Navigating Natural Gas Exports

Policies and implications

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Issue Definition

The recent revolution in natural gas production technology has caused an upheaval in the energy markets and overturned conventional thinking on the global energy outlook. Recent advancements in natural gas production have made previously trapped reserves accessible resulting in massive increases in natural gas withdrawals. Production of natural gas has increased dramatically since 2006 (see Figure 1).

Figure 1. Domestic Natural Gas Production (EIA 2013)

The boom in natural gas may have the potential to revitalize parts of the ailing economy and halt environmental degradation. Natural gas is cleaner than coal as it releases less carbon dioxide and other pollution. By using natural gas, the US can reduce pollution while not sacrificing energy output (Moniz et al. 2011). Energy intensive manufacturing industries, once thought to be facing near extinction in the US, are embracing the low energy prices and have been re-shoring facilities, i.e. building production facilities domestically rather than abroad (The Economist 2013).

In 2005 the Department of Energy was predicting that the US would remain a net importer of natural gas for the foreseeable future, but these predictions have shifted dramatically as the full potential of unconventional reserves have been realized. Domestic producers of natural gas are now seeking to expand the market for natural gas by exporting the resource globally. Prices in US are nearly half of those in Europe and a quarter of those in Japan (Ebinger et al. 2012). Natural gas producers are enticed by the prospect of capturing this price differential by selling natural gas on the international market.

The intent by producers to export natural gas has been hampered by laws that require governmental authorization. Exports via pipelines to Canada and Mexico have long been
approved, as are exports to other countries that have a free trade agreement with the US, but these countries represent a relatively small market (Ratner et al. 2013). The larger East Asian and European markets are more enticing, but shipping natural gas to these markets requires the gas to be liquefied through expensive processes and shipping it via tankers. Any liquefaction facility that intends to export liquefied natural gas (LNG) to non-free trade countries requires DOE approval (DOE/FE 2013).

Advocates for exporting natural gas say that investments in natural gas transportation and production facilities along with the increased profit for producers would provide much needed economic growth to the country. Key trading partners, like Japan and the Europe Union, would have lower natural gas prices, which would help spur global economic growth. Moreover, empowered by increased economic ties, the US would be able to exert more influence globally. The US would embody the free trade principles, from which the US has benefited and espouses. Nations that have been reliant on natural gas imports from a few countries will now have the opportunity to renegotiate disadvantageous gas contracts and gas markets will become more open and global (Levi 2012, Ebinger et al. 2012, Senate Energy and Natural Resource Committee 2013).

Detractors of natural gas exports say that trading this limited domestic resource will increase domestic prices thus hindering the US from harnessing the full potential of cheap energy prices. The law of supply and demand dictates that an increase in demand due to exporting natural gas will cause prices to increase. Increased prices of natural gas will hurt domestic manufacturers which require cheap energy prices to remain globally competitive. Increased energy prices will also hurt households. Chemical manufacturers, which use natural gas as a raw material to produce products as diverse as plastic bottles and anti-freeze, will be hurt. Furthermore, the increased demand for natural gas will cause ever more potentially harmful environmental activities, such as hydraulic fracturing (Levi 2012, Ebinger et al. 2012, Senate Energy and Natural Resource Committee 2013).

Those seeking to export natural gas are urging the government to act quickly. The high global gas price differentials are causing foreign companies to increase their own supply. If the US does not act quickly, advocates say, the competitive advantage the US has will evaporate, and an immensely profitable opportunity will be lost. Detractors warn that the associated costs of exports may be severe to some Americans, and caution must be taken to any LNG facilities (Levi 2012, Ebinger et al. 2012). The decision of whether and how much natural gas should be exported is a critical issue, and a comprehensive, fair, and intelligent policy must be taken. This topic is particularly challenging because of the massive shift that has occurred in recent years as more energy is produced domestically. How citizens, businesses and the government view energy must now undergo a crucial paradigm shift. This report will present a brief overview of the background and history of this issue, describe and evaluate various policy alternatives, and propose recommendations.
Background and History

Current Policies on Exporting Natural Gas

Natural gas is imported and exported to and from the US through pipelines from Canada and Mexico and via shipping tankers carrying liquefied natural gas (LNG). Department of Energy (DOE) authorization is required for any facility that intends to import or export natural gas\(^a\). By law, DOE should, however, grant such permission to any facility unless it is deemed that the application is not in the public interest. Imports and exports to certain countries that have free trade agreements (FTA) with the US are assumed to be in the public interest and receive automatic approval\(^b\). Prior to the recent growth in domestic natural gas production, the US faced a natural gas shortfall. Seeking to incentivize more imports, Congress specified that imports from any international supplier should also be automatically approved\(^c\). Because Canada and Mexico are FTA countries, exports via pipelines are automatically approved, and the controversy surrounding natural gas exports revolves around LNG shipments (House Energy and Commerce 2013, DOE/FE 2013).

Development of Unconventional Production Techniques

The advent of cost-effective techniques to access natural gas shifted the debate from whether to encourage imports to a debate on whether to export this resource. It was known that there were large amounts of domestic natural gas in shale rock, but these deposits were difficult and expensive to access. The high demand for natural gas led to the development of techniques and methods, such as hydraulic fracturing (fracking) and horizontal drilling, which enabled producers to easily obtain these resources. Although there are other sources of natural gas and unconventional drilling does not make up a majority of production, shale deposits have significantly altered the US energy landscape (see Figure 2) (Levi 2012, Ebinger et al. 2012).

In the middle part of the 2000s, the impact of unconventional drilling technology began to be realized. Natural gas prices reached record lows and there is reason to believe that there will continue to be an abundant supply. EIA predicts the US has 2,203 trillion cubic feet (Tcf) of natural gas that is technically recoverable. At the 2011 consumption rate of 24 Tcf per year, the US would have enough gas to last 92 years (Levi 2012, Ebinger et al. 2012). Some worry that

\(^a\) Due to a natural gas surplus and insufficient pipelines to the lower-48 states, Alaska has been exporting natural gas to Japan since 1969 with a few interruptions. Since the Alaskan Kenai facility received DOE approval to export natural gas decades ago, it is not a facility that receives significant attention in the current debate (DOE/FE 2013)

\(^b\) Under Section 3 of the 1938 Natural Gas Act (NGA), DOE (previously Federal Power Commission) authorization is required for any facility that seeks to import or export natural gas. The Energy Policy Act of 1992 amended section 3 of NGA to state that facilities that import natural gas should receive automatic approval as should facilities that export to certain FTA countries -- Australia, Bahrain, Canada, Chile, Colombia, Dominican Republic, El Salvador, Guatemala, Honduras, Jordan, Mexico, Morocco, Nicaragua, Oman, Panama, Peru, Republic of Korea and Singapore (DOE/FE 2013)

\(^c\) The 2002 decision by the Federal Energy Regulatory Commission (FERC) voted to streamline the process by which natural gas was imported. The decision eliminated tariff requirements and non-discriminatory pricing rates for LNG import terminals. LNG facilities were then able to charge market-based rates and were treated in regulation as sources of natural gas rather than a component of the transportation chain. This decision was codified by congress in the 2005 Energy Policy Act (15 USC §717b) (FERC 2002)
short natural gas well lifetimes indicate that there may not be as much domestic supplies as originally thought, but most experts predict ample reserves (Senate Energy and Natural Resource Committee 2013).

These developments have been hailed as a windfall for the US economy. Energy intensive manufacturing is being re-shored to the US to take advantage of low energy prices. Chemical manufacturers are expanding production because of a cheap natural gas feedstock
d. Despite the concerns over pollution caused by fracking, there may be public health benefits from the substitution of natural gas for coal in power generation; Natural gas releases less carbon dioxide and no mercury, sulfur oxides, or nitrous oxides. (Senate Energy and Natural Resource Committee 2013, House Energy and Commerce 2013, Levi 2012, Ebinger et al. 2012).

![Graph showing sources of total domestic natural gas production](image)

**Figure 2. Sources of total domestic natural gas production**

Many countries do not have the volume of natural gas that the US has. Prices in the European Union, Japan, and other countries have remained high. US producers are seeking to expand the market by capturing the global price differentials via exporting LNG. In 2012, the cost of natural gas was $11 per million British thermal units (MBtu)\(^d\) in Europe and nearly $17/MBtu in Japan; in the US, the cost was lower than $3/MBtu. Prior to the recent growth in domestic natural gas production, world prices tended to move together with oil prices, but this

\(^d\) Natural gas wells produce various hydrocarbon products: methane, ethane, propane, pentanes and butane. Methane is separated or “cracked” from the other, heavier compounds and either burned at power plants or in-house at manufacturing facilities for power and heat, used as a raw material for chemical processes, or liquefied and shipped as LNG. The heavier compounds, or natural gas liquids, are used for chemical processes. Depending on geological factors, natural gas wells can have more of the heavier products, called “wet” wells, or have more methane, called “dry” wells. As the price of dry natural gas has decreased in recent years, producers have been focusing on developing wet wells because the liquids can be sold to increase the total profit of the well (CRS 2013, Moniz et al. 2011)

\(^e\) 1 Mcf (thousand cubic feet) = 1.027 MBtu for natural gas
trend has changed (see Figure 3). Once the $6/Mcf cost of liquefying and shipping is taken into consideration, there is still the potential for large profits. These prices have changed slightly with the price in the US rising slightly, but there still exists a substantial difference (Levi 2012, Ebinger et al. 2012). In September, 2010, Sabine Pass Liquefaction, LLC, was the first company to request permission to export LNG to non-FTA countries from a facility in Cameron Parish, Louisiana. As of June 7, 2013, there have been 21 more applications filed.

**Figure 3. International prices of natural gas** (BP 2013)

### Policy Actors

The strongest advocates for allowing exports to non-FTA countries are the natural gas producers. Due to the low domestic price of natural gas, producers are not investing in expanded production until prices increase. By exporting the natural gas, these producers would have a larger market to sell their products (Levi 2012, Ebinger et al. 2012). Many of these companies are invested in natural gas production as well as the export facilities. They intend to use the opportunity of ample domestic reserves and high prices internationally to increase profits and increase investments (Senate Energy and Natural Resource Committee 2013, House Energy and Commerce 2013).

Communities in which the export facilities are to be built are also interested in having the multi-billion dollar investments in their communities. Thousands of construction jobs are required to build the facilities as well as the workers required to operate the terminal.

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\(^{f}\) This figure plots standard benchmark hub natural gas pricing indexes from around the world. cif is the combined contract, insurance and freight cost for shipping natural gas. The Japanese and German prices are proxies for regional oil indexed prices. The UK NBP is the United Kingdom’s National Balancing Point. Henry Hub price is the distribution head of a pipeline in Erath, Louisiana and is a proxy for the US price. There is a small difference between the US and Canadian prices due to transportation costs via pipeline. These differences may become more dramatic with exports (BP 2013, Sabine n.d.)

\(^{g}\) There is a strong interest from energy companies, including ExxonMobil, Dominion Resources Inc, Sempra Energy, BG Group Plc., and Veresen Inc. (Senate Energy and Natural Resource Committee 2013)
Communities that produce the natural gas would also benefit from increased production. Across the country there are businesses that are peripherally involved in exporting or producing natural gas. Many of these companies are strong advocates of any increase in business. Communities hope they will also see indirect job creation from the increased gas business and are desperate for relief from persistent economic doldrums (Senate Energy and Natural Resource Committee 2013, House Energy and Commerce 2013).

Foreign governments in Europe and Asia are also proponents of US exportation of natural gas. Many these countries are facing high energy prices and disadvantageous supply contracts. Because many of these countries are severely dependent on natural gas as a source of energy, suppliers use this leverage to extend political influence on client countries. European and Asian countries hope that a more open, competitive, and diversified global natural gas market would lower prices and ensure stability (Levi 2012, Ebinger et al. 2012, Montgomery et al. 2012).

There are also many detractors of exporting US natural gas. Companies that cite the detrimental effect of higher natural gas prices are led by the trade group America’s Energy Advantage. These manufacturers are very reliant on energy to produce their products. Because of recent low energy prices, manufacturers have been increasing domestic production and investing in new facilities. If the price of energy turns out to be higher than original predictions, these investments may be for naught. Chemical manufacturers are particularly vulnerable to increasing prices because of the cost of energy and natural gas’ use as a chemical feedstock. The products from these processes tend to have low profit margins, and any increase in costs may severely damage their competitive outlook (Dlouhy 2013a, America’s Energy Advantage 2013).

Companies fear that unfettered exports would cause price volatility and create an unpredictable market. These companies must make large investments in plants and facilities that take years before they begin to see returns. Any uncertainty in the markets makes it difficult to make decisions and limits propensity of companies to make investments (Dlouhy 2013a, America’s Energy Advantage 2013).

h. Supply contracts for natural gas vary by region. In Japan and Korea, because of little domestic production and no pipelines, they are entirely dependent on LNG imports. This reliance forces them to sign expensive contracts which are tied to crude oil prices (oil can be a substitute for natural gas in some cases). Since the Fukushima Daiichi nuclear disaster, Japan has significantly reduced its use of nuclear power, and the dependence on energy imports will only increase. Despite producing natural gas domestically, rapid growth in energy demand in India and China forces them to also sign inflexible contracts. Europe has faced harsh gas contracts because it was dependent on pipeline imports from Russia. Russia often used this leverage to impose political terms with the contracts. By diversifying the source of natural gas by promoting LNG imports from the Middle East, some European countries have recently been able to move away from petroleum prices contracts to more competitive pricing schemes (Montgomery et al. 2012)

i. America’s Energy Advantage members include Dow Chemical, Eastman Chemical, Alcoa, Celanese, America Public Gas Association, Huntsman, and Nucor

j. There are still many energy dependent manufacturers that advocate exporting natural gas because of free market principles and a fear of creating precedent that would lead to further reaching trade restrictions which would constrict their own export markets (Dlouhy 2013a).
From a sustainability perspective, environmental groups are worried that the additional profit from natural gas due to exports would encourage more fracking. There is still a debate on whether fracking has deleterious effects on the environment. Furthermore, while natural gas is cleaner than coal, the benefits are lessened if it is shipped via LNG. Shipping LNG is energy intensive and causes pollution. The process of liquefaction and shipping takes energy and there is an increased chance of methane leaks—which has a greenhouse gas factor five times that of carbon dioxide. The end result may be that shipped natural gas is just as dirty as coal (Walsh 2013).

Current approval process

DOE has set up a process to review the competing interests and make decisions on whether to approve proposed export facilities. The Federal Energy Regulatory Commission (FERC) has been tasked with regulating on-shore and near-shore export facility siting. The environmental and safety impact of a facility is regulated and monitored as the facility is built. Other agencies, such as the Department of Transportation and the Coast Guard, may also regulate facility construction as per their jurisdiction. Responsibility for regulating natural gas exports as a commodity lies with the DOE Office of Fossil Fuel (DOE/FE), not FERC (Wright 2013).

DOE’s review process is substantial and involves significant public input into its decisions, but the process is significantly less costly for applicants than the FERC approval process. The criteria DOE uses to determine public interest are not statutory; DOE states that the criteria have been established through internal deliberation as well as the comments received during the public review stages. The criteria includes, but is not limited to: domestic need for the natural gas proposed for export, domestic natural gas supply, US energy security, impact on the US economy, impact on domestic natural gas prices, international relations impact, and environmental impact. Facilities are approved to export a specified amount of LNG. Additional facilities are assessed with consideration to the cumulative volume previously approved for export. In theory, DOE can use this authority to control the total volume of exports (Smith 2013).

\[k \text{ The FERC approval processes consists of three phases: pre-filing review, application review, and post-authorization review. The pre-filing review consists of early analysis of the project proposal and provides the public, other governmental agencies, and business, with a transparent review of the processes. Subsequently in the application review phase, FERC reviews the application and ensures that there is a plan to address environmental and safety concerns as well as a schedule for additional environmental reviews. In the post-authorization phase, FERC ensures that the facility successfully addressed the environmental and safety issues that were raised in the previous phases (Wright 2013).}\]

\[l \text{ Upon receiving an application to export LNG to non-FTA countries, DOE issues a notice in the Federal Register and solicits public comments and protests on the application for a defined period of time. After this first stage, another period of commenting is undertaken for the applicant and the public to respond to the comments made in the first stage. After this second period of comments closes, DOE reviews the application and the evidence. After this review, DOE either approves the application with or without small changes or denies it completely. DOE’s decisions can be challenged and reheard by DOE or, after exhausting the departmental review processes, can be challenged in court (Smith 2013).}\]
Recent Developments

In May 2011, Sabine Pass Terminal received DOE approval to export 2.2 billion cubic feet per day (Bcf/d) of LNG to non-FTA countries for 20 years; it was the first facility in the lower-48 to receive such approval. The decision to grant approval was met with controversy and criticism. DOE commissioned a two-part study on the microeconomic and macroeconomic impact of exporting LNG (DOE/FE 2013, Smith 2013).

The studies have received praise and criticism. Other studies on the economic impact of LNG exports have found similar results. Groups advocating LNG exports have noted the findings of the studies indicate that there will be a net benefit to the economy. Those organizations that want to limit exports emphasize the unequal distribution of benefits. Critics of the studies argue that the assumptions in the economic models were not valid and that they failed to include regional, sectoral, or environmental issues (Smith 2013).

Just before soliciting public comment on the study in the Federal Register, DOE released the order in which it was going to review future pending applications. Applications that had received FERC approval to use the pre-filing process application on or prior to December 5, 2012, would be reviewed in the order they were received. Applications that had not been approved to use the FERC pre-filing process would be placed in the cue after those that had received approval. Future applications would be reviewed in the order they were received (DOE/FE 2013).

DOE used FERC approval to begin the pre-filing application as a litmus test for those projects that were likely to succeed and which required prompt review. The FERC approval process costs millions of dollars while the DOE export application only costs $50. Some critics claim that this new queue is invalid since DOE applied this order retroactively to applications without allowing time for public notice and comments. It is not entirely clear what the full legal impact of this criticism will be (Dlouhy 2013b).

The speed at which future applications will be processed is also still uncertain. On May 17, 2013, DOE approved a second facility to export LNG to non-FTA countries at the Freeport LNG Terminal. However, the new Energy Secretary, Ernest Moniz, indicated that he will review the evidence presented thus far and reassess the public interest of future exports (German 2013).

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m The first part was conducted by EIA with the intent to assess the impact of further LNG exports on domestic natural gas markets. The second part was contracted out to NERA Economic Consulting and was to assess the macroeconomic impact of LNG exports on the US economy while accounting for global energy markets. Both studies were completed by December 11, 2012 and published in the Federal Register with a public commenting period lasting until January 24, 2013, and a reply period lasting until February 25, 2013 (DOE/FE 2013, Smith 2013).

n There have been many other studies on natural gas exports. An excellent review of the primary studies can be found in the American Petroleum Study performed by ICF International <http://www.api.org/~media/Files/Policy/LNG-Exports/API-LNG-Export-Report-by-ICF.pdf> (p. 102-105). There were two recent reports not included in the ICF summary: A Purdue study by Sarica and Tyner found a small net negative impact on GDP (Sarica and Tyner 2012), and a study by PIRA Energy Group found that there would be increased volatility due to exports (Dlouhy 2013b)
There has been pressure from Congress, businesses and organizations for competing outcomes. The Senate Energy and Natural Resources Committee and the House Energy and Commerce Committee held hearings on May 21 and June 18, 2013, respectively, on the topic of exporting LNG. Legislation has been proposed to alter the process that DOE uses to approve applications. Members of Congress have written letters to DOE urging quick decisions on export facilities. Businesses that hope to export LNG are worried that they will lose a transient opportunity to enter global markets as other countries increase production. Groups opposing exports hope to delay clear decisions until additional trade is no longer feasible (Senate Energy and Natural Resource Committee 2013, House Energy and Commerce 2013).

Alternative Policies

There have been numerous proposals to modify regulations surrounding LNG exports, including several bills introduced in Congress. These proposals range from streamlining the approval process and increasing the number of countries with automatic approval to severely limiting exports and increasing export barriers. Fundamentally, the disagreements rest on the question of who should reap the benefits and who should pay the costs (Ratner et al. 2013). There are numerous ways to affect policy -- bills, executive orders, departmental decisions, private sector actions, etc. While bill are useful for increasing debate and applying indirect pressure to DOE, most legislation is unlikely to succeed in Congress, particularly in the current political climate. Actions in the executive branch and internal departmental or private sector are much more flexible and implementable (Teter 2013).

Myriads of organizations have studied the potential consequences of natural gas exports and how the costs and benefits will be distributed. These studies have found a wide range of impacts and it is beyond the scope of this document to present all the results. For this paper, the study commissioned by DOE and performed by NERA Consulting will be used in order to gain perspective on the potential impact of additional LNG exports.

Impacts of LNG Exports

The total volume of LNG exported will depend on the international market. Companies in Qatar, Australia, and Nigeria are in the process of building natural gas liquefaction facilities. Since there is already a large global supply, the entrance of the US into this market is unlikely to alter total trade volumes. US prices will not rise to the world price due to the high costs of liquefying and transporting LNG, additional competitors entering the market, natural gas contracts, and the internal demand curves of countries. As more competitors enter the market, the international price of natural gas will be driven down. If the well head price increases above a certain point, countries will find it more profitable to buy from sources other than the US. US

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° There have been some proposals to compensate those that pay the costs of LNG exports by taxing companies or individuals that benefit. Unfortunately, this classic proposal to evenly distribute the benefits of trade is not permitted under the US Constitution or World Trade Organization rules, and will not be discussed in this report (Levi 2012).

° While this study has flaws, it is provides a useful point of analysis.
companies will find it more economical to sell the product domestically than export it. This balancing effect between decreasing international prices and increasing domestic prices will keep domestic prices from increasing dramatically. Under current international demand projections, US companies will find it more economical to sell natural gas domestically than internationally. Only under higher than expected international demand, lower than expected international supply, or higher than expected US shale gas yields will it be profitable to export LNG\(^1\) (Montgomery et al. 2012).

The NERA study agreed with traditional economic theory. The study predicted that the balancing effect will ensure that no matter what level of exports DOE permits, there will be a net benefit to the US economy. As the volume of LNG exports permitted by DOE is enlarged, the net economic benefit will increase (see Figure 4). A DOE policy of unconstrained exports was found to have the largest increase in GDP above the no-export baseline scenario. If DOE allowed unlimited LNG exports at currently predicted US shale gas yields and higher than expected international demand, the average US GDP through 2035 would be increased by $17 billion per year\(^3\) (Montgomery et al. 2012).

![Figure 4. Change in GDP from baseline no export scenario for different volumes of permitted LNG exports (Montgomery et al. 2012)\(^1\)](image)

These benefits will not be evenly distributed (see Figure 5). If DOE permits more export facilities, the natural gas production sector will see significantly greater wage income growth than it would otherwise. Other relevant sectors would see a very small decrease in wage income from baseline projections. However, even the most energy intensive sectors, such as

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\(^1\) Increased international demand could be driven by Japan and Korea choosing to reduce their use of nuclear energy, although unlikely in the case of Korea. Reduced international supply could be caused by political unrest in the Middle East and Africa, or Australia choosing to reduce its level of exports. All these factors have varying degrees of likelihood but are examples of possible scenarios rather than predictions (Ebinger et al. 2012).

\(^3\) This is assuming that a foreign company will ship the LNG. If a US company handles shipping, the US could see a larger increase in GDP.

\(^1\) “Low export level” is 6 Bcf/d phased in at 1 Bcf/d per year. “High export level” is 12 Bcf/d phased in at a rate of 3 Bcf/d per year.
the paper, chemical, glass, cement, and metal manufacturers, will see less than 1% decrease in wage income from the no-exports baseline projections (Montgomery et al. 2012).

![Figure 5. Change in wage income from baseline by sector (Montgomery et al. 2012)](image)

Although exports may increase the market for natural gas, it is unlikely that the price will become more volatile. Because of the extensive infrastructure requirements for liquefaction, shipping, and import facilities, the shipped volume at a given time will not change rapidly. This scenario, combined with the price contracts often used in LNG trade, it is not likely that there will be significant price volatility due to increased trade (Ebinger et al. 2012)

Because natural gas prices will not see severe price increases, most manufacturing industries will not be critically impacted. If there is excessively high global demand, the US will export 20% of natural gas production and the price will rise at most 20% from the baseline in 2015. These conditions represent an extreme in global demand, and export volume and price increases are likely to be much smaller. The price increase will be greater as more exports are permitted (see Figure 6). Under all conditions, the price of gas will not become linked to the price of oil (Montgomery et al. 2012).
If DOE permit more exports, sources of income will also shift. Total income from capital and wages will be reduced from a baseline no export scenario. Net transfers and resource income will increase from the baseline (see Figure 7). As previously stated, the net effect will be an increase in GDP. If there is high global demand, the labor and investment income could be reduced from the baseline by as much $45 billion. This will compensated by more than $50 billion increase in resource and net transfers (Montgomery et al. 2012).

The costs and benefits will also be distributed unevenly among socioeconomic groups. Households that have investments in natural resource companies will benefit while households that depend solely on wages will not. Regions that produce natural gas will see benefits, while regions that depend on manufacturing or natural gas will feel the costs (Montgomery et al. 2012). Manufacturers located near natural gas wells and far from export facilities will not see higher costs, while those manufacturers located near export facilities will (Choi et al. 2013).

\[^{u}\text{Net transfers represent an increase in favorable US trade balance}\]
The environmental costs and benefits of LNG exports are also mixed. Leakages of methane, which has a much higher greenhouse gas effect than carbon, will increase with increased exports, but there is still no consensus on the amount. Moreover, with an increased price of natural gas, power companies will still rely on some dirty coal plants rather than using gas plants. Increased prices, however, also benefit cleaner technologies in the US which have been crowded out by low natural gas prices. The net effect is that US carbon dioxide emissions will not increase more than 1% (EIA 2012). In other countries, lower natural gas prices will reduce the use of coal and carbon dioxide emissions. The net effect of these policies is that the total increase or decrease in greenhouse gas emissions will be small (Ebinger et al. 2012).

While the emission of greenhouse gasses may not change, there will be additional hydraulic fracturing because of increased international demand. The impact of fracking is still hotly debated and it is beyond the scope of this paper to present every facet of this complex issue. Most experts agree that the risk of fracking chemicals or methane leaking into the water aquifers though the shale rock is unlikely, but this may depends on the geological composition of the site. The more pressing issue is the well casings which run through aquifers to reach gas deposits. Most of the reported incidents of well contamination have been caused by poorly designed or inspected well casings. The US Geological Survey concluded that the risk of earthquakes associated with fracking was very small, but there may be increased seismological activity due to the disposing of waste chemicals by reinjection into old wells. While there is not clear consensus on the impact of fracking, the process itself is not inherently unsafe and the possible detrimental effect can likely be mitigated through increased regulations and safety practices (Ebinger et al. 2012, Levi 2012).
The outcome of the debate surrounding fracking will impact how the natural gas revolution evolves. If it is found that all unconventional natural gas production methods are unsafe, although this scenario is unlikely, it would mean that the government would halt all such activities. If this hypothetical scenario occurred, it would mean that the natural gas supply would decrease, prices would increase and exports would no longer be economical. The entire issue of natural gas exports would be moot and policies surrounding LNG exports would be irrelevant. Therefore, this report will not discuss the issue of fracking in detail. Although it is important to the broader natural gas debate, the outcome of the issue will not alter the policies to be implemented, only the economic reality.

Proposals for Limiting LNG Exports

Advocates for and against additional LNG exports cite different portions of the studies as evidence for their position. At one extreme is complete prevention of LNG exports. This position, while still advocated by some, is not widely supported. The driving factors for these proposals are the uneven distribution of costs and benefits. Some proponents of limiting exports theorize that there is an export volume “sweet spot” beyond which there is a negative impact on the economy. While this theory is not backed by most research, including the NERA study, advocates state that trying to reach this theoretical middle point would be a good compromise. (Senate Energy and Natural Resource 2013, House Energy and Commerce 2013).

There have been several bills proposed in Congress intended to limit the volume of LNG exports. Keep American Natural Gas Here Act (H.R.1191) would reduce LNG exports by preventing additional natural gas produced on federal lands to be sold internationally. 17.8% of US natural gas production comes from federal lands (EIA 2013). The effectiveness of such a law to limit exports is speculative since many companies may choose to sell the gas from federal lands domestically which would free up gas from private lands to be sold internationally.

The American Natural Gas Security and Consumer Protection Act (H.R.1189) is another bill that would encourage limited exports. It would prohibit the export of natural gas without the explicit approval the Secretary of Energy indicating the exports are in the public interest. It would modify the current procedure by eliminating the presumption that exporting natural gas is in the public interest. The bill clarifies the public interest mandate in the Natural Gas Act with wording that makes approval of exports less favorable. The bill would require explicit consideration of the environmental impact of LNG exports. Although the bill does not limit the topics to be considered, it specifically notes the importance of price increases when determining whether exports are in the public interest.

Proposals to Expand LNG Exports

On the other side of the spectrum are advocates for unlimited exports. These advocates cite the net benefit to US GDP and state that any limits on exports intended to protect some communities are essentially harming others with the opportunity costs. However, some experts warn that unlimited exports would actually increase uncertainty in the business climate. There is considerable economic uncertainty of the size of the global LNG market. Having some predictability and loose limits on exports would limit the amount of uncertainty in the global
markets to which businesses are exposed (Ebinger et al. 2012, Levi 2012, Senate Energy and Natural Resource 2013).

The Expedited LNG for American Allies Act of 2013 (H.R.580 and S.192) would encourage more exports of natural gas by including countries in the North Atlantic Treaty Organization, Japan, and any country later deemed appropriate by the Secretary of State to receive automatic approval for exports. This bill would allow nearly unlimited exports since Europe and Japan are two of the largest consumers of natural gas and much of the LNG from the US would be going to these sources. However, since this law does not include India and China, two other potentially large consumers of US LNG, in this automatic approval process, the US gas market would not be completely open.

**Streamlining the Approval Process**

Much of the debate surrounding levels of exports is somewhat moot. DOE is likely to continue to approve additional permits. Perhaps the more substantial debate is how the process works. DOE is not explicitly denying applications, but the approval process is extremely slow, and there have been numerous proposals to make it more efficient. DOE has been criticized for moving slowly though the highly bureaucratic processes and not quickly addressing the application queue (Poe 2013, Dlouhy 2013b).

The Expedite Our Economy Act of 2013 (H.R.2471) would change the responsibility of regulating LNG exports from DOE to FERC. Since FERC is an independent commission, it would be less influenced by politics and would likely approve the applications faster. The intent of this proposal is to allow some regulation, while increasing the speed at which applications are approved (Poe 2013).

Because there are many applications pending DOE approval, the issue of which projects will be considered first has been a key issue. Since the application is straightforward and relatively cheap, many more projects have filed applications than would be economically feasible to build and use. The global market for LNG from the US is only likely to be a fraction of the proposed liquefaction capabilities. Many of the more viable projects which have potential sources of capital are being held up by less viable applications higher in the queue. A benefit to changing the current approval processes is that DOE could do it internally without drawn out congressional action (Smith 2013, Ebinger et al. 2012, Senate Energy and Natural Resource 2013, House Energy and Commerce 2013).

One way ensure that the most viable projects are approved first is to impose a litmus test. DOE did this initially when it set up the queue order in December 2012 by giving preference to companies that had already begun pre-filing for the FERC site approval process, a much more rigorous procedure. DOE could extend this litmus test by giving further preference to companies that have garnered some capital investment for the project and secured partial supply contracts for the shipments (Ebinger et al. 2012, Levi 2012).

Another option would be to increase the fee required for the application process. The current $50 application fee is minimal compared to the massive costs required to build an export facility (Smith 2013). DOE exerts time and money to examine the applications,
commission impact studies, and process public comments. It would be reasonable for DOE to require the companies that benefit from these approvals to pay the costs for the processes. By requiring a larger application fee, DOE may be able ensure that only serious projects are being processed.

While these two approaches to modifying the DOE application may be more viable than Congressional action, some companies worry about such approaches. The time and effort required to change the approval process might be better spent making decisions on applications. Any change to the application queue would require time for review, comments, and decisions, a process DOE was criticized for when the initial queue order was announced\(^v\) (House Energy and Commerce 2013).

**Recommendations**

The recent revolution in natural gas production has created massive opportunities. The country is now faced with the challenge of how best to harness these opportunities. Should the US keep natural gas domestically or should it allow it to be sold abroad? Currently, the US has restrictions on exporting to non-FTA countries, but this is changing. DOE has recently approved some facilities to begin exporting LNG. If the US chooses to export natural gas, what is the best approach? Those seeking to trade LNG are urging the government to act quickly. The high global gas price differentials are causing foreign companies to increase their own supply. If the US does not act quickly, advocates say, the competitive advantage the US has will disappear as will a profitable opportunity. Detractors warn that the associated costs of exporting may be severe to some Americans, and caution must be taken (Levi 2012, Ebinger et al. 2012). The decision of whether and how much natural gas should be exported is a critical issue, and a comprehensive, fair, and intelligent policy must be taken.

This report recommends that the government should allow LNG to be exported. DOE should continue to approve the applications without waiting for congressional guidance. It is unreasonable to expect explicit legislation in this area to be successful (Teter 2013). Internal agency processes may be able to succeed in making the processes more efficient. DOE should impose a larger fee for future applications to ensure that the costs required to process applications are paid by those companies benefiting.

Approving more applications would be widely beneficial. There would be increased economic growth domestically from the revenue of selling LNG abroad (Montgomery et al. 2012). This would be advantageous not only because of trading revenue, but also because it would build a stronger relationship with other countries, global economic growth would increase, and the US would live up to the free trade principles it espouses. The US would be able to exert more influence globally and ensure that allies are not forced into politically compromising situations because of energy dependence.

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\(^v\) In 2012 when the queue order was initially released, preference was given to companies that had begun the FERC pre-filing approval. Since this queue was arranged from something other than chronological order of receiving the application, some interpret the law as requiring DOE to allow time for comments on the new queue order. Since DOE did not follow this process, some think DOE broke the law (House Energy and Commerce 2013)
There will be those that will not benefit as much as they would otherwise or even suffer because of this proposed policy. This is the unfortunate reality of trade. The benefits are not evenly distributed. While this report does not advocate a specific program, the government should, as with all trade policies, implement programs to help those paying the costs of trade, such as job retraining programs.

There may also be environmental consequence because of this proposal. Greenhouse gas emissions will likely not increase significantly, but the number of hydraulic fracturing operations would. The energy production potential of the US rests heavily on unconventional natural gas production techniques (Levi 2012, Ebinger et al. 2012). If these production operations prove to be unsafe and are halted, it would make LNG exports economically infeasible. Since this outcome would negate the need to have any sort of policies, it is beyond the scope of this research.

The recent boom in natural gas was rapid and few predicted it. The US, after decades of energy dependence, may now be facing the prospect of ample domestic production of some sources of energy. The US now has a golden opportunity to increase economic growth by exporting LNG.

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This paper has been written as part of the Washington Internships for Students of Engineering (WISE) program. This program provides upper-class engineering students an opportunity to study the policy implications inherent in technological issues. The program is sponsored by a variety of engineering societies and allows students to interact with policy makers, lobbyists, companies, think tanks and advocates to understand how policy and technology interact.

The engineering society sponsoring this paper is the American Institute of Chemical Engineers (AIChE). AIChE is a society dedicated to promoting the chemical engineering profession through publications, conferences, advising the government and educators, and promoting safe and responsible use of chemical resources. While this paper authored by an intern sponsor by AIChE, it is not the expressed opinions of AIChE.

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