Briefing Paper

LNG Exports:
What State Utility Commissions Need to Know

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Report No. 12–14

October 2012

National Regulatory Research Institute

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Acknowledgments

The author wishes to thank the Honorable Mark Sievers of the Kansas Corporation Commission; Robert Keating of Keating Strategies; Robert Reed of the Alabama Public Service Commission; Dr. Ken Zimmerman, formerly of the Oregon Public Utility Commission; and NRRI colleague Tom Stanton. Any errors in the paper remain the responsibility of the author.

Executive Summary

Since 2008, shale gas has energized the U.S. natural gas sector to higher expectations. The current consensus is that shale gas will provide the U.S. with plentiful gas supplies over the next several decades.

With an abundance of domestic natural gas because of the combination of hydraulic fracturing and horizontal drilling, the U.S. will depend far less on foreign sources of gas, especially liquefied natural gas (LNG). Total U.S. natural gas production rose from 23.5 trillion cubic feet in 2006 to 28.6 trillion cubic feet in 2011, an increase of over 20 percent. Domestic demand for gas grew at a far slower rate over the same period, resulting in a gas surplus. During that time, domestic natural gas prices fell sharply, dropping further below prices in European, Asian, and other foreign markets.

Recently the policy debate has shifted 180 degrees from LNG imports to whether the U.S. should export LNG. In March 2011, the U.S. Department of Energy (DOE) approved an application by Cheniere Energy to export LNG. As of May 2012, another 12 projects had submitted similar applications. Under Section 3(a) of the Natural Gas Act, the DOE has the authority to approve exports. The expectation is that LNG exports will begin no sooner than 2015. Many analysts predict that LNG exports could account for as much as 10 percent of U.S. gas production by 2025.

This paper will assist state utility commissions in better understanding the debate over LNG exports. The core of this debate is whether exports will drive up the domestic price of natural gas to a level that will impose an undue burden on domestic gas consumers. As a rule, exports of a good or service improve general economic conditions. When restricting exports, the government (in the case of LNG, the DOE) would thus need to justify its action on other grounds. One of these grounds can be the distributional effect—for example, higher domestic gas prices inflicting substantial damage on low-income households and gas-intensive industrial firms. Government can then justify restricting trade even when a "deadweight loss" (i.e., aggregate economic-welfare loss) results.

Opponents of LNG exports have argued that the welfare of the U.S. will improve when domestic consumers, rather than foreign countries, benefit from cheap natural gas. Opponents also point to the possibility that LNG exports could hurt the environment by increasing domestic gas production, making gas less competitive with coal for electricity generation, and diminishing the attractiveness of natural gas as a vehicle fuel.

Proponents of LNG exports, on the other hand, contend that LNG exports could transform the natural gas sector into a more vibrant industry, which would ultimately benefit domestic consumers. They argue that LNG exports will drive up natural gas prices to levels that would lead to more investment in drilling and exploration activities and sustainable gas production. Some analyses, including that of the U.S. Energy Information Administration, argue that sustainable gas production will require minimum gas prices in the $5-$6 price range. State utility commissions would want to know which of these outcomes is more likely. One possible

outcome is that both effects could happen, with retail gas customers worse off in the short run but better off in later years because of additional investments in drilling. The latter outcome requires a dynamic analysis that accounts for the long-term effects of market changes.

Federal and state policymakers face the quandary of evaluating LNG exports that may be in the country's best interest but not in the short-term best interest of gas consumers; they need to weigh these two factors in taking action. Policymakers need to look at noneconomic factors (e.g., international relations), as well as the long-run effects. State utility commissions look at the long-run effects of their decisions in defining the public interest. The DOE should apply the same approach when it rules on LNG-export applications.

This debate likely will continue for some time, so this paper is timely in helping state utility commissions to become better informed, and, if they wish, actively participate in the public-policy dialogue. This paper provides a disinterested perspective on the effects LNG exports will have on the domestic natural gas sector. This paper reviewed other studies, most of them published since 2011. It supplements the information in those studies to arrive at several conclusions. These conclusions are as follows:

1. The distributional effects from trading with other countries can dwarf the net welfare gain, making foreign-trade decisions especially susceptible to politics when domestic consumers or producers suffer large economic losses.

2. Most serious analyses recommend against prohibiting or restricting LNG exports.

3. Most studies predict that exports will raise domestic natural gas prices moderately.

4. In reviewing LNG export applications, the DOE should consider both the economic and foreign-policy effects.

5. The positive effect of LNG exports on the U.S. economy would likely be minimal.

6. Many of the arguments against LNG exports are conjectural, devoid of empirical evidence, sound theoretical bases, and a public-interest perspective.

7. LNG exports would have a mixed effect on the environment.

8. The biggest risk from LNG exports lies with multibillion-dollar liquefaction facilities left idle or underutilized because of changed market conditions.

9. State utility commissions understandably are most concerned about the effect of LNG exports on domestic natural gas prices.

10. U.S. policy should support LNG exports as part of a free-trade stance that with a few exceptions would serve the country's interest.

This paper's recommendations should provide state utility commissions with some guidance on what positions they might want to take on LNG exports. Although commissions have limited authority over LNG exports, they might want to voice their opinions in different forums. Their main concern, naturally, is the effect LNG exports would have on domestic gas prices. This paper's major conclusion is that even if natural gas prices increase, it would be wrong to conclude that LNG exports are bad for the country.

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LNG Exports: What State Utility Commissions Need to Know

Introduction

Since 2008, shale gas has energized the U.S. natural gas sector to higher expectations. The current consensus is that shale gas will provide the U.S. with plentiful U.S. gas supplies over the next several decades. Total U.S. natural gas production rose from 23.5 trillion cubic feet in 2006 to 28.6 trillion cubic feet in 2011, an increase of over 20 percent. Domestic demand for gas grew at a much slower rate over the same period, resulting in a gas surplus.[1] During that time, domestic natural gas prices fell sharply, dropping further below prices in European, Asian, and other foreign markets.

With an abundance of domestic natural gas, the U.S. will depend far less on foreign sources of gas, especially liquefied natural gas (LNG). As recently as 2007, North America was home to more than 60 proposed LNG import-regasification projects. Some of those projects never left the drawing board, and several project owners now plan to convert their import and re-gasification facilities to liquefaction and export facilities.[2]

The shale-gas revolution has stimulated efforts by the U.S. natural gas industry to increase the consumption of natural gas. One promising pursuit is LNG exports. Gas producers and exporters hope to expand their market for selling gas; a wider market translates into higher prices and more sales. The economic incentive is robust, as reflected by players willing to invest billions of dollars in liquefaction facilities. "Greenfield" liquefaction facilities can cost as much as $4 billion per billion cubic feet (Bcf) of daily export capacity. This amount is several times greater than the cost of an import facility of similar size.[3]

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[1] Even though gas use for electric generation and industrial production has increased, the demand created by these uses falls short of the increase in gas production. The slow economic recovery plus the warmer-than-normal winter weather has kept gas consumption from growing more rapidly. In 2011, for example, domestic gas production grew by 7.9 percent while domestic consumption fell by over 10 percent. Because of low gas prices, some gas producers recently have retrenched drilling by slowing the gas flow from existing wells or taking the extreme action of capping wells. Their motive is to delay production until prices increase to more profitable levels.

[2] The Northeast will continue to import LNG for winter heating requirements. Even at their highest volumes, LNG imports never averaged more than 3.3 Bcf per day over any month.

[3] *See* Michael Ratner et al., *U.S. Natural Gas Exports: New Opportunities, Uncertain Outcomes* (Washington, D.C.: Congressional Research Service, November 4, 2011) at http://www.fas.org/sgp/crs/misc/R42074.pdf.

Under Section 3(a) of the U.S. Natural Gas Act, the DOE has the authority to approve exports.[4] In March 2011, the U.S. Department of Energy (DOE) approved the application of Cheniere Energy to export LNG. Cheniere Energy is converting the Sabine Project in Louisiana into an LNG liquefaction and export facility[5] and is proposing a second LNG export facility. It has already signed a long-term contract for gas exports, set to begin in 2015.[6] As of May 2012, another 12 projects had submitted similar applications.[7] Under Section 3(a) of the Natural Gas Act, the DOE has the authority to approve exports.

The expectation is that LNG exports will begin no sooner than 2015. Many analysts predict that LNG exports could account for as much as 10 percent of U.S. gas production by 2025. An expected range of daily LNG exports is around 6 Bcf. Incidentally, this range corresponds closely to the percentage of U.S. coal production exported to other countries. In the first quarter of 2012, for example, coal exports accounted for 10.7 percent of domestic coal production.[8]

Most experts predict that the vast majority of applications, even if approved, will not lead to the building of LNG export facilities.[9] These facilities require large sums of financing (e.g., $4-$6 billions of dollars) that applicants might fail to acquire because of their inability to sign long-term contracts with entities in other countries. The economics of facilities could also quickly shift because of global gas-market dynamics, dissuading some owners from continuing with a project that no longer looks profitable.

This paper will assist state utility commissions in understanding the debate over whether the U.S. should export LNG.[10] The core of this debate is whether exports will drive up the

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[4] *See 15 USC §717b* and http://fossil.energy.gov/programs/gasregulation/.

[5] The facility will cost close to $6 billion, and at 100 percent utilization will require 2 Bcf of natural gas daily.

[6] The Cheniere application, filed with DOE on September 7, 2010, was the first application for long-term authority to export LNG produced in the lower 48 states to non-FTA countries.

[7] The proposed LNG export projects have a total capacity of 18.8 Bcf per day, which is about 28 percent of the 2011 domestic gas consumption. This capacity also represents close to 57 percent of the global LNG market. *See* "Natural Gas, NGLs, and Crude Oil Outlook," presented by Bentek Energy to the National Association of Regulatory Utility Commissioners, September 28, 2012, 15.

[8] *See* http://www.eia.gov/coal/production/quarterly/

[9] The same outcome has occurred at re-gasification facilities, where only a small percentage of the proposed projects (more than 60) ever operated.

[10] For an excellent presentation of the myriad issues surrounding LNG exports, *see* Harry Vidas et al., "LNG Exports from North America: Regulations and Market Impacts," EUCI seminar, December 7, 2011.

domestic price of natural gas to a level that will impose an undue burden on domestic gas consumers. As a rule, exports of a good or service improve economic efficiency and the nation's economy. When restricting exports, the government (e.g., the DOE) thus would need to justify its action on other grounds. One of these grounds can be the distributional effect—for example, higher domestic gas prices inflicting substantial damage on low-income households[11] and gas-intensive industrial firms. Government can then justify constraining trade even when a "deadweight loss" (i.e., an aggregate economic-welfare loss) results.[12]

Opposition to LNG exports has come from environmentalists, Dow Chemical, Industrial Energy Consumers of America, and the American Public Gas Association.[13] Unless the DOE assumes that these groups' well-being is synonymous with the public interest, its mandate does not allow it to reject LNG export applications simply because they would be harmful to these groups' interests (more on this topic in Part II).

Politicians have also chipped in on the debate. With regard to LNG exports, for example, Senator Jeff Bingaman has said, "U.S. energy security requires reliable and affordable energy prices, not just reliable supplies."[14] The price effect has become an important factor in evaluating LNG exports, as the DOE will consider it in its review of applications.

At the time of this writing (late September), a debate has erupted in the U.S. House of Representatives over whether the DOE should speed up the process for approving LNG export applications. Some House Democrats have also petitioned the DOE to perform an environmental study focusing on hydraulic fracturing before approving LNG exports.[15]

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[11] One analyst calculated that a one-dollar rise in natural gas prices would raise the combined natural gas and electricity bills of low-income households by a total of $50 each year. *See* Michael Levi, "A Strategy for U.S. Natural Gas Exports," The Hamilton Project, Discussion Paper 2012-04, June 2012, 16 at http://www.brookings.edu/research/papers/2012/06/13-exports-levi.

[12] As discussed later, the "deadweight loss" from export restrictions equals the excess of economic losses to domestic exporter/gas producers over the economic gains of domestic gas consumers.

[13] Somewhat surprisingly, the American Gas Association does not oppose LNG exports. It hedges its position by stating: "Should access to the domestic resource base be unreasonably constrained, or should other unforeseen market transformations occur that would likely result in significant negative impacts on the customers of local gas utilities, this position [support for LNG exports] could be re-evaluated." *See* http://www.aga.org/our-issues/supply/Pages/LNGandLNGExports.aspx.

[14] *See* his comments at a hearing of the Senate Committee on Energy and Natural Resources on November 8, 2011 at http://www.gpo.gov/fdsys/pkg/CHRG-112shrg72461/html/CHRG-112shrg72461.htm.

[15] *See*, for example, "House Democrats Want Energy Dept. to Delay Okaying Natural Gas Exports," *The Daily Caller*, September 28, 2012 at http://dailycaller.com/2012/09/28/house-democrats-want-energy-dept-to-delay-okaying-natural-gas-exports/. The U.S. House of Representatives also has

I. Reasons for the Interest in LNG Exports

The presence of ample gas supplies to meet foreign demand have motivated U.S. producers and other providers to seek ways to increase demand for natural gas, including the possibility of meeting foreign demand. Since 2007, domestic gas production has increased by more than 11 Bcf/day. This addition has caused total production to exceed domestic demand. Additional gas can fuel natural gas vehicles; electricity generation; industrial demand; residential, commercial, or industrial fuel switching from electricity, oil, or coal to gas; and exports. By far the most promising driver of increasing demand for U.S. natural gas is electricity generation, either from the retirement of coal-fired plants or the addition of new generating capacity. Exports more marginally have the potential to grow demand and make the domestic gas sector more profitable.

A. High price spread

The current wide gap between domestic and foreign gas prices explains the industry's interest in exports. The price spread depends on three major factors: (1) the Henry Hub price, (2) the world oil price, and (3) the foreign LNG price (e.g., the price at which Australia is willing to sell LNG to Japan). The second factor is particularly important, as the price for much of the gas purchased in international markets correlates with the price of oil.[16] One pertinent question for export-facility developers is whether, and for how long, this gap will continue. Will the current "overpricing" of gas in international gas markets erode over time as more countries enter these markets to supply LNG?

Unlike oil, natural gas does not have a single international price, mainly because of relatively high transportation costs and government price controls in some markets.[17] Delivering

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proposed bills that would prohibit FERC approval of LNG export facilities until 2025, as well as exports of gas produced on federal lands.

[16] Asian LNG contracts, for example, link gas prices to a basket of crude oils imported into Japan. In Europe, contacts link gas prices to a basket of refined oil products.

[17] As one report remarked:

> In contrast to oil, the total cost of delivering gas to international markets is strongly influenced by transportation costs, either via long-distance pipeline or as LNG. Transportation costs will obviously be a function of distance, but by way of illustration, resources that can be economically developed at a gas price of $1 or $2/million British thermal units (MMBtu) may well require an additional $3 to $5/MMBtu of transport costs to get to their ultimate destination. These high transportation costs are also a significant factor in the evolution of the global gas market.

(Massachusetts Institute of Technology (MIT) Energy Initiative, *The Future of Natural Gas: An Interdisciplinary MIT Study* (Cambridge, MA: Massachusetts Institute of Technology, 2011), 25 at http://web.mit.edu/mitei/research/studies/natural-gas-2011.shtml.)

natural gas internationally is more complicated because of the combination of liquefaction, transportation by ocean-going tanker ships, and finally regasification. Natural-gas trades typically occur regionally, and thus far, the gas has primarily moved via pipeline rather than as LNG. One question is whether the current price gap will continue or close as LNG exports simultaneously drive domestic prices up in exporting countries and down in importing countries. Narrowing of the current price gap would jeopardize the profitability of LNG liquefaction facilities.

One factor that could lower foreign prices is a breakdown of the traditional pricing practice of indexing natural gas prices to oil prices. This development is more likely: (1) when different markets open up to competition and (2) with ample gas supplies around the world. Some analysts contend that LNG exports from the U.S. will change the dynamics of international gas markets to narrow the gap between U.S. and foreign natural gas prices. As of now, European markets seem more likely to liberalize than Asian markets.[18] For this and other reasons, most analysts consider the current price spread as not representative of the future, giving a distorted picture of the future economics of LNG exports. If LNG exports reduce foreign gas prices, and because domestic prices would increase simultaneously, we should expect to see a natural market narrowing of the price spread. This phenomenon would act to limit LNG exports over time. Another reason for expecting the price spread to fall is the current abnormally low U.S. natural gas price. Following the rather slow and weak economic recovery, above-average storage levels, and an unusually warm winter of 2011-2012, we should expect to see domestic prices increase as conditions return to normal.

B. A digression on arbitrage

Arbitrage is important in defining economic markets. At given prices, country B is in the same economic market as country A if, when the price in A exceeds the price in B, prices in the two regions converge because of arbitrage. Under this condition, if producers in A decide to increase their prices by some small amount, arbitrage from B would take place. Thus, in a perfectly functioning competitive economy, if B belongs to the same economic market as A, the price in A can exceed the price in B only by exactly the transaction or transportation costs from B to A. In other words, in a fully integrated gas market, the price of gas in one country should differ from the price in another country only by the cost of transportation.[19]

One exception upon which most analysts would agree is the single integrated market between the U.S. and Canada. A major reason for this integration is the extensive pipeline system between the two countries.

[18] Some countries still impose price controls on natural gas prices.

[19] Co-integration of regional prices confirms the "law of one price." This law says that in a market equilibrium, prices for a given commodity are the same across markets. If prices differ, unexploited gains from trade exist, leading to an arbitrage opportunity. In an unrestricted market, trade would continue until the price spread between two markets equals the transportation cost. At this point, arbitrage opportunities would cease. Statistical analysis can test the hypothesis of co-integration. With

If price were higher in one country, sellers would prefer to enter that market because returns would be higher. Supplies would then be greater in that country, driving down price; also, supplies in the lower-price country would decline, driving up that price. This process would continue until sellers are indifferent to which country to enter. At that point, prices would reach equilibrium, with prices in the two countries the same, adjusted for differences in transportation costs. Because trading provides no additional benefits, it ceases with exports driven down to zero. In this scenario, integration can only occur with price transparency and in the absence of transportation barriers.[20]

Particularly lucrative "arbitrage" opportunities exist in Asian markets; the wide gap exists inclusive of liquefaction, transportation, and re-gasification costs. As of May 2012, LNG prices were in the $16-$18 per MMBtu range in Asia and the $11-$14 per MMBtu range in Europe.[21] In comparison, the Henry Hub price was less than $3 per MMBtu. Competition for selling into the Asian market will likely be fierce, however, largely because of Australian exports.

C. Other factors

A second reason for the interest in LNG exports is higher gas-demand growth in other countries than in the U.S., largely because of greater economic growth and increasingly strict environmental policies. Globally, natural gas is replacing coal as the fuel of choice for electric generation and other end uses.

A third reason for the interest in LNG exports is that owners of LNG import gasification facilities want to retain some economic value from those facilities.[22] In addition, building "greenfield" projects would be more expensive and less profitable. Some analysts contend that the costs associated with constructing a "greenfield" terminal would be at least 50 percent higher than the incremental cost of adding liquefaction capability to an existing import terminal.

Overall, at this time the U.S. appears to be in a good position to export its low-cost, abundant gas supply to other countries that have high gas-demand growth and market prices. LNG exporters are betting large sums of money that economic opportunities will continue over the next several years. The U.S. government might exploit LNG exports as a strategic tool for

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co-integration, arbitrage is effectively working to narrow inter-country price differences. Co-integration means that transportation and transaction costs largely explain inter-country price differences.

[20] The relatively isolated, regionalized gas markets could continue for many more decades. On the other hand, it is possible that LNG or pipeline transport could grow, linking the North American, European, and Asian markets, with the effect of increasing interregional gas competition, loosening price contracts tied to oil products, and moderating the price spreads between countries.

[21] *See* Navigant Energy Practice, *NGMarket Notes*, July 2012.

[22] Analysts refer to facilities that modify existing re-gasification facilities to accommodate the exporting of liquefied gas as "brownfield" projects.

international negotiations and trade. Policymakers often ignore this potential for strategic negotiating gains when assessing the cost of a protectionist policy. As an example, the U.S. could condition LNG exports on a country's (1) giving the U.S. favorable treatment for some other product or (2) removing trade restrictions that jeopardize U.S. interests.

II. Government Authority Over LNG Exports and Facilities

A. Federal

1. The DOE

The DOE's Office of Fossil Energy has authority over LNG exports under Section 3 of the Natural Gas Act. It also has the authority to rule on applications for re-exporting LNG that originally came to domestic LNG import terminals from foreign countries. Federal legislation requires the DOE to review applications from a public-interest perspective.

The DOE automatically approves an application when the U.S. has a free-trade agreement (FTA) with the importing country.[23] It must approve the application without delay or modification. The presumption is that LNG exports would be in the public interest and that rejection would violate the spirit of an FTA.[24] FTA countries currently import little LNG. Economists have argued that in the absence of trade agreements, protectionism would prevail, especially when the beneficiaries of such a policy are politically powerful. Protectionism in the form of export restrictions essentially subsidizes consumers at the expense of domestic producers. In other words, the government plays the role of reallocating wealth from producers to consumers. Other trade restrictions have the effect of benefiting a certain group at the expense of the public.[25]

For non-FTA countries, the DOE determines whether the application would be in the public interest. These countries account for over 90 percent of current world demand for LNG. They include China, India, Japan, and Spain. Although seemingly contrary to the principle of free trade, this policy gives the U.S. leverage in negotiating trade agreements with non-FTA countries.

The DOE must first publish notice of an LNG export application involving a non-FTA country in the *Federal Register* and then solicit comments from interested parties before ruling. Section 3(a) of the Natural Gas Act creates a rebuttable presumption[26] that exports of natural gas

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[23] *See* Section 3(c) of the Natural Gas Act at http://www.mde.state.md.us/programs/ResearchCenter/FactSheets/Documents/www.mde.state.md.us/assets/document/Natural%20Gas%20Act%20as%20Amended_1.pdf

[24] In other words, the DOE does not have to conduct an analysis as to whether the application would be in the public interest.

[25] One exception is the presence of market failures (e.g., "dumping" of products by importers) that can justify government intervention.

[26] This term reflects a statutory presumption that favors DOE approval of an application. Rejection requires evidence showing that approval of an application would be incompatible with the public interest.

would be in the public interest. The DOE and other parties have the right to provide evidence that LNG exports are not in the public interest.

DOE has the job of assessing the public-interest effects of exports. It has compiled a list of items to review, some of which conflict and are not subject to quantification.[27] They include U.S. energy security, environmental considerations, geopolitical considerations, job creation, the effect on the U.S. economy, and the adequacy of the domestic natural gas supply. To reach a decision, therefore, the DOE needs to evaluate tradeoffs and exercise value judgment in other aspects.[28] Compromises involve weighing different goals. Special interests will try to sway the DOE to their point of view. Who will prevail in specific application depends partially on the amount of resources that the different parties expend.

The DOE has said that it has the right to revoke a past approval if conditions change. Some analysts have criticized this authority as creating uncertainty for exporters and thus increasing their risk. The DOE considers this discretion a hedge against unforeseen events that could (1) drive up the domestic price of natural gas beyond acceptable levels and (2) cause shortages of domestic gas supplies.

The DOE is currently withholding approvals for LNG-export applications to non-FTA countries until after the completion of two studies. The first study, completed in January of 2012, examined the domestic-price and other market effects from LNG exports.[29] The second study, whose expected release date is after the 2012 presidential election, will look at the general economic effects (e.g., jobs, GDP, trade balance) of LNG exports. The DOE has indicated that it will wait to make decisions on the non-FTA applications until after the second study's completion.

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[27] *See* the presentation by Christopher Smith, "LNG: Out through the In Door," from the 2012 NARUC Winter Meetings at http://www.naruc.org/Committees/CommitteePresentations.cfm?c=51. The DOE established these items in 2011. Prior to that time, the DOE used only two criteria for evaluating non-FTA applications: one relating to the promotion of competition, the other to available gas supplies in relation to domestic gas needs.

[28] This judgment includes assessing the veracity of the information provided by different parties. For example, (a) Is the evidence from the applicant credible that any price change from approval would be modest; and (b) Would approval decrease the competitiveness of the U.S. petrochemical and other gas-intensive industries?

[29] This paper includes a discussion of this study in Part IV.

2. FERC

The Federal Energy Regulatory Commission (FERC) grants the authority to site, construct, and operate onshore LNG export facilities. It has jurisdiction over their safety and environmental effects.[30] Converting import facilities to have liquefaction capability will require new equipment, such as liquefaction trains, storage tanks, compressors, piping, and other equipment. An applicant interested in converting an import facility would need to get authorization from FERC to make these modifications. The National Environmental Policy Act also requires FERC to conduct an environmental impact statement. If FERC approves an application, it will issue a certificate of public convenience and necessity.

3. Other federal agencies

Other federal agencies with authority over the construction and operation of LNG facilities include the Department of Homeland Security, Department of Transportation, Army Corp of Engineers, Environmental Protection Agency, and Coast Guard.[31]

B. States

States also have some regulatory authority over LNG facilities.[32] Section 311 of the Energy Policy Act of 2005 ("Act") explicitly allows for state involvement in the decision-making process. First, FERC must consult with the states about the safety aspect of an LNG terminal. The section requires FERC to "review and respond specifically" to the safety issues raised by a state agency in an advisory report or some other medium. Section 311 requires the governor of a state with a proposed LNG terminal to designate a state agency to consult with FERC on safety issues.

States also have the right to refuse a permit to an LNG applicant pursuant to the Coastal Zone Management Act, the Clean Water Act, or the Clean Air Act. States can veto an LNG terminal that does not satisfy these statutory requirements.

States, along with the U.S. Coast Guard and local agencies, will also provide advice on the development of an emergency-response plan, which the Act requires for construction approval. Finally, states have the option, upon written notice to FERC, to conduct safety inspections, in compliance with federal regulations and guidelines, of an operating LNG

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[30] *Title 18, C.F.R., Part 153* identifies FERC requirements for filing an application for the authorization of LNG export facilities. Offshore facilities need siting and construction approval from the Maritime Administration and the U.S. Coast Guard.

[31] *See* Michael Ratner et al., *U.S. Natural Gas Exports: New Opportunities, Uncertain Outcomes.*

[32] *See* "States' Rights in Authorization of LNG Facilities" on the FERC website at http://www.ferc.gov/industries/gas/indus-act/lng/state-rights.asp.

terminal. States do not have the authority, however, to impose sanctions for alleged safety violations. They are to report any violations to the federal Office of Pipeline Safety for further review and determination of action.

Overall, the Act allows states to become actively involved in the LNG-permitting process. FERC ultimately has discretion to consider the information that the states provide, especially about safety matters.

III. Positions on LNG Exports

A. Supporters

Those who support LNG exports make the following arguments:

1. **Free trade improves general economic conditions.** In almost all instances, exports enhance a country's economic well-being on the aggregate, even though not everyone benefits.[33]

2. **Exporters are bearing the risks, not society.** Exporters are bearing the risks because they put up their money betting that their investments will become profitable.

3. **No valid reason exits for restricting LNG exports, at least based on historical precedents for restricting exports of different products.** Governments sometimes limit or prohibit exports for national-security or other reasons that result from extreme events; for example, countries have restricted exports of food during a drought condition. None of these reasons seems to exist for curtailing LNG exports.

4. **The economic value of domestic gas resources would increase.** To the extent that domestic gas producers receive a higher price from foreign buyers, their gas resources increase in value. They are likely then to invest more in exploration and drilling over time.

5. **Sustainable natural gas production requires prices above a certain threshold, which are more likely with LNG exports.**[34] The EIA and others have contended that unless gas prices reach a certain level over time (e.g., $5-$6 per Mcf), gas production will drop or exhibit high volatility.[35] The result would be higher prices over time and a lower supply of natural gas for domestic use.[36]

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[33] For a good exposition of international trade theory and real-world applications, *see* Paul Krugman and Maurice Obstfeld, *International Economics: Theory and Policy* (Boston, MA: Addison Wesley, 2008).

[34] The argument is that the increase in demand caused by LNG exports would allow adequate gas supplies to stabilize gas prices.

[35] Prices below this range, such as 2012 prices, presumably would reduce investments in gas exploration and drilling over time.

[36] One consulting group commented that:

> In a market of surplus supply, access to large export markets will serve to balance supply and demand, thereby dampening price volatility, increasing natural gas prices moderately, and, over the long term, providing a sustainable natural gas market in North America—with the supply and price stability needed by North American industrial

6. **U.S. balance of payments would improve.** More exports, *ceteris paribus*, mean that fewer dollars will leave the U.S. relative to the amount of dollars coming in, at least in the short run.[37]

7. **A cleaner environment would result in other countries, as cheaper natural gas will displace coal in power generation and oil in industrial facilities.** The environment effect of LNG exports in the U.S. is ambiguous. It seems far clearer, however, that the availability of lower-cost gas in other countries will lead firms to substitute natural gas for more polluting coal and oil.[38]

8. **Additional tax revenues would go to different levels of government.** With additional income accruing to gas producers, gas exporters, and other affected firms, all levels of government should realize greater tax revenues. These revenues would come from taxes, royalty payments, and economic development.

9. **International relations would improve even with minimal exports.** The benefits of improved international relations can spill over to other goods and services. For example, restricting LNG exports could result in other countries' reciprocating by curbing exports of valuable goods to the U.S. and imports from the U.S.

10. **LNG exports from the U.S. could change the dynamics of global natural gas markets.** As a potentially large supplier, the U.S. could pressure other gas-supplying countries to lower the price they charge to importing countries. Large economic gains could result in those countries.

B. Opponents

Those who oppose LNG exports argue that:

1. **Domestic prices would rise while gas exporters/producers reap higher profits.** Higher exports should produce a net economic gain for the country as a whole, but

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markets. It would seem, then, that industrial opposition to LNG exports, based on perceptions of price impact, is shortsighted.

(Navigant Consulting, "North American LNG Export—A Positive Development," *NGMarket Notes*, July 2012, 3.)

[37] Over time, assuming flexible exchange rates, the balance of payments may readjust toward its former level: LNG exports would tend to increase the value of the dollar, making imports to the U.S. cheaper and exports from the U.S. more expensive. One study estimated that LNG exports would have a minimal effect on the value of the dollar. *See* "Edward Morse et al., "Energy 2020: North America, the New Middle East?" Citigroup, March 20, 2012.

[38] This outcome is most evident when China starts to import large amounts of LNG to fuel power plants and industrial facilities, displacing both coal and oil.

the distributional effect in which gas producers and exporters benefit at the expense of domestic gas consumers would be much larger. As one opponent has said, supporters of LNG exports are "wagering our long-term national well-being on short-term profits."[39]

2. **Domestic prices would not only increase but would also become more volatile.** The DOE should strive to preserve rather than undermine the stability of the domestic gas market. It acts contrary to this goal by increasing LNG exports when the future domestic gas supply is uncertain. Under plausible conditions, domestic gas prices could sharply rise and become highly volatile.

3. **Rather than exporting raw natural gas, the U.S. should encourage the exportation of products that use natural gas as an input.** Exporting LNG is contrary to this objective because it would increase the domestic price of natural gas, making those products that use large amounts of gas in production (e.g., plastics, fertilizers) less competitive in global markets.

4. **Doubts remain about the size of available domestic gas supplies in the future (e.g., because of the uncertainty over shale-gas production).** It seems too risky at this time to start exporting gas that is more valuable when domestically consumed. With declines in conventional gas production and additional domestic demands for gas, it is an unreasonable gamble to place our bets on shale gas. Environmental concerns and the uncertain decline rate of shale fields raise legitimate questions about whether the U.S. has adequate gas supplies to meet both domestic needs and foreign demands. Because the public perception of "fracking" is negative, tighter federal, state, or local regulations could restrict the future supply of shale gas.

5. **LNG exports would accelerate the depletion of U.S. gas resources and lead to higher prices or even gas shortages for future generations.** What should a country's policy be in preventing future shortages of an essential good, such as food or fuel, in the domestic market when producers find it more profitable to export the good?[40] Natural gas has become a highly valuable "bridge fuel" in the transition to a carbon-free world with minimal use of fossil fuels. In many instances, even though

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[39] *See* the comment of the American Public Gas Association at http://www.pressaction.com/news/weblog/full_article/agaexports07092011/.

[40] Exporting LNG does not seem to fall within this example because of the low likelihood that exports will cause domestic shortages; exports would, however, place pressure on domestic gas prices in the short term to increase beyond what they would otherwise be. Concerning faster depletion of U.S. gas resources, the EIA estimated that even at high rates of LNG exports, total gas production in 19 years would equal what production would have been in 20 years without exports. *See* U.S. Energy Information Administration, *Effect of Increased Natural Gas Exports on Domestic Energy Markets* (Washington, D.C.: U.S. Energy Information Administration, January 2012).

banning exports is antithetical to free trade, a country might have a valid reason to do so.

6. **Allocating more domestic gas to internal use would decrease oil imports and contribute to a cleaner environment.** A sound energy policy would encourage the increased share of natural gas in the U.S. fuel mix. One underlying premise is that a higher domestic price would stifle the development of alternative fuel vehicles such as natural gas vehicles (NGVs),[41] delay the conversion of power plants from coal to natural gas, and obstruct the resurgence of the petrochemical and other gas-intensive industries.

7. **LNG exports are contrary to the objective of energy independence.** We should maximize the use of our valuable gas supplies domestically. For example, the U.S. would benefit from replacing oil with natural gas for various end uses.[42]

8. **Increased consumption of fossil fuels is contrary to the policy objective of relying less on this energy source as soon as possible.** Rather than increase domestic gas production, the U.S. should promote renewable energy and phase out the usage of all fossil fuels, including natural gas.

As with the supporters of LNG exports, opponents of LNG exports frequently present their arguments in terms of the public interest. The available empirical evidence seems not to support at least some of the opponents' arguments. Political considerations may move DOE decisions in one direction or the other, however.

Environmentalists have taken different positions on the merits of LNG exports. Those opposing exports, including the Sierra Club, fear the damage from hydraulic fracturing in producing additional domestic gas; other opponents contend that the higher gas prices will make coal more competitive in electricity generation. A third group of opponents believes that cheaper

[41] Serious challenges for NGVs include: (a) expanding the refueling infrastructure to include more stations and other sources of refueling and (b) narrowing the price difference between a conventional vehicle and an NGV. Overcoming the first challenge will demand a much higher number of NGVs to justify economically the building of more refueling stations. Nevertheless, achieving that would first require the building of more refueling stations—a classic chicken-and-egg problem that might justify some form of governmental or utility assistance. The second challenge might require government incentives to lower the purchase price of an NGV and stimulate the building of new refueling stations. It seems, therefore, that the expected decrease in domestic gas prices from banning LNG exports would have a nominal effect on the economic attractiveness of NGVs. *See*, for example, Alan Krupnick, "Energy, Greenhouse Gas, and Economic Implications of Natural Gas Trucks," *Resources for the Future Backgrounder*, June 2010, at http://www.rff.org/RFF/Documents/RFF-BCK-Krupnick-NaturalGasTrucks.pdf.

[42] While for decades the U.S. energy market placed high priority on promoting energy independence by importing less oil and other forms of energy, it is less clear how reducing energy exports coincides with this objective.

gas in other countries will make renewable energy less economically viable there. Environmentalists who lean more favorably toward LNG exports believe that cheaper gas in other countries could help speed the retirement of coal-fired power plants and industrial facilities that use oil. Some in this group also believe that higher domestic gas prices will make renewable energy more competitive and energy efficiency more economical.

IV. An Analysis from the Public-Interest Perspective

As it relates to LNG exportation, the concept of the public interest takes into account the collective well-being of stakeholders affected by LNG exports. That is, it refers to the "common well-being" or "general welfare." Although few people would oppose policies advancing the public interest, consensus is difficult to reach over what constitutes the public interest. Two people can have dissimilar and sometimes conflicting perceptions of the public interest because these individuals may (1) consider different factors in determining the public interest and (2) assign different weights to each factor. Some of these factors may also be non-quantifiable, thus increasing the need for policymakers to use their judgment.

Policymakers do not have the luxury of simply adding up the dollar amounts of different options and comparing them in order to arrive at a decision. One person, for example, may assign the highest weight to economic efficiency, while a second person may assign primary importance to the distributional effect. A third person may put job creation first, while a fourth person may focus on natural gas as a tool for international relations. The first person would tend, in general, to favor free trade more than the second person, who would focus more on trade's winners and losers. Policymakers also need to distinguish between those arguments driven by self-interest but presented under the guise of the public interest and fairness, and those arguments purely motivated to advance the public interest. State utility commissions understand these challenges, as they confront them frequently.

A. Historical context of "export" restrictions

Policymakers can rightly restrict exports when important national-security or other policy reasons exist; for example, potential military use or concern about the importer can justify a strategic trade policy that is contrary to the principles of free trade. Generically, a strategic trade policy involves government intervention in the market for imported or exported goods for some intended purpose. A policy of restricting exports seems desirable, because consumers would tend to benefit from lower prices. One inference is that this outcome would be good for the country. This statement is a *non sequitur* because domestic producers likely would lose more than consumers would gain. A policymaker could defend this outcome as being in the public interest if he assumed that taking $1.20 from producers and giving $1 to consumers (i.e., a "deadweight loss" of 20 cents) would promote both fairness and aggregate societal welfare. This policy implicitly assigns a higher weight to consumer welfare than to producer welfare.

The economics literature is replete with real-world examples in which export controls distort pricing or inflict net welfare losses on the economy that created them. Indeed, this literature detailing the gains from international trade and the effect of restrictions on that trade dates back to Adam Smith's book, *The Wealth of Nations*, published in 1776, and David Ricardo's writings in the early 1800s.[43] Offsetting these negatives are the claims that restrictions

[43] Ricardo was the first person to present formally the principle of comparative advantage, which is the major rationale for international trade (*see* the next subsection of this paper).

protect consumers or, more cynically, win their political support. So, in spite of economic arguments that trade restrictions reduce social welfare, trade restrictions persist.

In the U.S., since the end of World War II, export restrictions have been uncommon because policymakers recognize the national benefits derived from allowing exports. Economics suggests that a country's products increase in value as market size expands. Would the U.S. or individual states even think of restricting the market for wheat, soybeans, or corn so that domestic or in-state consumers can enjoy lower prices? From a strictly economic perspective, whoever values a product the most (i.e., is willing to pay the highest price) should receive it. In this way, producers profit from higher prices, and society as a whole benefits.

In sum, the common practice in the U.S. is to allow export even if domestic consumers must thereby pay higher prices for the exported good or service. Other reasons might prevail to restrict or prohibit exports, but they do not seem applicable to LNG.

B. Arguments in favor of free trade

1. Principle of comparative advantage

The underlying economic rationale for free trade is what economists call the *principle of comparative advantage*. This term refers to the efficiencies that a country achieves when specializing in producing certain goods that have the lowest opportunity costs for the country (or similarly, for which it has a relative cost advantage). Comparative advantage says that both trading countries benefit from trade.[44] As one author remarked:

> The principle is that two nations…can gain by trade if each produces the goods for which it has a comparative advantage. Nation A has a comparative advantage over Nation B in producing a good if the cost of producing that good in A relative to the cost of producing other goods in A is lower than the cost of producing that good in B relative to the cost of producing other goods in B. [45]

2. Economic and noneconomic

Benefits should exceed costs and other downsides. One study states the economic benefits from LNG exports as the following:

> Current U.S. gas prices are determined by U.S. supply and demand. If exports from the United States are allowed, the U.S. price will rise and the United States will produce more gas. The gains from trade are then the extra money earned by

[44] One benefit to the exporting country can derive from economies of scale in which, by producing more to satisfy the demands of foreign countries, production costs can fall.

[45] David D. Friedman, *Price Theory* (Cincinnati, OH: South-Western Publishing Co., 1986), 123.

> U.S. producers on what they would have sold anyway, minus the extra amount that U.S. consumers pay and what they lose from consuming less (for example, because they produce less steel), plus the net economic gain from the new production.[46]

For the U.S., the economic welfare gain is the net change in producer surplus (i.e., the profits of gas producers, exporters, transporters, and others) and in consumer surplus.[47] Allowing LNG exports essentially grows the size of the market—it shifts the aggregate demand curve for U.S. natural gas to the right. Consequently, the domestic price rises; this rise translates into increased profits. Profits also increase from selling abroad at a price greater than costs. Domestic consumers suffer from having to pay a higher price for gas, in addition to losing the net value from less consumption because of the elasticity effect.[48] Foreign consumers, on the other hand, benefit from an additional source of gas supply.

The increase in producer surplus would exceed the decrease in consumer surplus for U.S. gas use, resulting in a net economic gain for the country. Said differently, as economists have long recognized, unambiguous economic-welfare gains originate from trade and expanding markets.[49] The Appendix shows both graphically and mathematically the economic-welfare effects of LNG exports.

3. Three economic standards for assessing LNG exports

Is a change in trade policy good or bad for society? Economists often resort to three concepts for judging whether a policy change benefits society. They can help to determine, for example, whether LNG export controls are in society's interest.

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[46] Michael Levi, "A Strategy for U.S. Natural Gas Exports," 14. The author estimated that the economic welfare gain from exporting 6 Bcf per day would be in the range of $2.7-$3.2 billion. Most of the gain derives from the producer surplus associated with new production. Compared to the gross domestic product ($15.1 trillion in 2011), this gain is nominal (around 0.02%). Levi estimated that economic welfare would increase by $1.1 billion for every additional dollar that exporters receive per Mcf of gas sold internationally.

[47] *Consumer surplus* is the difference between the value that consumers place on a good or service and the amount that they actually pay. Technically, consumer surplus is the area under the demand curve and above the price. When price increases, consumer surplus decreases by the sum of (a) the loss in net benefits from less consumption and (b) the additional payment for consuming at the actual level compared with what consumers would have paid at the same consumption level under the old price.

[48] For example, some consumers would be worse off because they pay more for the gas they purchased in the smaller market. Some consumers (e.g., those consumers in the importing countries) may benefit because they now have a source of gas that was not available because of export controls.

[49] Viewed from a global perspective, free trade becomes even more attractive, as the countries that buy our good are better off.

- **Pareto efficiency:** A Pareto-efficient market makes it impossible to effect a change that makes anyone better off without making someone worse off.[50] This concept of efficiency is an absolute one and assumes no additional gains from trade.[51] A variation of Pareto efficiency expressed in relative terms, and more useful for evaluating public policies, is whether a policy change would increase or reduce efficiency. For example, would LNG exports improve the efficiency of the U.S. and global gas markets? It reflects the aggregate changes in producer surplus and consumer surplus that we previously discussed. A policy that maximizes the sum of producer surplus and consumer surplus tends to be superior in maximizing net benefits. Thus, it is also consistent with maximizing relative economic efficiency. We observe, however, that society usually does not make decisions based on maximizing efficiency or the sum of producer surplus and consumer surplus. It usually assigns dissimilar weights to different groups of consumers and producers. For example, imputing a much higher weight to producers would tend to create policies that favor them.

- **Pareto improvement:** This concept involves a change that makes at least one person better off without making anyone else worse off.[52] Even when trade outcomes increase Pareto efficiency, typically they do not produce a Pareto improvement. International trade usually results in winners and losers, for example.

- **Hicks-Kaldor (H-K) compensation principle:** H-K efficiency assesses the benefits and costs to winners and losers.[53] Efficiency improves when the gains to the winners are larger than the losses to those made worse off by a change. For example, the principle says that trade improves efficiency when the benefits are large enough to compensate those who are worse off. The H-K principle applies to a hypothetical compensation scheme. When this compensation actually occurs, economists refer to the outcome as a Pareto improvement.

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[50] One implication is that additional trade cannot increase efficiency. The assumptions underlying this condition include perfect competition, full information, no externalities, and no transaction costs. Pursuit of self-interest by market participants yields maximum aggregate economic welfare. Under the previous (admittedly stringent) assumptions, society cannot improve upon this outcome without making at least one person worse off. Thus, it represents a Pareto-efficient condition.

[51] *See* Lee S. Friedman, *The Microeconomics of Public Policy Analysis* (Princeton, NJ: Princeton University Press, 2002), 54-7.

[52] Sometimes economists refer to this outcome as "Pareto-superior."

[53] *See* John R. Hicks, "The Valuation of Social Income," *Economica*, vol. 7 (May 1940):105-24; and Nicholas Kaldor, "Welfare Propositions of Economics and Interpersonal Comparisons of Utility," *Economic Journal*, vol. 49 (September 1939): 549-51.

How do these three standards fit together? Free trade is typically Pareto efficient in promoting economic efficiency (i.e., increasing the "size of the pie" potentially makes some people better off without making anyone worse off).[54] This outcome does not mean that everyone's condition has improved (i.e., a Pareto-improvement condition). For U.S. LNG exports, producers in the importing country may be worse off, as will be the consumers in the exporting country.[55] Theoretically, the government can redistribute the gains from trade to make everyone better off (i.e., a Pareto improvement or an H-K compensation via lump-sum transfers[56]), but rarely if ever do governments take such action. In addition to the high transfer cost of redistributing gains, it may be politically untenable.

The distributional effects from trading with other countries, in fact, may dwarf the net welfare gain (*see* the discussion in the Appendix), making foreign-trade decisions susceptible to politics because of the losses afflicting some parties (e.g., domestic consumers in exporting countries). Politics especially come into play when the losers from free trade or trade restrictions suffer high *per capita* losses and possess substantial financial resources to sway policymakers. Efficiency suffers, however, anytime the government tries to block international trade to achieve "equity" objectives. In other words, intervention would likely create "deadweight losses." Society would then have to decide on the tradeoff between efficiency and equity.

In sum, LNG exports would likely produce the following outcomes:

1. **Improved aggregate economic welfare for the U.S. because the gain in producer surplus would exceed the loss in consumer surplus:**[57] The gain would be greater to the extent that LNG exports come from new gas production rather than decreased domestic gas consumption.[58]

2. **Increased domestic gas prices, at least in the short run, but indeterminate over the long run as producers react to market price signals:** Exports reduce the availability of gas to domestic customers, with domestic prices increasing to account

[54] Another important term used in this paper, "deadweight loss," measures the lost economic efficiency from outcomes than deviate from Pareto efficiency.

[55] While producers in foreign countries would be worse off, the gains to foreign consumers would likely more than offset the losses. This outcome is the basic reason why economists oppose tariffs, import quotas, and other import restrictions.

[56] If such a wealth transfer is feasible and appropriate, it means that policymakers can avoid choosing between equality and efficiency: No one is worse off, and at least one party is better off. In the example of LNG exports, the government could theoretically tax a portion of the gains to gas exporters/ producers and redistribute those revenues to gas consumers, to offset the higher consumer prices for gas.

[57] As noted elsewhere, consumer surplus may not decrease in the long run.

[58] The EIA calculated that the higher prices caused by LNG exports would have the greatest effect on reducing gas consumption for power generation.

for this reduced availability. By itself, however, this outcome does not represent a real economic welfare loss; it is largely a distributional effect, with gas providers gaining at the expense of consumers. From a market perspective, LNG-export-driven price increases have the same effect as an increase in domestic demand for natural gas, say, from an increase in NGVs, electricity generators switching from coal to natural gas, or an increase in consumption by petrochemical companies. These price increases incent producers to enter the market and increase supply. In a well-functioning market, when supplies increase, prices fall to create new segments of demand. The new demand competes with existing demands to drive prices up. LNG exports represent a new demand segment that would help to absorb the abundance of domestic gas supplies that analysts expect.[59] As an additional benefit, to the extent that the natural gas industry features scale economies, a larger market can place downward pressures on both costs and prices.

3. **Largely a redistribution of wealth from consumers (at least in the short term) to domestic producers and exporters:** From a global perspective, with the U.S. becoming a potential major competitor in global markets, LNG exports would hurt foreign gas producers and exporters.

4. **Increased economic value of domestic gas from expanding its market:** Foreign countries, at least for now, are willing to pay more for U.S. gas than domestic consumers are. How much more is conjectural; the maximum price they would be willing to pay corresponds to the price from alternate sources minus transportation, liquefaction, and re-gasification costs.

5. **Benefits to importing countries:** These benefits are both economic and environmental. The greater supply of gas in world markets would lower prices, benefitting consumers in other countries.[60] Although these benefits occur outside the U.S, they are nevertheless real benefits for the rest of the world.[61]

6. **Improved inter-country relations:** We should expect relations to improve with countries benefiting from our products and services. The U.S. may also be able to exploit its LNG exports in negotiating trade strategies with importing countries.[62]

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[59] Six Bcf of daily LNG exports, the higher range of expected exports, would constitute less than 10 percent of domestic gas production and, over a 20-year period, about 2 percent of the estimates for technically recoverable gas.

[60] Such benefits are equivalent to the economic gains of U.S. consumers from the import of cheaper products.

[61] Foreign gas exporters and producers would be worse off with lower prices and, thus, lower profits.

[62] LNG exports to Europe can also place countries in a more favorable position for negotiating gas trades with countries such as Russia.

Restricting LNG exports can create bad feelings and incite retaliatory actions. Besides, an export ban could violate existing trade agreements between the U.S. and other countries, a prominent one being the North American Free Trade Agreement (NAFTA).

7. **Additional investments in domestic gas production, which can benefit domestic gas consumers in the long run**

8. **Narrowing of the gap between U.S. prices and foreign prices, leading to a more efficient global gas market**[63]

No good reason for restricting exports is apparent based on the usual rationales for restricting or disallowing them—namely, national security, trade retaliation, prevention of shortages of a good in the domestic market, trade sanction, or embargo.[64]

4. The benefits and costs

The benefits and costs of LNG exports from the U.S. perspective are as follows. Some of these are pecuniary in the sense that they redistribute wealth from one group to another without affecting aggregate welfare. One example is higher domestic gas prices, which represent a shifting of wealth from gas consumers to gas producers.

- **Benefits** include greater economic output,[65] higher gas-industry profits, improved trade balance, increased employment, less price volatility, cleaner global environment, increased government revenues, improved trade relations, and increased U.S. leveraging in trade negotiations.

- **Costs** include a higher domestic price of natural gas, a potential increase in economic inequality, job and profit losses in gas-intensive industries, increased price volatility from the linkage of domestic and foreign natural gas prices, a disproportionate effect on low-income households, less U.S. security as a result of importing more oil for

[63] This outcome assumes that LNG exports would affect international gas prices or increase domestic prices.

[64] Occasionally, developing countries have restricted exports of food, or taxed food exports, to hold down domestic food prices. In several instances, these restrictions have followed urban riots and other protests against food-price increases. The result is not only lower efficiency of food production but also increased inequality and overall poverty. In the long term, consumers suffer when farmers invest less in greater production. The explanation for this economically irrational policy is that urban food consumers have more political influence than farmers have.

[65] The change in economic output should account for the fewer dollars domestic gas consumers would have for spending on other goods and services because of higher gas prices.

transportation, and adverse environmental effects from less displacement of coal-fired power plants and new domestic gas production.

A superficial analysis in which trade is a zero-sum game would seem to favor export restrictions. Such an analysis assumes that the benefits to gas producers and exporters would equal the losses to domestic gas consumers. Fairness may call for rejecting this outcome: Policymakers might consider this redistribution of money contrary to the public interest. The (incorrect) perception of a zero-sum game also occurs between two countries engaging in trade. For example, the country buying a good loses, while the exporting country wins.[66] One has to ask why a country would consummate a voluntary trade unless it expects to gain.

As shown elsewhere in this paper, a more complete analysis would place LNG exports in a more favorable light. It would include the effects (1) in the long run, (2) on the aggregate economic welfare, and (3) on importing countries and trade relations. Overall, long-term positive outcomes should outweigh any short-term negative consequences. The net gains for gas producers would exceed the losses for gas customers. Some of the benefits from trade may not reveal themselves immediately. They can include sustainable gas production with less price volatility and improved foreign relations. Politically, policymakers whose greatest concerns are the immediate and short-run effects may discount these benefits.

C. LNG exporters bear the risks

Two major factors will determine the commercial viability of LNG projects: private financing and interested buyers. Financing will require long-term contracts, and interested buyers depend on the U.S. to export gas at a competitive price. The latter factor hinges on international gas-market supply-and-demand conditions. LNG production in other countries would make it more difficult for U.S. exporters to compete.

LNG exporters face uncertainty over the competitiveness of U.S. gas in both Europe and Asia. They have a locational disadvantage relative to other exporting countries such as Australia, Russia, Qatar, Nigeria, Indonesia, and Algeria.[67] Some countries, like Qatar, can produce gas at a much lower cost than can the U.S. One major natural gas study even shows results in which the U.S. would be a large LNG importer as the world gas markets evolve over time,[68] partially because other countries can undercut U.S. prices.

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[66] This perception of trade is associated with mercantilism.

[67] Some of these countries, especially Australia, Nigeria, and Russia, plan to invest in large liquefaction facilities.

[68] The study shows the precariousness of LNG exporters participating in the world gas markets and expecting to profit from multibillion-dollar investments:

> International natural gas markets are in the early stages of integration, with many impediments to further development. While increased LNG trade has started to connect

Exporters need long-term contracts to gain financing for liquefaction facilities. Investors will not fund those facilities unless buyers commit to providing revenues on a long-term basis. This commitment would require buyers to undertake the debt-service obligation, as investors would be unwilling to absorb all of the risks. The presumption is that liquefaction facilities would otherwise carry excessive risk relative to the expected returns. One major risk is the non-marketability of LNG to world markets because of competition from other countries.

Another risk stems from changes in the value of the U.S. dollar or foreign exchange rate.[69] As the value increases, U.S. exports become more expensive and thus less competitive.

Narrowing of the price spread could be commercially disastrous to U.S. exporters. Gas oversupply in different regions of the world likely will add flexibility to gas-pricing mechanisms and accelerate the development of spot pricing. Both of these results could contribute to the demise of linking gas prices to oil prices (which is starting to happen in Europe). As concluded in one study, this outcome could threaten the long-term profitability of U.S. LNG export facilities.[70]

Another threat is increased shale production in other countries. Forty-eight major basins in 32 countries have shale-gas resources. Development of these resources would reduce the demand for U.S. gas exports, as these resources potentially represent new gas supplies in global gas markets. Governmental restrictions and lack of investments, however, may cause these resources not to be developed. One example is China, which has an abundance of shale-gas resources; however, the costs to develop these resources and the resources' deliverability to consumption locations in China are unknown.

Exporters also face counterparty and incomplete-contract risks. The latter risk stems from the contract price being far above the prevailing market price, motivating buyers to demand renegotiation or termination of the contract.

> these markets, they remain largely distinct with respect to supply patterns, pricing and contract structures, and market regulation. If a more integrated market evolves, with nations pursuing gas production and trade on an economic basis, there will be increased trade among the current regional markets and *the U.S. could become a substantial net importer of LNG in future decades*. [Emphasis added]

Massachusetts Institute of Technology (MIT) Energy Initiative, *The Future of Natural Gas: An Interdisciplinary MIT Study*, 14.

[69] *See*, for example, Kenneth B. Medlock III, "US LNG Exports: Truth and Consequence," James A. Baker III Institute for Public Policy, Rice University, August 10, 2012 at http://bakerinstitute.org/publications/US%20LNG%20Exports%20-%20Truth%20and%20Consequence%20Final_Aug12-1.pdf.

[70] *See*, for example, Kenneth B. Medlock III, "US LNG Exports: Truth and Consequence," 30 (Table 1).

Regulatory risk can cause LNG exporters to face unexpectedly high costs because of new regulations. These regulations may relate to safety, the environment, and security. By driving up costs, domestic gas prices would increase, making exports less economically attractive for exporters and reducing the utilization of their multibillion-dollar facilities.

D. The downside of controlling domestic gas prices

The political reality is that higher domestic gas prices from LNG exports would invite formidable opposition. Higher domestic prices are more of a certainty in the short term. In the longer term, greater supply and the innovations that would result from higher prices could benefit consumers. As with price controls imposed by government, export restrictions may benefit consumers temporarily but would tend to hurt them in the long term.

One can look at the history of wellhead gas-price controls in the U.S., which eventually led to curtailments and large losses for the economy. The lesson learned here is that price controls or export restrictions tend to be self-defeating in protecting consumers from market rules. Unless a serious market failure exits, exports or price controls serve largely to distort the market by stifling innovations and supply, leading ultimately to lower economic growth and declines in consumer welfare. The implication for policy is that any restrictions on exports must rest on noneconomic grounds.

E. The price effect

A crucial question in the debate over LNG exports is what effect they would have on domestic gas prices. The increase in domestic gas prices would have a distributional effect—namely, the money transfer from domestic gas consumers to gas producers and exporters. As noted earlier, the distributional effect in dollars could be far greater than the aggregate welfare gain from exports. Unlike trades between individuals, exchanges between countries result in winners and losers within each country.[71] For example, some workers in an importing country would be worse off, while the consumers of the imported product would benefit.

The price charged to domestic customers should differ from the foreign price. Gas-to-gas competition in the U.S. should keep prices close to the costs of the marginal producers. Because prices are far higher in foreign countries, exporters should be able to charge these countries a higher price. This two-tier pricing scheme should net exporters and domestic gas producers higher profits. The price to foreign buyers can be as high as the netback price and as low as what U.S. consumers pay (exclusive of liquefaction and international shipping costs).[72] The most likely price is probably somewhere between these two extremes.[73]

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[71] In other words, trades between individuals produce Pareto improvements, at least *ex ante*.

[72] The netback price would correspond to prices that foreign countries currently pay for gas rather than the U.S. spot price (e.g., the Henry Hub price). What price U.S. exporters can charge depends on their market power. Market power reflects the price elasticity of demand facing U.S. exporters. The higher the elasticity, the less market power exporters have. The elasticity itself hinges on three factors:

1. Price elasticities and aggregate economic welfare

The sensitivity of domestic prices to the volume of exports affects the aggregate benefits of LNG exports to the U.S. Specifically, the less sensitive the prices are, the higher are the benefits from trade. The reason is that new gas production would be higher for a given volume of exports. In the extreme instance where domestic consumption remains the same, exports would equal new production. In a more likely scenario, new production would be less than the volume of exports. The outcome is lower net benefits from trade.[74]

The long-run welfare effect also depends on the supply's price elasticity. With an export ban, prices would tend to fall because of the reduction in total demand. Prices would stabilize as the quantity of supply falls and the quantity of demand increases.[75] When supply is responsive to price decreases, the demand side would require a smaller adjustment. This outcome means a lower quantity distortion and therefore a smaller welfare loss. Similarly, price distortion would also decline because greater price responsiveness in the supply implies the presence of less excess supply in the domestic market and thus a lower price decrease needed to return to a steady-state condition.

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the market share of exporters, the price elasticity of supply of competing suppliers, and the price elasticity of demand for gas in foreign countries.

[73] The Cheniere Energy contracts, for example, call for an export price of 115 percent of the Henry Hub price (exclusive of a fixed liquefaction fee). *See* Michael Levi, "A Strategy for U.S. Natural Gas Exports," 13.

[74] The EIA projects that 80 percent of LNG exports would come from new natural-gas production. The other 20 percent would come from existing natural-gas production that domestic consumers previously purchased. *See* U.S. Energy Information Administration, *Effect of Increased Natural Gas Exports on Domestic Energy Markets* at http://www.eia.gov/analysis/requests/fe/pdf/fe_lng.pdf.

[75] The changes would reflect downward movements along the supply and demand curves, respectively.

2. Factors affecting price

Domestic prices will increase depending on four major factors:[76]

- **The amount of gas exported:** The consensus is that the upper bound of a reasonable range of LNG exports will be 6 Bcf per day by the end of this decade, or less than 10 percent of domestic production.[77]

- **The price elasticity of supply (i.e., the rise in supply price at higher levels of domestic gas production):** One study estimated that this elasticity has sharply increased since the shale revolution—from 0.29 to 1.52, in the price range of $4-$6 per MMBtu.[78] A higher elasticity means that for a given level of LNG exports, domestic prices would increase less. With a high elasticity, for example, the U.S. could export 6 Bcf of LNG daily with only a moderate effect on the domestic price. As an illustration, with a price elasticity of supply (ε) of 1.52 and an increase in new domestic gas production of 8 percent (ΔQ/Q) because of LNG exports, the implicit price change would be 5.3 percent (ΔP/P); that is, $\Delta P/P = \Delta Q/Q \cdot 1/\varepsilon$ (or .08·.658). With an elasticity of 0.29, the implicit price change would be much higher at 27.6 percent. This example shows that the actual price change from increased production caused by exports is highly sensitive to the price elasticity of supply. At an extremely high elasticity, the U.S. could export large volumes of LNG with hardly any effect on the domestic price. This scenario is conceivable if the U.S. unexpectedly discovers new shale-gas resources unknown as of today.

- **The rate of LNG exports:** The EIA study[79] in particular shows that for a given level of LNG exports, a faster rate of development would cause prices to rise more sharply. Another factor is whether the increased foreign demand for U.S. gas comes unexpectedly. If so, gas producers may take longer to meet this demand, potentially driving up prices sharply in the short run.

- **The correlation between domestic prices and (higher) foreign prices:** Most analysts would agree that although LNG exports will narrow the gap between U.S.

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[76] *See*, for example, U.S. Energy Information Administration, *Effect of Increased Natural Gas Exports on Domestic Energy Markets*.

[77] This amount is about half the proposed LNG export capacity under review by the DOE. *See* http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_Long_Term_Applications.html.

[78] Kenneth B. Medlock III, "US LNG Exports: Truth and Consequence."

[79] U.S. Energy Information Administration, *Effect of Increased Natural Gas Exports on Domestic Energy Markets*.

and foreign gas prices, it is unlikely that prices will converge within the next several years.

One question with obvious policy implications is: What is the likelihood that domestic gas prices would rise sharply as a result of LNG exports? In addition to the volume and pace of exports, two other important factors are the steepness of the supply curve for domestic gas production (as we just showed above) and the domestic demand for gas. One example of a pessimistic scenario in which prices could increase sharply involves the following: (1) the disappointing development of shale gas because of environmental restrictions and rapidly depleting shale-gas resources, and (2) high growth in domestic demand from massive fuel switching of electric power plants to natural gas, together with a high growth of natural gas vehicles and industrial consumption of gas. Although the odds may be small that these events would occur, they are greater than zero and could have dire consequences for domestic gas prices if commitments by U.S. exporters are substantial.

3. Empirical evidence

One analyst summarized various studies by noting:

> The policy discussion in the United States has heretofore centered on the domestic price impact of LNG exports, should they occur. The results of the various studies that have been commissioned to investigate this issue reveal for a pre-specified volume of exports of 6 billion cubic feet per day an impact of anywhere between $0.22 per Mcf and $1.50 per Mcf).[80]

The empirical evidence, taken together, shows a modest increase in domestic gas prices from LNG exports. As another analyst concluded, "An increment of approximately 10 to 20 cents per thousand cubic feet (Mcf) for every billion cubic feet a day of exports is consistent with the most published projections for the impact of gas exports."[81]

Assume a price effect of 20 cents per Mcf, LNG exports of 6 Bcf per day, and total domestic gas consumption of 66.7 Bcf per day (which was the actual amount for 2011). Domestic gas consumers as a whole would pay an additional $2.9 billion for natural gas.[82] This amount is relatively small amount compared with what they annually pay for natural gas (namely, hundreds of billions of dollars). It also is far less than estimates of the net gains to exporters, producers, and other firms. One study calculated these gains, also assuming 6 Bcf in

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[80] Kenneth B. Medlock III, "US LNG Exports: Truth and Consequence," 7-8.

[81] Michael Levi, "A Strategy for U.S. Natural Gas Exports," 13. *See* also U.S. Energy Information Administration, *Effect of Increased Natural Gas Exports on Domestic Energy Markets* and Gordon Pickering, "Market Analysis for Sabine Pass LNG Export Project," Navigant Consulting, 2010.

[82] This amount assumes no elasticity effect.

daily exports, at $10 billion a year.[83] Yet some consumers could face some hardship: Low-income consumers may experience more difficulty in paying their gas bills, and gas-intensive industrial customers may see their profits erode.

The price effect is hard to predict and depends on several factors. Policymakers such as the DOE therefore should rely on a range of forecasts. Few analysts believe that LNG exports would change the dynamics of the U.S. gas market. One such change would link U.S. prices to international prices or the prices that LNG exporters charged foreign buyers.

Table 1 shows projected price effects from LNG exports of 6 Bcf per day.[84] The projections come from five different studies: (1) U.S. Energy Information Administration,[85] (2) ICF International,[86] (3) Navigant Consulting,[87] (4) Deloitte Center for Energy Solutions and Deloitte MarketPoint LLC,[88] and (5) RBAC.[89] Although this paper does not provide a thorough review of these price projections, it concludes that they represent the most credible projections that are at least publicly accessible.[90]

The RBAC projection appears as an outlier on the high side, while the Deloitte projection is an outlier on the low side. RBAC speculates on the reason for this variance:

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[83] Michael Levi, "A Strategy for U.S. Natural Gas Exports," 5.

[84] This table corresponds closely to Table 4 (p. 33) in Charles Ebinger et al., "Liquid Markets: Assessing the Case for U.S. Exports of Liquefied Natural Gas." As noted in the table, some of the projections do not correspond exactly to 6 Bcf per day.

[85] U.S. Energy Information Administration, *Effect of Increased Natural Gas Exports on Domestic Energy Markets*.

[86] ICF International, "Resource and Economic Issues Related to LNG Exports," August 17, 2011.

[87] Navigant Consulting, "Jordon Cove LNG Export Project Market Analysis Study," prepared for Jordon Cove Energy Project, L.P., January 2012, at http://www.jordancoveenergy.com/pdf/Navigant_Jordan_Cove_LNG_Export_Study_012012.pdf.

[88] Deloitte Center for Energy Solutions, "Made in America: The Economic Impact of LNG Exports from the United States," November 2011 at http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/Energy_us_er/us_er_MadeinAmerica_LNGPaper_122011.pdf.

[89] Robert Brooks, "Using GPCM® to Model LNG Exports from the US Gulf Coast," March 2, 2012 at http://www.rbac.com/press/LNG%20Exports%20from%20the%20US.pdf. RBAC is a consulting firm that specializes in developing and licensing management-decision support systems to the energy industry and government.

[90] Another group, IHS CERA, has projected that LNG exports likely will have a minimal effect on domestic gas prices. See http://www.ihs.com/products/cera/energy-report.aspx?id=1065971201.

> RBAC's 6 bcf/day scenario does not forecast that the industry will respond with speed and efficiency with an insignificant gas-price increase as does the Deloitte model. The flexibility of the industry to respond to this large and sudden increase in demand comes at a price.[91]

As stated in an RBAC press release, "The question is[,] to what extent and how quickly will an industry now focused on higher priced oil and natural gas liquids shift investment back to lower-profitability dryer gas plays needed for LNG exports?"[92] Another potential obstacle is infrastructure bottlenecks that could stifle the delivery of gas to export facilities.[93]

The Deloitte study, in contrast, concluded that:

> The results show that the North American gas market is dynamic. If exports can be anticipated, and clearly they can with the public application process and long lead time required to construct a LNG liquefaction plant, then producers, midstream players, and consumers can act to mitigate the price impact. Producers will bring more supplies online, flows will be adjusted, and consumers will react to price change resulting from LNG exports.[94]

EIA conducted a scenario analysis that showed that, under certain conditions, domestic natural gas prices could rise substantially from higher LNG exports.[95]

Two studies[96] concluded that LNG exports would (1) only moderately increase electricity prices and (2) only marginally diminish the competitiveness of the industrial sector (e.g., the

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[91] Robert Brooks, "Using GPCM® to Model LNG Exports from the US Gulf Coast," 6.

[92] *See* the RBAC website "What's New" at http://www.rbac.com/WhatsNew/tabid/54/Default.aspx.

[93] Bottlenecks can cause not only supply problems but also high and volatile prices.

[94] Deloitte Center for Energy Solutions and Deloitte MarketPoint LLC, "Made in America: The Economic Impact of LNG Exports from the United States," 2. The Deloitte analysis applies an integrated model that includes a world gas-market component. The study attributes the modest price increase to the large domestic gas-resource base and the highly integrated North American energy market. The study also assumes a high price elasticity of supply. The study did acknowledge that temporary supply tightness could cause prices to rise sharply and become more volatile. For example, prices could rise sharply when demand increases unexpectedly and the short-run price elasticity of supply is extremely small.

[95] *See* U.S. Energy Information Administration, *Effect of Increased Natural Gas Exports on Domestic Energy Markets*. For 2025, the EIA projects price increases from 9.6 percent to 32.5 percent, depending on the scenario. EIA's scenarios account for the volume and pace of LNG exports in addition to the growth of shale-gas production.

[96] See Michael Levi, "A Strategy for U.S. Natural Gas Exports," 25; and Charles Ebinger, et al., "Liquid Markets: Assessing the Case for U.S. Exports of Liquefied Natural Gas," Brookings Institution Policy Brief 12-01, May 2012, 18, at

petrochemical sector) because of the low price of gas in the U.S. relative to gas and oil prices in other countries. The feedstock costs for many foreign industrial firms correlate with oil prices, which currently on an MMBtu basis are several times higher than the price of natural gas in the U.S. Further, as LNG exports increase domestic gas production, it is likely that they will increase the production of natural gas liquids such as ethane, which is a valuable feedstock for industrial customers.

4. The importance of scenario analysis

Basing a decision solely on a single-point, "best guess" forecast adds unnecessary risk. Doing so is valid only when (1) the policymaking places a high degree of confidence in single-point forecasts, and (2) the consequences of an incorrect price forecast are small. This situation is analogous to a person choosing a financial asset with the highest expected return—say, stock in a high-tech company—without considering its risk relative to other assets. Most people would decide not to allocate all of their investments to this high-return, high-risk asset. They would tend to diversify their investment portfolios to balance the tradeoff between return and risk. In evaluating the price effect of LNG exports, the DOE should consider a reasonable range of price forecasts.[97] The midpoint of the range might represent the "best guess" forecast, with the boundary prices representing the high and low prices associated with alternative scenarios.

Scenario analysis is a tool that policymakers often use to (1) structure the uncertainty (i.e., identify the probability of midpoint and upper and lower "boundary" values or a range of values or input predictive variables), and then (2) examine the robustness of potential outcomes to changes in the underlying assumptions. Would more LNG exports cause the domestic price to rise to a level that would be both politically and economically unacceptable? At what range of prices would LNG exports be socially tolerable, and what is the probability of prices falling within this range? Under what conditions could LNG exports cause domestic gas prices to rise steeply? How likely are these conditions?

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http://www.brookings.edu/~/media/research/files/reports/2012/5/02%20lng%20exports%20ebinger/0502_lng_exports_ebinger.pdf.

[97] It can review, for example, the results of the EIA study "Effect of Increased Natural Gas Exports on Domestic Energy Markets."

V. Major Findings

After reviewing other studies and applying economic theory and policy analysis, this paper finds that:

1. **The distributional effects from trading with other countries can dwarf the net welfare gain, making foreign-trade decisions especially susceptible to politics when domestic consumers or producers suffer large economic losses.** Politics come into play when the losers from trade restrictions suffer high *per capita* losses and have substantial financial resources for lobbying. It seems likely, then, that "trade" beneficiaries will prevail in the political arena, meaning we should expect few restrictions on LNG exports. One complicating factor is that LNG opponents include some environmentalists and large consumer groups who have substantial resources with which to oppose LNG exports. It is not altogether clear, however, that LNG exports are ultimately detrimental to these groups. Additional investments in gas production stimulated by LNG exports could better sustain stable gas prices over time. Higher short-term domestic gas prices could make both renewable energy and energy conservation more economical. The opponents to LNG exports, however, cloud any predictions regarding the ultimate position of the U.S. government toward LNG exports.

2. **Most serious analyses recommend against prohibiting or restricting LNG exports.** They conclude that the U.S. would realize a net economic gain and improved international relations from LNG exports. These studies go beyond economics by looking at the diplomacy, geopolitics, and trade-policy implications of a free-trade stance. They also predict that the market will offer a natural constraint on the volume of LNG exports. With the building of more LNG liquefaction facilities, for example, declining economics would set in as the spread between domestic prices and foreign prices narrows. Although these studies oppose restrictions on LNG exports, they do not favor the government's encouraging exports (e.g., via subsidies to exporters).[98] Instead, they advocate that the market determine the volume of exports, subject to justifiable regulations for controlling "externalities" and mitigating other social problems.

[98] Restricting exports would constitute a subsidy to consumers, while encouraging exports would constitute a subsidy to gas exporters/producers.

Table 1: Estimated Price Effect during 2015-2035 from LNG Exports of 6 Bcf/day (see notes for deviations)

Study	Price Increase ($/MMbtu)	Percent Price Increase
EIA*	$0.50	9%
ICF**	$0.64	11%
Navigant***	$0.34	6%
Deloitte****	$0.12	2%
RBAC*****	$1.33	30%

* Based on the reference case, low/slow export scenario.

** Represents the mid-point of the Henry Hub price projections for two scenarios distinguishable by the supply response to price changes.

*** Projects the Henry Hub price and assumes 6.6 BCF per day.

**** Represents the average effect on U.S. prices. Projections vary across regions of the country. For example, the average effect on the Henry Hub price is $0.22/MMBtu, while the average effect is less than $0.10 for the Midwest and Mid-Atlantic regions.

***** Projects the Henry Hub price for the period 2016-2035.

3. **Most studies predict that exports will raise domestic natural gas prices moderately.** These predictions presume LNG exports within the range of 6 billion cubic feet (Bcf) per day and robust shale-gas production. Studies also generally have concluded that higher domestic gas prices driven by LNG exports will have a minimal effect on electricity prices and the competitiveness of the U.S. industrial sector.

4. **In reviewing LNG export applications, the DOE should consider both the economic and foreign-policy effects.** The DOE has the responsibility to assess the public-interest effects of exports. It reviews a list of items, some of which conflict and are not subject to quantification. Thus, the DOE will need to make tradeoffs and exercise value judgment in reaching a decision. Tradeoffs involve weighing different public-interest goals.

5. **The positive effect of LNG exports on the U.S. economy would likely be minimal.** The share of income from LNG exports relative to the national income would be small (less than 0.1 percent, under reasonable assumptions about the volume and price of LNG exports). Job creation would likely be relatively small, as well, and would tend to dwindle over time. The U.S. is a $15 trillion economy, so LNG exports within the reasonable range of $10-$20 billion would be a minor factor in its growth.

6. **Many of the arguments against LNG exports are conjectural, devoid of empirical evidence, sound theoretical bases, and a public-interest perspective.** The more credible evidence comes from those studies that oppose export restrictions. These studies come across as objective and as providing reliable evidence showing LNG exports to be in the public interest. One such piece of evidence is that the U.S. has adequate gas resources to accommodate both domestic demand and exports without causing sharp price increases or supply shortfalls. As one study pointed out, LNG exports are "technically and logistically feasible."

7. **LNG exports would have a mixed effect on the environment.** LNG exports would increase domestic natural gas production and make natural gas less competitive with coal for electric generation. Each outcome would hurt the environment. On the other hand, higher domestic natural gas prices would make both renewable energy and energy efficiency more economical at the margin.

8. **Studies on LNG exports generally rely on "best guess" outcomes for their recommendations.** One such outcome is the vigorous development of shale gas over the next several decades. Something we have learned from the natural gas sector over the past decade is that the unexpected can easily occur and have a substantial effect on market outcomes. Under worst-case scenarios, LNG exports could lead to far higher domestic natural gas prices. For example, tight regulatory restrictions on "fracking" and shale-gas production along with an unexpected decline in shale gas productivity could cause domestic gas prices to rise sharply. According to the EIA's scenario analysis, under worst-case conditions domestic natural gas prices could rise

substantially because of LNG exports. Under extreme export volume and pessimistic gas-market assumptions, for example, domestic gas prices could rise as much as 54 percent over the baseline price (assuming zero LNG exports) by 2018. Providing only best-guess forecasts can convey an incomplete picture of possible outcomes and lead to suboptimal policy decisions.

9. **The biggest risk from LNG exports lies with multibillion-dollar liquefaction facilities left idle or underutilized because of changed market conditions.** These conditions include U.S. exports becoming uncompetitive or unprofitable because of a narrow spread between U.S. prices and foreign prices. As the international gas markets become more competitive, oil indexation of prices likely will erode, driving down foreign prices and diminishing arbitrage opportunities for U.S. exporters. One study shows that price spreads would likely narrow over time, making many LNG exports facilities unprofitable. If the study's analysis is correct, great doubt falls on the future commercial viability of LNG exports from the U.S. What we can say with confidence is that arbitrage opportunities for U.S. LNG exporters currently are at their maximum. We can expect price spreads to fall in the future, causing prospective liquefaction-facility developers or investors to pause before committing to multibillion-dollar investments.

10. **State utility commissions understandably are most concerned about the effect of LNG exports on domestic natural gas prices.** From a broader public-interest perspective, however, commissions should also understand the positive aspects of LNG exports on the domestic economy and U.S. relations with other countries. Restricting exports simply to avoid a short-term rise in domestic prices, for example, could lead to retaliations by foreign countries that could jeopardize U.S. imports or exports of other goods and services. Commissions should also consider the long-run effects of LNG exports on domestic prices. Some analysts contend that exports could better sustain gas production, making prices more stable and even lower in the long run.

11. **U.S. policy should support LNG exports as part of a free-trade stance that with few exceptions would serve the country's interest.** A protectionist policy, such as restricting LNG exports, generally jeopardizes the national interest to benefit special interests. Frequently, however, governments compromise on efficiency (i.e., accept a "deadweight loss") for the benefit of shielding domestic consumers or producers from severe economic losses. For example, export restrictions protect consumers (at least in the short run), while import restrictions protect producers.

VI. Recommendations for Policymakers

Policymakers face the quandary of judging an activity (LNG exports) that may be in the country's interest but not in the short-term interest of gas consumers; they need to weigh these two factors in taking action. Policymakers need to look at noneconomic factors (e.g., international relations) as well as the long-run effects. State utility commissions look at the long-run effects of their decisions in defining the public interest. The DOE should apply the same approach when it rules on LNG-export applications.

Policymakers should take into account the benefits from trade that are difficult to quantify or not evident at first sight. These benefits include bettering international relations, positive effects on importing countries, and leveraging of U.S. position in trade negotiations. Policymakers should not evaluate LNG exports in isolation but as part of the government's overall trade policy. The possible aftermath of banning the trade of a single product is the unwillingness of foreign countries to trade other products and services with the U.S.

One option that policymakers might consider is to limit the volume of LNG exports. Policymakers, for example, can favor LNG exports as a general policy but support restricting the magnitude of exports to prevent "excessive" domestic price increases and mitigate the environmental damage from gas production. Restrictions on the volume of LNG exports can reflect a political compromise. In addition to determining who can export, the government would need to make arbitrary decisions that would likely create distortions. Export quotas could also jeopardize U.S. relations with other countries. Quotas have their own inherent problems that generally are not in a country's best interest.

One position the DOE might take is to "draw the line" by limiting LNG exports when domestic prices would rise beyond a predetermined level. That is, the DOE would consider the cumulative price effect of exports as additional applicants petition for export authorization. Problems with this position include (1) setting the "predetermined level" that would be in the public interest and (2) jeopardizing the economic and trade-policy gains of unrestricted trade. One plausible scenario is for the DOE to approve applications from non-FTA countries until the cumulative domestic price effect becomes conspicuous enough to invite strong opposition from consumer groups. Based on the evidence, however, it is unlikely that LNG exports will occur at a volume sufficient to cause a "conspicuous" price increase.

Some of the studies reviewed for this paper argue that the market offers a natural adjustment mechanism to higher domestic gas prices by making exports less profitable. For example, with a lower spread between domestic and foreign prices likely, we would see fewer LNG facilities built over time. The studies are effectively recommending that the market, rather than government, should constrain the number of LNG export facilities and export volumes.

These recommendations should provide state utility commissions with some guidance on what positions they might want to take on LNG exports. Although commissions have limited authority over LNG exports, they might want to voice their opinions in different forums. Their main concern, naturally, is the effect that exports would have on domestic gas prices. This

paper's primary conclusion is that, even if natural gas prices increase because of LNG exportation, it would be wrong to conclude that LNG exports are bad for the country.

Appendix: Welfare Effect of LNG Exports

Figure 1 illustrates graphically the distributional and aggregate welfare effects of LNG exports. It depicts a static analysis that shows the short-term effects of exporting LNG.[99] LNG exports shift the demand curve for U.S. natural gas from D to D'. D is the demand curve for gas consumed domestically, and D' is the demand curve with LNG exports. With this rightward movement of the demand curve, the quantity of domestic production rises. Assuming an upward-sloping supply curve (S), the marginal cost of domestic gas increases. A higher marginal cost results in a higher price for domestic gas consumers. When the supply curve is flat, implying an extremely high price elasticity, any growth in demand would have a zero or minimal effect on price. Under this scenario, the presumption is that the U.S. has ample gas resources to accommodate growth in demand without noticeably increasing price.

In Figure 1, the sum of areas CL_1 and CL_2 measures the welfare loss to domestic gas consumers. Mathematically, assuming linear demand and supply curves, the decrease in consumer surplus equals $\frac{1}{2}\cdot(\Delta P\cdot\Delta Q) + Q_2\cdot\Delta P$, where ΔP is the change in the domestic gas price ($P_2 - P_1$) , ΔQ is the decline in domestic gas consumption ($Q_1 - Q_2$) from the elasticity effect of a higher price, and Q_2 is the actual domestic consumption after the price increase. The first component (CL_1) is the increase in consumers' cost for consuming Q_2 relative to what they would have paid without the price increase. The second component (CL_2) measures the welfare loss to consumers when they use less gas.

The increase in producer surplus equals $\frac{1}{2}\cdot(\Delta P\cdot\Delta Q) + Q_2\cdot\Delta P + 1/2\cdot(\Delta P\cdot E)$, where E is the volume of exports. (We are assuming that gas exporters/producers are charging the same price to foreign buyers as they are to domestic consumers.) E is the difference between total gas production and the volume of this gas consumed domestically welfare gain ($Q_T - Q_2$). The first two components are simply the loss in consumer surplus ($CL_1 + CL_2$), thus representing the distributional effect from LNG exports; the last component [$1/2\cdot(\Delta P\cdot E)$] is thus the net economic-welfare gain from trade. Figure 1 measures it as WG. It equals the difference between producers' gains and consumers' losses. The welfare gain also represents the "deadweight loss" from an export ban. This gain is small relative to the distribution effects; that is $\frac{1}{2}\cdot(\Delta P\cdot\Delta Q) + Q_2\cdot\Delta P$ is much greater than $1/2\cdot(\Delta P\cdot E)$, under reasonable assumptions.[100] The net welfare gain increases when gas exporters/producers receive a higher price from foreign buyers. Such a two-tier pricing seems likely, especially since gas prices in other countries are substantially higher than prices in the U.S.

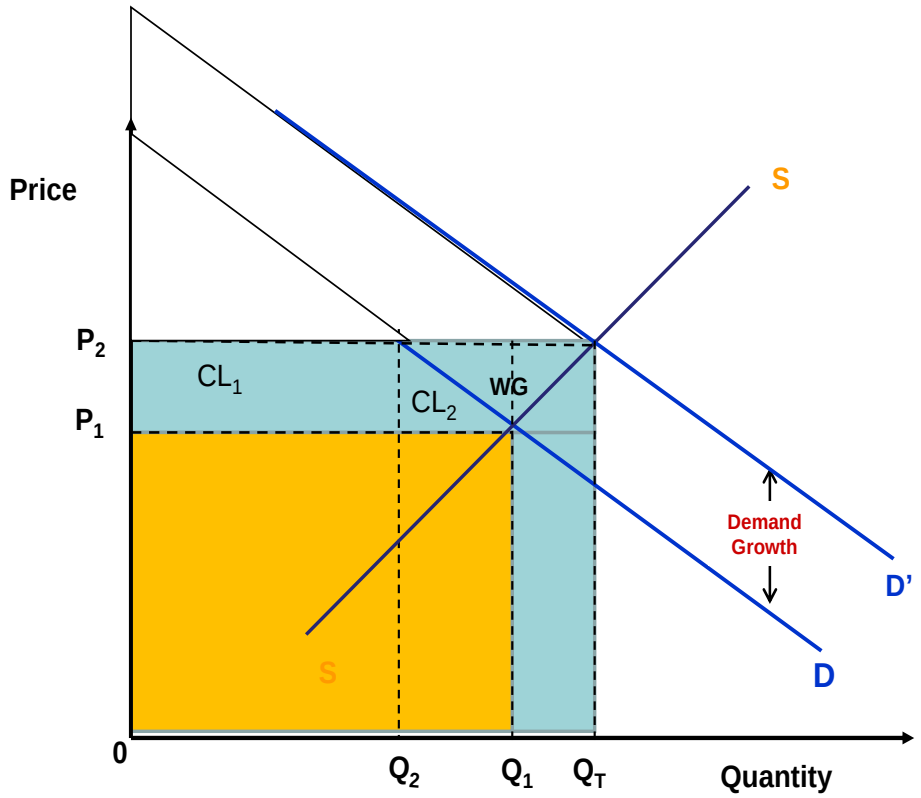
[99] A dynamic analysis would consider the pace of LNG exports; for example, it would include the period-by-period effect of exports on price, rather than just the new equilibrium price. It also would distinguish between growth in LNG exports anticipated by domestic gas producers and growth unanticipated by producers. The difference can affect the magnitude of any short-term price increases.

[100] These assumptions include the price elasticities of supply and demand.

Something else to note is that the net increase in domestic gas production ($Q_T - Q_1$) is less than the export volume. The reason for this difference is the decline in domestic consumption ($Q_1 - Q_2$). With a lower domestic-consumption decrease, the net welfare to the U.S. from a given volume of exports would be greater.

Finally, policymakers frequently are willing to tolerate a "deadweight loss" to prevent a redistribution outcome that they consider undesirable. It is hard to evaluate this position, since it requires a value judgment. On the other hand, the aggregate welfare of the country suffers, and complementary actions—for example, additional monetary assistance to low-income gas consumers—may mitigate any serious distributional effects at a lower societal cost. Policymakers should consider both factors.

Figure 1: Welfare Implications of LNG Exports



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