations:

- The Clean Water Act—the U.S. Army Corps of Engineers, the Environmental Protection Agency (EPA), the U.S. Coast Guard, and state environmental protection agencies;
- The Clean Air Act—EPA and state environmental protection agencies;
- The Endangered Species Act—the Department of the Interior's U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service, and state natural resource agencies; and
- The National Historic Preservation Act—the Advisory Council on Historic Preservation, the State Historic Preservation Officer, or Tribal Historic Preservation Officer.

In addition to meeting appropriate environmental requirements, an LNG export-related authorization may be required to comply with additional safety or security-related requirements implemented by agencies including, but not limited to:

- The Department of Transportation's Office of Pipeline Safety (OPS) within the Pipeline and Hazardous Materials Safety Administration (PHMSA);
- National Fire Protection Association (NFPA); and
- Federal Emergency Management Agency (FEMA).[26]

[24] For more information about NEPA compliance requirements, see CRS Report RL33152, *The National Environmental Policy Act (NEPA): Background and Implementation*, by Linda Luther.

[25] For additional information on siting a liquefied natural gas terminal see CRS Report RL32205, *Liquefied Natural Gas (LNG) Import Terminals: Siting, Safety, and Regulation*, by Paul W. Parfomak and Adam Vann.

[26] For additional information on siting a liquefied natural gas terminal see CRS Report RL32205, *Liquefied Natural* (continued...)

New Sources of Natural Gas: The Game Changer

The growth in U.S. natural gas resources, particularly from shale gas, and the projected continued growth are what makes increased natural gas exports a possibility. EIA data highlight the change in the U.S. position, as proved reserves—those resources that can be produced with existing technology and prices—almost doubled between 2008 and 2009. Additionally, the most recent resource assessment of future U.S. natural gas supplies by the Potential Gas Committee (PGC)[27] reaffirmed the abundance of U.S. natural gas resources. The 2010 assessment showed potential total U.S. supplies rising 4.3% to 2,170.3 trillion cubic feet over the PGC's 2008 assessment.[28] At current U.S. consumption rates, this amounts to almost a 90-year supply. However, it is important to note that the amount of the resource that is actually produced can rise or fall depending on many factors, such as technology and prices. To highlight how things can change, the PGC's 2008 assessment showed an almost 40% increase in potential U.S. natural gas supplies over its 2006 assessment, the largest increase ever assessed by the PGC.[29] Much of the increases in the reassessments are attributed to improved techniques for accessing natural gas from shale formations. EIA projects in its 2011 Annual Energy Outlook, that overall U.S. natural gas production will grow 24% between 2010 and 2035, and that shale will comprise almost 50% of that production, up from 23% in 2010 (see **Figure 8**).

Although not as widely touted as shale gas, natural gas in Alaska is also attracting attention as a possible source for exports. The cost of producing and transporting Alaskan natural gas to the lower 48 for consumption is high when compared with current U.S. prices. Asian countries, particularly Japan and South Korea, have historically paid the highest prices to guarantee supplies (see **Figure 2**). It is unlikely that the North Slope natural gas production could use the Kenai LNG facility because of the long distance, so a new LNG export terminal would have to be constructed closer to the production source. As Alaskan oil production declines, companies may seek to monetize or sell their natural gas, which is typically reinjected into oil wells to boost production. There are also new potential natural gas supplies in Alaska that may be more conducive to export compared to North Slope natural gas.

As the prospective U.S. natural gas resource base has grown, it has raised the question of what the United States will do with all its natural gas. In 2009, the United States became the world's largest producer of natural gas, passing Russia for the first time since 2001.[30] Yet, U.S. consumption of natural gas as a percent of primary energy over the last 10 years has stayed been

(...continued)

Gas (LNG) Import Terminals: Siting, Safety, and Regulation, by Paul W. Parfomak and Adam Vann.

[27] The Potential Gas Committee (PGC) is an independent, nonprofit organization made up of knowledgeable volunteer members who work in various part of the natural gas industry. PGC is loosely affiliated with the Colorado School of Mines through the school's Potential Gas Agency. Funding for PGC mostly comes from industry-related organization.

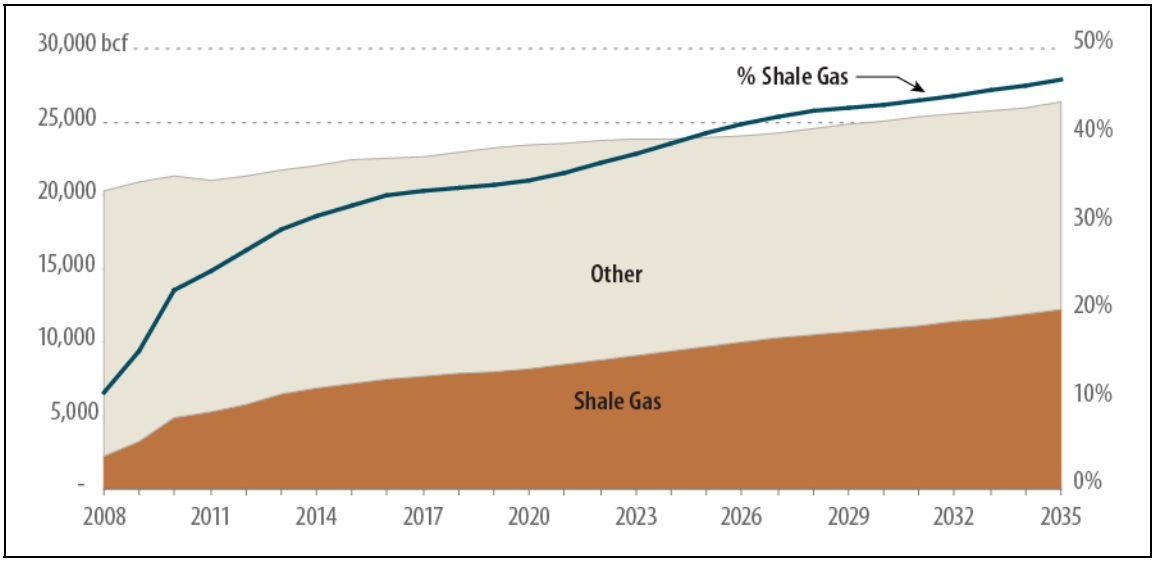
[28] Potential Gas Committee, *Potential Gas Committee Reports Substantial Increase in Magnitude of U.S. Natural Gas Resource Base*, Golden, CO, April 27, 2011, http://www.potentialgas.org/.

[29] Potential Gas Committee, *Potential Gas Committee Reports Unprecedented Increase in Magnitude of U.S. Natural Gas Resource Base*, Golden, CO, June 18, 2009, http://www.mines.edu/Potential-Gas-Committee-reports-unprecedented-increase-in-magnitude-of-U.S.-natural-gas-resource-base.

[30] BP, *BP Statistical Review of World Energy 2011*, June 2011, p. 22, http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/statistical_review_of_world_energy_full_report_2011.pdf.

between 22 % and 27 %.[31] In absolute terms, U.S. natural gas consumption has grown to over 24 tcf in 2010, up 3% over 2000.

Figure 8. Projected U.S. Natural Gas Production



Source: EIA Annual Energy Outlook 2011, Natural Gas Section, reference case, http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=3-AEO2011&table=13-AEO2011&region=0-0&cases=ref2011-d020911a.

Note: Units = billion cubic feet (bcf) per year.

Issues and Interest

There have been many bills introduced in the 112th Congress related to natural gas, but none directly address natural gas exports. The legislation introduced thus far in both the House of Representatives and Senate can be divided into three main categories: bills that would increase domestic consumption of natural gas, bills that would increase production of natural gas, and bills that would decrease production of natural gas. There was also an amendment to revoke FERC's siting authority of LNG facilities.

The Senate Energy and Natural Resources Committee has scheduled a hearing on natural gas exports for November 8, 2011. Some congressional representatives from the states where the LNG facilities are planned have submitted letters of support for the different projects to various regulatory agencies. Additionally, other Members have mentioned the possibility of natural gas exports in public statements, and some of those have expressed concerns about the potential effect on domestic prices and supplies.

The public focus on U.S. exports of natural gas has been on the applications to export LNG, despite the United States exporting much more natural gas by pipeline. Formal opposition to the

[31] BP, *BP Statistical Review of World Energy 2011*, June 2011, pp. 25, 40, http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/statistical_review_of_world_energy_full_report_2011.pdf.

individual company applications has been limited. Groups such as the Industrial Energy Consumers of America (IECA), a national association of manufacturing companies, and the American Public Gas Association (APGA), a national association of publicly-owned natural gas distribution systems, have filed motions to intervene against various projects.[32] Both of these organizations represent firms that use natural gas and would be negatively affected if natural gas prices rose. Natural gas producers and certain local businesses have supported the projects as they would benefit from access to new overseas markets and higher international prices. Analyses of the price effects of potential natural gas exports are underway and likely will receive greater attention as companies move forward with their projects.

Expectations about the economic impacts of greater U.S. natural gas exports depend on assumptions about the volume of exports, economic growth, market segmentation, and environmental regulations, among other market parameters. Some initial estimates project a modest rise in absolute terms in domestic natural gas prices if all the proposed export projects—over 12.5% of current production—are built, premised on a relatively flat supply curve for natural gas. These estimates also project that U.S. natural gas prices will stay relatively low in historic terms as well as in comparison to global prices. Those in favor of exports add that increased production will result in increased revenue for local, state, and federal governments (through taxes, royalty payments, and economic development), more employment, an improved international trade balance, and reductions in natural gas flaring. Natural gas consumers counter that higher natural gas prices abroad could eventually lead to higher prices in the United States, and possible supply shortages, as producers seek to maximize profits by diverting more and more U.S. natural gas to overseas markets.[33]

In the near term, increased use of natural gas in the U.S. economy is limited, except for electric power generation. Natural gas-fired electric power plants account for a significant and growing share of U.S. natural gas demand. Although coal is currently the dominant fuel for U.S. electric power generation, environmental concerns regarding atmospheric emissions is limiting its use and prompting the retirement of older coal plants that are less equipped to curtail emissions. Switching from coal to natural gas in electric power generation may consume incremental U.S. natural gas supply increases before exports do. Outside of electric power generation, however, there will not likely be a significant increase in demand for natural gas in the United States within the next five years, at least. Other sectors such as transportation, petrochemicals, manufacturing, services, and housing are not likely to see a substantial rise in natural gas demand. This could change if technologies can be improved to increase the use of natural gas in transportation, such as gas-to-liquids, natural gas vehicles, or electric vehicles (assuming the electricity is generated by natural gas). Although proponents see strategic value in such fuel-switching as a means to

[32] Letter from Paul N. Cicio, President of Industrial Energy Consumers of America, to U.S. Department of Energy, Office of Fossil Energy, Office of Oil and Gas Global Security and Supply, December 13, 2011, http://www.ieca-us.com/documents/121310.pdf.

American Public Gas Association, "APGA Files Motion to Intervene and Protest Freeport Export Application," press release, March 28, 2011, http://www.apga.org/files/public/Press%20Releases/2011/Press%20Release%20-%20Motion%20to%20Intervene%20in%20Freeport%20Application,%202011.pdf.

American Public Gas Association, "APGA Files Motion to Intervene in Sabine Pass LNG Export Facility Application," press release, March 4, 2011, http://www.apga.org/files/public/Press%20Releases/2011/Press%20Release%20-%20Comments%20Sabine%20Pass-%20March%203,%202011.pdf.

[33] Margaret Ryan, "USAEE Notebook: DOE Weighing LNG Export Price Effect," *AOL Energy*, Internet blog, October 10, 2011, http://energy.aol.com/2011/10/10/usaee-notebook-doe-weighing-lng-export-price-effect/.

reduce U.S. dependence on imported oil, high technology costs diminish this prospect in the near term.

Although much less attention is paid to natural gas exports by pipeline, it is possible that these will continue to increase as more shale gas is developed. Canada's natural gas production has been declining, but it is possible this will be reversed as Canada develops its own shale gas resources, which are estimated to be large. However, Canadian consumption may also increase as production from oil sands is projected to rise. Natural gas is heavily used in the extraction of petroleum from oil sands. Canada also has at least two of its own LNG export projects being considered. A recent EIA study estimated Canada's technically recoverable shale gas resources at 388 trillion cubic feet, almost 70 years' worth at their current production rate.[34] If Canada develops these resources, they could be an additional source of natural gas for the United States as well.

Mexico's natural gas production has been rising steadily for the last decade, but not quickly enough to keep up with consumption. Imports now account for over 20% of consumption compared to under 10% in 2000, and imports from the United States made up two-thirds of all natural gas imports to Mexico in 2010.[35] Although Mexico may have even more technically recoverable shale gas resources than Canada, 681 trillion cubic feet or 385 years at their current production level, Mexico is much further behind in developing these resources,[36] and will likely remain dependent on U.S. supplies to meet growing demand.

Receiving permits to export natural gas by pipeline to Canada and Mexico is easier than receiving a permit to build an LNG export facility, even though pipeline projects require authorization from the Secretaries of Defense and State. Both Canada and Mexico are FTA countries and exports are assumed to be in the U.S. national interest by statute. Pipeline export projects tend to be less costly and easier to finance than LNG export projects may be; however, none of the latter have been built in the United States in 40 years.

As highlighted above, the development of shale gas resources will be a key factor in the United States becoming a net natural gas exporter. Infrastructure constraints within some of the major shale gas producing areas may limit the amount of natural gas that can reach markets and be available for export. Changes to the regulatory environment will also have an impact on natural gas production.

Environmental groups differ on the desirability of greater natural gas use in general. Although burning natural gas produces less pollution than burning other fossil fuels, it still emits greenhouse gases and other atmospheric pollutants. Some environmental groups view natural gas as a necessary bridge fuel to a zero carbon economy, while others want to go to the zero carbon economy directly. Some environmental groups see natural gas exports raising domestic natural gas prices, making renewables more viable. Additionally, there are concerns about risks to water supplies associated with hydraulic fracturing, the technique for extracting shale gas which uses water, sand, and chemicals to create fissures in shale, allowing the trapped natural gas to be cost-

[34] U.S. Energy Information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, Washington, DC, April 2011, p. 4, http://www.eia.doe.gov.

[35] BP, *BP Statistical Review of World Energy 2011*, June 2011, pp. 23, 28, http://www.bp.com/sectionbodycopy.do?categoryId=7500&contentId=7068481.

[36] U.S. Energy Information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, Washington, DC, April 2011, p. 4, http://www.eia.doe.gov.

effectively extracted.[37] The possibility of increased shale gas development and pipeline construction in the United States to supply overseas LNG buyers troubles some environmental advocates.

With natural gas prices low and projected to remain so, producers want new markets for their product. Exports represents one alternative outlet for natural gas. Other options for increasing U.S. natural gas usage exist but except for electric power generation, few appear viable at this time.

[37] For additional information and analysis of shale gas and fracking see CRS Report R40894, *Unconventional Gas Shales: Development, Technology, and Policy Issues*, coordinated by Anthony Andrews.

Appendix A. Supply/Demand Balance

Table A-1. 2010 U.S. Supply and Demand Balances

	Volume (bcf)	Percentage of Consumption
Consumption	**24,088**	**100%**
Commercial	3,183	13%
Electric Power	7,378	31%
Industrial	6,600	27%
Residential	4,931	21%
Other	1,996	8%
Production[a]	**21,577**	**90%**
Onshore	18,504	77%
- Shale Gas[b]	4,800	20%
Offshore	3,073	13%
Net Imports	**2,604**	**11%**
Imports	3,741	16%
- Canada	3,280	14%
- LNG	431	2%
Exports	1,137	5%
- Canada	739	3%
- LNG (Alaska)	45	<1%
- Re-Export	20	<1%
Change in Inventories	**93**	**<1%**

Source: U.S. Energy Information Administration databases, http://www.eia.gov/naturalgas/data.cfm

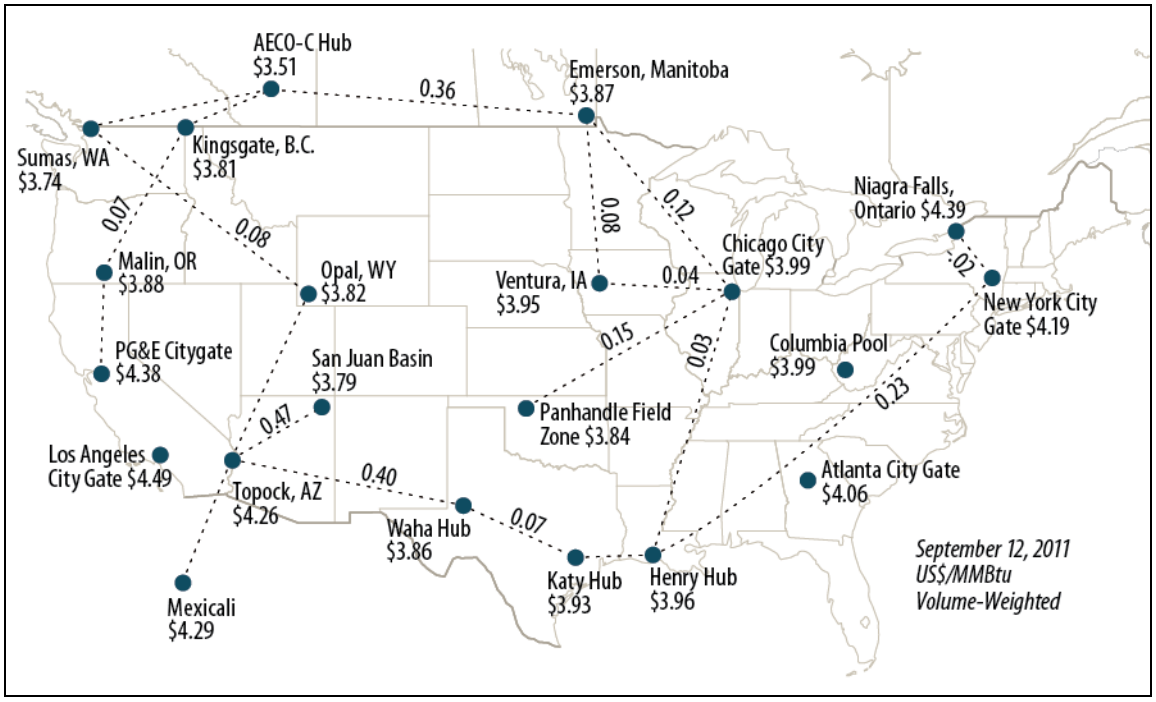
Notes: Units = billion cubic feet (bcf). Table shows data for major sub-categories, which may not equal the section total.

a. Dry natural gas production.

b. Shale gas production is an estimate.

Appendix B. Natural Gas Hub Map

Figure B-1. Natural Gas Hub and City Gate Prices



Source: Natural Gas Week, September 12, 2011, as modified by CRS.

Note: The figures along the dotted lines indicate transportation costs between hubs and city gates.

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