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Will LNG Exports Benefit the United States Economy?

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1. Overview

DOE is considering whether large scale exports of liquefied natural gas (LNG) are in the public interest. As part of that inquiry, DOE has commissioned a team of researchers from NERA Economic Consulting, led by W. David Montgomery, to prepare a report entitled “Macroeconomic Impacts of LNG Exports from the United States” (hereafter, the NERA Report) in December 2012.¹ Unfortunately, that report suffers from serious methodological flaws which lead it to significantly underestimate, and, in some cases, to entirely overlook, many negative impacts of LNG exports on the U.S. economy.

NERA finds that LNG exports would be very good for the United States in every scenario they examined:

...the U.S. was projected to gain net economic benefits from allowing LNG exports. Moreover, for every one of the market scenarios examined, net economic benefits increased as the level of LNG exports increased. (NERA Report, p.1)

The measure of benefits used by NERA, however, reflects only the totals for the U.S. economy as a whole. In fact, the NERA study finds that natural gas exports are beneficial to the natural gas industry alone, at the expense of the rest of the U.S. economy—reducing the size of the U.S. economy excluding LNG exports.

This white paper examines the NERA Report, and identifies multiple problems and omissions in its analyses of the natural gas industry and the U.S. economy:

- NERA’s own modeling shows that LNG exports in fact cause GDP to decline in all other economic sectors.
- Although NERA does not calculate employment figures, the methods used in previous NERA reports would indicate job losses linked to export of tens to hundreds of thousands.
- NERA undervalues harm to the manufacturing sector of the U.S. economy.
- NERA ignores significant economic burdens from environmental harm caused by export.
- NERA ignores the distribution of LNG-export benefits among different segments of society, and makes a number of questionable and unrealistic economic assumptions:
 - In NERA’s model, everyone who wants a job has one; by definition, LNG exports cannot cause unemployment.
 - All economic benefits of LNG export return to U.S. consumers without any leakage to foreign investors.
 - Changes to the balance of U.S. trade are constrained to be very small.

¹ W. David Montgomery, et al., *Macroeconomic Impacts of LNG Exports from the United States*, December 2012. http://www.fossil.energy.gov/programs/gasregulation/reports/nera_lng_report.pdf

- NERA’s modeling of economic impacts is based entirely on the proprietary N_{ew}ERA model, which is not available for examination by other economists.
- NERA’s treatment of natural gas resources and markets makes selective use of data to portray exports in a favorable light. In some cases, the NERA Report uses older data when newer revisions from the same sources were available; at times, it disagrees with other analysts who have carefully studied the same questions about the gas industry.

Even if NERA’s flawed and incomplete analysis were to be accepted at face value, its conclusion that opening LNG exports would be good for the United States as a whole is not supported by its own modeling. Instead, NERA’s results demonstrate that manufacturing, agriculture, and other sectors of the U.S. economy would suffer substantial losses. The methodology used to estimate job losses in other NERA reports, if applied in this case, would show average losses of wages equivalent to up to 270,000 jobs lost in each year.

2. LNG exports: Good for the gas industry, bad for the United States

According to the NERA Report, LNG exports would benefit the natural gas industry at the expense of the rest of the U.S. economy. Two sets of evidence illustrate this point: a comparison of natural gas export revenues with changes in gross domestic product (GDP), and a calculation, employed by NERA in other reports, of the “job-equivalents” from decreases in labor income. Applying this calculation to the NERA Report analysis suggests that opening LNG exports would result in hundreds of thousands of job losses. These losses would not be confined to narrow sections of U.S. industry, as NERA implies.

The NERA Report presents 13 “feasible” economic scenarios for LNG export, with projections calculated by NERA’s proprietary N_{ew}ERA model for 2015, 2020, 2025, 2030, and 2035. The scenarios differ in estimates of the amount of natural gas that will ultimately be recovered per new well: seven scenarios (with labels beginning with USREF) use the estimate from the federal Energy Information Administration’s AEO 2011; five (beginning with HEUR) assume 150 percent of the AEO level; and one (beginning with LEUR) assumes 50 percent of the AEO level. In the LEUR scenario, LNG exports are barely worthwhile; in the HEUR scenarios, exports are more profitable than in the USREF scenarios.

LNG exports cause U.S. GDP (excluding LNG exports) to fall

Careful analysis of these LNG export scenarios reveals that the gain in GDP predicted by the NERA Report is driven—almost entirely—by revenues to gas exporters and gas companies; the remainder of the economy declines.

On average (across the five reporting years), export revenues were 74 percent or more of GDP growth in every scenario; in the eight scenarios with average or low estimated gas recovery per well, export revenues averaged more than 100 percent of GDP growth. In the median scenario, export revenues averaged 169 percent of GDP growth; in the worst case, export revenues averaged 240 percent of GDP growth.

Table 1 compares natural gas export revenues to the increase in GDP for each scenario.² When export revenues are greater than 100 percent of GDP growth, the size of the U.S. economy, excluding gas exports, is shrinking. For instance, for the year 2035 in the first two scenarios in Table 1, LNG export revenues are almost \$9 billion higher than in the reference case, while GDP—which includes those export revenues along with everyone else’s incomes—is only \$3 billion higher. Thus, as a matter of arithmetic, everyone else’s incomes (i.e., GDP excluding LNG export revenues) must have gone down by almost \$6 billion. (If your favorite baseball team scored 3 more home runs this year than last year, and one of its players scored 9 more than he did last year, then it must be the case that the rest of the team scored 6 fewer.)

Similarly, in every case where natural gas export revenues exceed 100 percent of the increase in GDP—cases that appear throughout Table 1—the export revenues are part of GDP, so the remainder of GDP must have gone down.

Table 1: LNG Exports as a Share of GDP Gains³

| Scenario | Exports as Percent of GDP Gains | | | | | average |
|-------------|---------------------------------|------|------|------|------|---------|
| | 2015 | 2020 | 2025 | 2030 | 2035 | |
| USREF_D_LSS | 72% | 75% | 193% | 225% | 286% | 170% |
| USREF_D_LS | 50% | 89% | 193% | 225% | 286% | 169% |
| USREF_D_LR | 62% | 112% | 257% | 338% | 429% | 240% |
| USREF_SD_LS | 50% | 77% | 204% | 258% | 468% | 211% |
| USREF_SD_LR | 59% | 90% | 244% | 258% | 702% | 271% |
| USREF_SD_HS | 50% | 67% | 140% | 216% | 429% | 180% |
| USREF_SD_HR | 59% | 75% | 158% | 216% | 501% | 202% |
| HEUR_SD_LSS | 19% | 38% | 69% | 109% | 152% | 77% |
| HEUR_SD_LS | 24% | 40% | 82% | 109% | 152% | 81% |
| HEUR_SD_LR | 31% | 42% | 82% | 123% | 152% | 86% |
| HEUR_SD_HS | 24% | 37% | 64% | 106% | 142% | 74% |
| HEUR_SD_HR | 28% | 39% | 74% | 111% | 142% | 79% |
| LEUR_SD_LSS | 0% | 164% | NA | NA | 158% | 107% |

NA - not applicable (GDP did not increase over the no-export reference case)

Source: Author’s calculations based on NERA Report, Figures 144-162.

As Table 1 demonstrates, export revenues exceed GDP growth: GDP (not including gas exports) is shrinking by 2030 or earlier in all scenarios, and by 2025 or earlier in all scenarios using the AEO assumption about gas recovery per well (i.e., USREF). In other words, after the initial years of construction of export facilities, when construction activities may create some local economic

² The increase in GDP is the difference between the scenario GDP projections and the GDP in the corresponding no-export reference case (for USREF, HEUR, or LEUR assumptions). Data from NERA Report, pp.179-197.

³ In the second term in the scenario names, international cases are defined by increases in global demand and/or decreases in global supply: D=International Demand Shock, SD=International Supply/Demand Shock. In the third term in the scenario names, export cases for quantity/growth are defined as follows: LSS=Low/Slowest, LS=Low/Slow, LR=Low/Rapid, HS=High/Slow, HR=High/Rapid.

benefits, gas exports create increased income for the gas industry, at the expense of everyone else.⁴

Loss of labor income from LNG exports is equivalent to huge job losses

NERA avoids predicting the employment implications of LNG export, and downplays the aggregate billions of dollars in decreased labor income predicted by its report. In fact, using NERA's own methods, the following analysis shows the potential for hundreds of thousands of job losses per year.

In other reports using the N_{ew} ERA model, NERA has reported losses of labor income in terms of "job-equivalents." This may seem paradoxical, since the N_{ew} ERA model assumes full employment, as discussed later in this white paper. As NERA has argued elsewhere, however, a loss of labor income can be expressed in terms of job-equivalent losses, by assuming that it consists of a loss of workers earning the average salary.⁵ In other words, a given decrease in labor income can be interpreted as a loss of workers who would make that income.

This method can be applied to the losses of labor income projected for each of the 13 scenarios in the NERA Report. These losses are expressed as percentages of gross labor income; we have assumed that NERA's "job-equivalent losses" represent the same percentage of the labor force. For example, we assume the loss of 0.1 percent of gross labor income in scenario HEUR_SD_HS in 2020 is equivalent to job losses of 0.1 percent of the projected 2020 labor force of 159,351,000 workers, or roughly 159,000 job-equivalent losses.⁶

The results of this analysis are shown in Table 2. Job-equivalent losses, averaged across the five reporting years, range from 36,000 to 270,000 per year; the median scenario has an average job-equivalent loss of 131,000 per year. We do not necessarily endorse this method of calculation of labor impacts, but merely note that NERA has adopted it in other reports using the same model. If NERA had used this method in the NERA Report analysis, it would have shown that LNG exports have the potential to significantly harm employment in many sectors.

⁴ Other modeled results in the record cast further doubt on NERA's study. See Wallace E. Tyner, "Comparison of Analysis of Natural Gas Export Impacts," January 14, 2013.

http://www.fossil.energy.gov/programs/gasregulation/authorizations/export_study/30_Wallace_Tyner01_14_13.pdf

⁵ See, e.g., NERA's Economic Implications of Recent and Anticipated EPA Regulations Affecting the Electricity Sector, October 2012, p. ES-6: "Job-equivalents are calculated as the total loss in labor income divided by the average salary." http://www.nera.com/nera-files/PUB_ACCCE_1012.pdf

⁶ The Bureau of Labor Statistics projects annual growth of the civilian labor force at 0.7% per year from 2010 to 2020 (Mitra Toosi. "Labor force projections to 2020: a more slowly growing workforce." Monthly Labor Review, January 2012. <http://www.bls.gov/opub/mlr/2012/01/art3full.pdf>.) We have used the same annual growth rate to project the labor force through 2035.

Table 2: Employment equivalents of reduced labor income

| | Job-equivalent loss, NERA method | | | | | average |
|--------------------|----------------------------------|--------------------|--------------------|--------------------|--------------------|---------|
| | 2015 | 2020 | 2025 | 2030 | 2035 | |
| USREF_D_LSS | 15,000 | 77,000 | 108,000 | 77,000 | 62,000 | 68,000 |
| USREF_D_LS | 31,000 | 77,000 | 108,000 | 77,000 | 62,000 | 71,000 |
| USREF_D_LR | 108,000 | 92,000 | 108,000 | 77,000 | 62,000 | 89,000 |
| USREF_SD_LS | 31,000 | 200,000 | 169,000 | 139,000 | 123,000 | 132,000 |
| USREF_SD_LR | 123,000 | 215,000 | 169,000 | 139,000 | 123,000 | 154,000 |
| USREF_SD_HS | 31,000 | 185,000 | 292,000 | 292,000 | 246,000 | 209,000 |
| USREF_SD_HR | 108,000 | 292,000 | 308,000 | 292,000 | 246,000 | 249,000 |
| HEUR_SD_LSS | 15,000 | 62,000 | 108,000 | 108,000 | 92,000 | 77,000 |
| HEUR_SD_LS | 15,000 | 169,000 | 139,000 | 108,000 | 92,000 | 105,000 |
| HEUR_SD_LR | 108,000 | 169,000 | 139,000 | 108,000 | 92,000 | 123,000 |
| HEUR_SD_HS | 15,000 | 154,000 | 246,000 | 215,000 | 200,000 | 166,000 |
| HEUR_SD_HR | 92,000 | 385,000 | 292,000 | 231,000 | 200,000 | 240,000 |
| LEUR_SD_LSS | 0 | 92,000 | 77,000 | 0 | 0 | 34,000 |
| Labor force | 153,889,000 | 153,889,000 | 153,889,000 | 153,889,000 | 153,889,000 | |

Source: Author's calculations based on NERA Report, Figures 144-162.

NERA downplays their estimated shifts in employment from one sector to another saying that is smaller than normal rates of turnover in those industries, but, of course, normal labor turnover is enormous. It is true that job losses caused by LNG exports will be less than the annual total of all retirements, voluntary resignations, firings, layoffs, parental and medical leaves, new hires, moves to new cities and new jobs, and switching from one employer to another for all sorts of reasons: Throughout the entire U.S. labor force normal turnover amounts to almost 40 million people each year.⁷ The comparison of job losses to job turnover is irrelevant.

Harm to U.S. economy is not confined to narrow sections of industry, as NERA implies

The NERA Report emphasizes the fact that only a few branches of industry are heavily dependent on natural gas (NERA Report, pp.67-70). This discussion is described as an attempt “to identify where higher natural gas prices might cause severe impacts such as plant closings” (p.67). The NERA Report makes two principal points in this discussion. First, it quotes a 2009 study of the expected impacts of the Waxman-Markey proposal for climate legislation, which found that only a limited number of branches of industry would be harmed by higher carbon costs; NERA argues that price increases caused by LNG exports will have an even smaller but similarly narrow effect on industry. Second, NERA observes that industries where value added (roughly the sum of wages and profits) makes up a large fraction of sales revenue are unlikely to have high energy costs, while industries with high energy costs probably have a low ratio of value added to sales.

⁷ “Job Openings and Labor Turnover,” Bureau of Labor Statistics, November 2012, Table 3. <http://www.bls.gov/news.release/pdf/jolts.pdf>

Both points may be true, but they are largely irrelevant to the evaluation of LNG exports. NERA's use of the Waxman-Markey study is inappropriate, as Representative Markey himself has pointed out, because that proposed bill directed significant resources to industries harmed by higher costs to mitigate any negative impact.⁸ No such mitigation payments are associated with LNG export, so relying upon Waxman-Markey examples to downplay potential economic damage is inappropriate. If those exports increase domestic gas prices, industry will be harmed both by higher electricity prices and by higher costs for direct use of natural gas. Further, it is true that direct use of natural gas is relatively concentrated, but it is concentrated in important sectors; as the natural gas industry itself explains, "Natural gas is consumed primarily in the pulp and paper, metals, chemicals, petroleum refining, stone, clay and glass, plastic, and food processing industries."⁹ These are not small or unimportant sectors of the U.S. economy.¹⁰ In any case, discussion of sectors where higher natural gas prices might cause "severe impacts such as plant closings" is attacking a straw man; NERA's own calculations imply moderate harm would be imposed throughout industry, both by rising electricity prices and by the costs of direct gas consumption—offset by benefits exclusively concentrated in the hands of the natural gas industry.

Similarly, it does not seem particularly important to know whether industries that use a lot of natural gas have high or low ratios of value added to sales. Are aluminum, cement, fertilizer, paper, and chemicals less important to the economy because they have many purchased inputs, and therefore low ratios of value added to sales?

3. Costs and benefits from LNG exports are unequally distributed

As the results above show, LNG exports essentially transfer revenue away from the rest of the economy and into the hands of companies participating in these exports. This shift has significant economic implications that are not addressed in the NERA Report's analysis.

The NERA Report asserts that "all export scenarios are welfare-improving for U.S. consumers" (NERA Report, p.55). While LNG exports will result in higher natural gas prices for U.S. residents, NERA projects that these costs will be outweighed by additional income received from the exports—and thus, "consumers, in aggregate are better off as a result of opening LNG exports." (NERA Report, p.55) Or, to put this another way, the gains of every resident of the United States, added together, will be greater than the losses of every resident of the United States, added together. The distribution of these benefits and costs—who will suffer costs and who will reap gains—is discussed only tangentially in the NERA Report, but is critical to a complete understanding of the effects of LNG exports on the U.S. economy. A closer look reveals that LNG exports benefit only a very narrow section of the economy, while causing harm to a much broader group.

⁸ Letter from Rep. Markey to Secretary Steve Chu (Dec. 14, 2012).

⁹ http://www.naturalgas.org/overview/uses_industry.asp.

¹⁰ Other commenters also point out that NERA does not even appear to have included some gas-dependent industries, including fertilizer and fabric manufacture, in its analysis. See Comments of Dr. Jannette Barth (Dec. 14, 2012).

Focus on “net impacts” ignores key policy issues

The results presented in the NERA Report focus on the net impacts on the entire economy—combining together everyone’s costs and benefits—and on the “welfare” of the typical or average family, measured in terms of equivalent variation.¹¹ NERA dismisses the need to discuss the distribution of the costs and benefits among groups that are likely to experience very different impacts from LNG exports, stating that: “[t]his study addresses only the net economic effects of natural gas price changes and improved export revenues, not their distribution.” (NERA Report, p.211) NERA alludes to an unequal distribution of costs and benefits in its results, but does not present a complete analysis:

Although there are costs to consumers of higher energy prices and lower consumption and producers incur higher costs to supply the additional natural gas for export, these costs are more than offset by increases in export revenues along with a wealth transfer from overseas received in the form of payments for liquefaction services. The net result is an increase in U.S. households’ real income and welfare. (NERA Report, p.6)

Instead, the NERA Report combines the economic impacts of winners and losers from LNG exports. In the field of economics, this method of asserting that a policy will improve welfare for society as a whole as long as gains to the winners are greater than costs to the losers is known as the “Kaldor-Hicks compensation principle” or a “potential Pareto improvement.” The critiques leveled at cost-benefit analyses that ignore important distributional issues have as long a history as these flawed methods. Policy decisions cannot be made solely on the basis of aggregated net impacts: costs to one group are never erased by the existence of larger gains to another group. The net benefit to society as a whole shows only that, if the winners choose to share their gains, they have the resources to make everyone better off than before—but not that they *will* share their gains. In the typical situation, when the winners choose to keep their winnings to themselves, there is no reason to think that everyone, including the losers, is better off.

As previous congressional testimony by W. David Montgomery—the lead author of the NERA Report—on the impacts of cap-and-trade policy support explained it: “There are enough hidden differences among recipients of allowances within any identified group that it takes far more to compensate just the losers in a group than to compensate the average. Looking at averages assumes that gainers compensate losers within a group, but that will not occur in practice.”¹²

¹¹ One of the complications in estimating the costs and benefits of a policy with the potential to impact prices economy-wide, is that simply measuring changes in income misses out on the way in which policy-driven price changes affect how much can be bought for the same income. (For example, if a policy raises incomes but simultaneously raises prices, it takes some careful calculation to determine whether people are better or worse off.) The NERA Report uses a measure of welfare called “equivalent variation,” which is the additional income that the typical family would have to receive today (when making purchases at current prices) in order to be just as well off as they would be with the new incomes and new price levels under the proposed policy. It can be thought of as the change in income caused by the policy, adjusted for any change in prices caused by the policy.

¹² Prepared Testimony of W. David Montgomery, before the Committee on Energy and Commerce Subcommittee on Energy and Environment, U.S. House of Representatives, Hearing on Allowance Allocation Policies in Climate Legislation, June 9, 2009. http://democrats.energycommerce.house.gov/Press_111/20090609/testimony_montgomery.pdf.

Wage earners in every sector except natural gas will lose income

In every scenario reviewed in the NERA Report, labor income rises in the natural gas industry, and falls in every other industry.¹³ Economy-wide, NERA finds that “capital income, wage income, and indirect tax revenues drop in all scenarios, while resource income and net transfers associated with LNG export revenues increase in all scenarios.” (NERA Report, p.63)¹⁴ Even without a detailed distributional analysis, the NERA Report demonstrates that some groups will lose out from LNG exports:

Overall, both total labor compensation and income from investment are projected to decline, and income to owners of natural gas resources will increase... Nevertheless, impacts will not be positive for all groups in the economy. Households with income solely from wages or government transfers, in particular, might not participate in these benefits. (NERA Report, p.2)

NERA’s “might not participate in these benefits” could and should be restated more accurately as “will bear costs.” Although NERA doesn’t acknowledge it, most Americans will not receive revenues from LNG exports; many more Americans will experience decreased wages and higher energy prices than will profit from LNG exports.

Wage earners in every major sector except for natural gas will lose income, and, as domestic natural gas prices increase, households and businesses will have to pay more for natural gas (for heat, cooking, etc.), electricity, and other goods and services with prices that are strongly impacted by natural gas prices. The NERA Report briefly mentions these price effects:

Natural gas is also an important fuel for electricity generation, providing about 20% of the fuel inputs to electricity generation. Moreover, in many regions and times of the year natural gas-fired generation sets the price of electricity so that increases in natural gas prices can impact electricity prices. These price increases will also propagate through the economy and affect both household energy bills and costs for businesses. (NERA Report, p.13-14)

Additional analysis required to understand electricity price impacts

There are no results presented in the NERA Report to display the effect of changes in electricity prices on consumers. Negative effects on the electricity sector itself are shown in NERA’s Figure 38, but changes in electric rates and electricity bills, and the distributional consequences of these changes, are absent from the results selected for display in this report. NERA certainly could have conducted such an analysis. NERA’s October 2012 report on recent and anticipated EPA regulations affecting the U.S. electricity sector using the N_{ew}ERA model displayed electricity price impacts for eleven regions and three scenarios.¹⁵

¹³ See NERA Report, Figure 39.

¹⁴ See NERA Report, Figure 40.

¹⁵ Harrison, et al., Economic Implications of Recent and Anticipated EPA Regulations Affecting the Electricity Sector, October 2012. NERA Economic Consulting. See Table 17. http://www.nera.com/67_7903.htm.

Dr. Montgomery previous testimony also presents increases in household electric utility bills.¹⁶ He describes a “decline in purchasing power” for the average household, claiming that “the cost for the average family will be significant” and “generally the largest declines in household purchasing power are occurring in the regions with the lowest baseline income levels.”¹⁷ A careful distributional analysis would greatly improve the policy relevance of the NERA Report’s economic impact projections.

Benefits of stock ownership are not as widespread as NERA assumes

There is no evidence to support NERA’s implication that the benefits of stock ownership are broadly shared among U.S. families across the economic spectrum—and therefore no evidence that they will “participate” in benefits secured by LNG exports.

NERA’s claim of widespread benefits is not supported by data from the U.S. Census Bureau. In 2007, just before the financial crash, only about half of all families owned any stock, including indirect holdings in retirement accounts. Indeed, only 14 percent of families with the lowest incomes (in the bottom 20 percent) held any stock at all, compared to 91 percent of families with the highest incomes (the top 10 percent).¹⁸

For most households the primary source of income is wages. According to the Federal Reserve, 68 percent of all family income in 2010 (the latest data available) came from wages, while interest, dividends and capital gains only amounted to 4.5 percent (see Figure 1). Families with the least wealth (the bottom 25 percent) received 0.2 percent of their income from interest, dividends, and capital gains, compared to 11 percent for the wealthiest families (the top 10 percent).

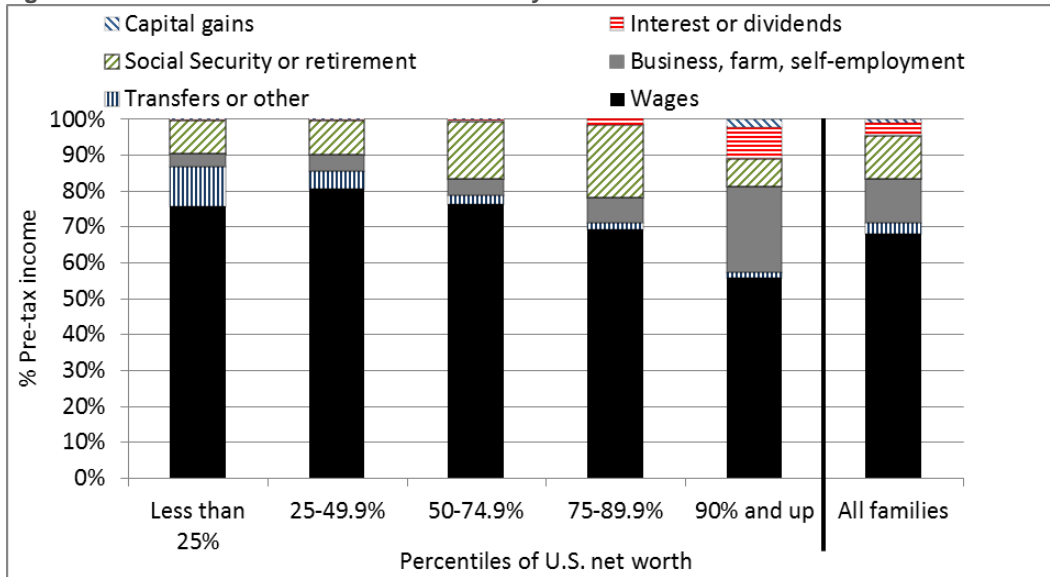
¹⁶ Prepared Testimony of W. David Montgomery, before the Committee on Energy and Commerce Subcommittee on Energy and Environment, U.S. House of Representatives, Hearing on Allowance Allocation Policies in Climate Legislation, June 9, 2009.

http://democrats.energycommerce.house.gov/Press_111/20090609/testimony_montgomery.pdf.

¹⁷ Ibid.

¹⁸ U.S. Census Bureau, Statistical Abstract of the United States: 2012, 2012. See Table 1211. <http://www.census.gov/compendia/statab/2012/tables/12s1211.pdf>.

Figure 1: U.S. Households Source of Income by Percentile of Net Worth in 2010



Source: Federal Reserve, *Changes in U.S. Family Finances from 2007 to 2010: Evidence from the Survey of Consumer Finances*, Table 2.

And yet the NERA Report appears to assume that the benefits of owning stock in natural gas export companies are widespread, explaining that:

U.S. consumers receive additional income from...the LNG exports provid[ing] additional export revenues, and...consumers who are owners of the liquefaction plants, receiv[ing] take-or-pay tolling charges for the amount of LNG exports. These additional sources of income for U.S. consumers outweigh the loss associated with higher energy prices. Consequently, consumers, in aggregate, are better off as a result of opening up LNG exports. (NERA Report, p.55)

In the absence of detailed analysis from NERA, it seems safe to assume that increases to U.S. incomes from LNG exports will accrue to those in the highest income brackets. Lower income brackets, where more income is derived from wages, are far more likely to experience losses in income—unless they happen to work in the natural gas industry—and natural gas extraction currently represents less than 0.1 percent of all jobs in the United States.¹⁹ At the same time, everyone will pay more on their utility bills.

¹⁹ Share of jobs in oil and gas extraction. Data for the share of jobs in the natural gas industry alone is not available but would, necessarily, be smaller. Support activities for mining represents an additional 0.25 percent of jobs, petroleum and coal products 0.08 percent, and pipeline transportation 0.03 percent. Taken together, these industries, which include oil, coal and other mining operations, represent 0.5 percent of all U.S. employment. Bureau of Economic Analysis, Full-Time and Part-Time Employees by Industry, 2011 data. <http://bea.gov/iTable/iTable.cfm?ReqID=5&step=1>

NERA's assumption that all income from LNG exports will return to U.S. residents is incorrect

In the N_{ew}ERA analysis, two critical assumptions assure that all LNG profits accrue to U.S. residents. First, "Consumers own all production processes and industries by virtue of owning stock in them." (NERA Report, p.55) The unequal distribution of stock ownership (shown as interest, dividend, and capital gains income in the Federal Reserve data in Figure 1) is not made explicit in the NERA Report, nor is the very small share that natural-gas-related assets represent in all U.S.-based publically traded stock.²⁰ In discussing impacts on households' wealth, NERA only mention that "if they, or their pensions, hold stock in natural gas producers, they will benefit from the increase in the value of their investment." (NERA Report, p.13) A more detailed distributional analysis would be necessary to determine the exact degree to which LNG profits benefit different income groups; however, it is fair to conclude that lower-income groups and the middle class are much less likely to profit from LNG exports than higher-income groups that receive a larger portion of income from stock ownership.

Second, the NERA Report assumes that "all of the investment in liquefaction facilities and natural gas drilling and extraction comes from domestic sources." (NERA Report, p.211) This means that the N_{ew}ERA model implausibly assumes that all U.S.-based LNG businesses are solely owned by U.S. residents. There is no evidence to support this assumption. On the contrary, many players in this market have significant foreign ownership shares or are privately held, and may be able to move revenues in ways that avoid both the domestic stock market and U.S. taxes. Cheniere Energy, the only LNG exporter licensed in the United States, is currently building an export terminal on the Gulf of Mexico for \$5.6 billion—\$1 billion of which is coming from investors in China and Singapore.²¹ Cheniere's largest shareholders include holding companies in Singapore and Bermuda, as well as a hedge fund and a private equity firm, which in turn have a mix of domestic and foreign shareholders.²² This situation is not atypical. As illustrated in Figure 2, 29 percent (by Bcf/day capacity) of the applications for U.S. LNG export licenses are foreign-owned, including 6 percent of total applications from foreign governments. Additionally, 70 percent of domestic applicants are publicly owned and traded, most of which have both domestic and foreign stock holders. Gas extraction companies, similarly, operate with a diverse mix of foreign and domestic investment, and of public and private ownership structures. NERA's claim that profits from LNG exports will be retained in the United States is unfounded.

NERA certainly could have addressed this issue in its analysis. Dr. Montgomery's previous testimony on cap-and-trade assumed that "all auction revenues would be returned to households,

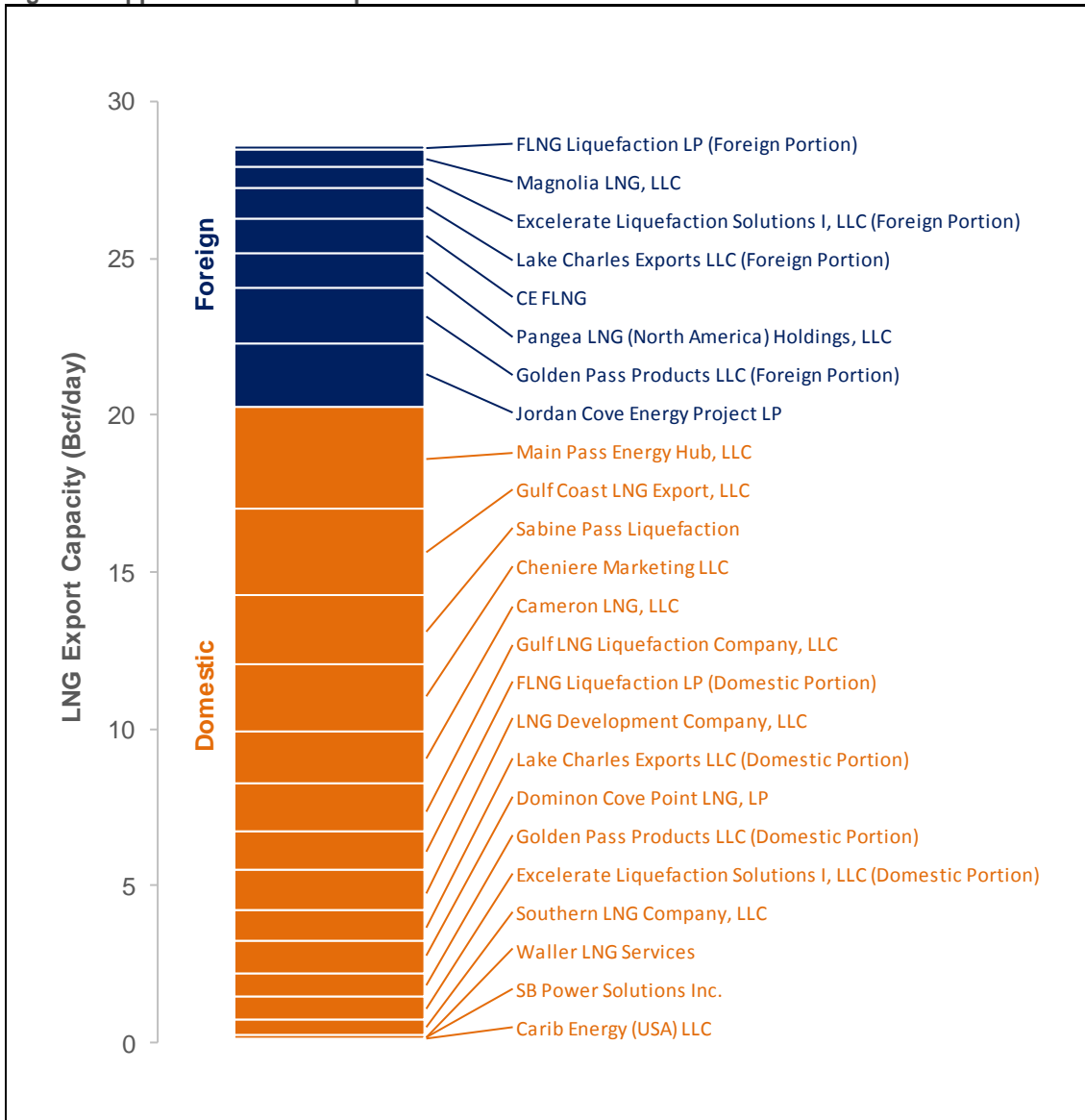
²⁰ NYSE companies involved in LNG export applications account for 5.8 percent of the total market capitalization, but this includes the value of shares from Exxon Mobil—by itself 2.9 percent of the NYSE market cap—as well as several other corporations with diverse business interests, such as General Electric, Dow, and Seaboard (owner of Butterball Turkeys among many other products). Reuters Stocks website, downloaded January 22, 2013 (following marketclose), <http://www.reuters.com/finance/stocks>. World Federation of Exchanges, "2012 WFE Market Highlights" (January 2013), page 6. <http://www.world-exchanges.org/files/statistics/2012%20WFE%20Market%20Highlights.pdf>.

²¹ "UPDATE 2-China, Singapore wealth funds invest \$1 bln in US LNG export plant-source." Reuters, August 21, 2012. <http://www.reuters.com/article/2012/08/21/cic-cheniere-idUSL4E8JL0SC20120821>

²² Ownership data from NASDAQ for Cheniere Energy, Inc. (LNG). <http://www.nasdaq.com/symbol/lng/ownership-summary#.UPmZgCfLRpU>.

except for the allowance allocations that are given to foreign sources.”²³ This assumption led him to conclude that, for the cap-and-trade program, a “large part of the impact on household costs is due to wealth transfers to other countries.”²⁴ This level of analytical rigor should have been applied when estimating the U.S. domestic benefits from opening natural gas exports.

Figure 2: Applicants for LNG Export Licenses



²³ Prepared Testimony of W. David Montgomery, before the Committee on Energy and Commerce Subcommittee on Energy and Environment, U.S. House of Representatives, Hearing on Allowance Allocation Policies in Climate Legislation, June 9, 2009, http://democrats.energycommerce.house.gov/Press_111/20090609/testimony_montgomery.pdf.

²⁴ Ibid.

Source: See Appendix A for a full list of sources.

Opening LNG export will also incur environmental costs

The discussion of LNG exports in the NERA Report, and most of our analysis of the report, is concerned with monetary costs and benefits: Exports cause an increase in natural gas prices, boosting incomes in the natural gas industry itself while increasing economic burdens on the rest of the economy. There are, in addition, environmental impacts of natural gas production and distribution that do not have market prices, but may nonetheless become important if LNG exports are expanded. Increases in exports are likely to increase production of natural gas, entailing increased risks of groundwater pollution and other environmental problems potentially associated with hydraulic fracturing (“fracking”). Increases in production, transportation of natural gas from wells to export terminals, and the liquefaction process itself, all increase the risks of leaks of natural gas, a potent greenhouse gas that contributes to global warming. These environmental impacts should be weighed, alongside the monetary costs and benefits of export strategies, in evaluation of proposals for LNG exports.

Clearly, as NERA itself acknowledges, the NERA Report would benefit from more detailed analysis of the distribution of costs and benefits from opening LNG exports: “Although convenient to indicate that there are winners and losers from any market or policy change, this terminology gives limited insight into how the gains and losses are distributed in the economy.” (NERA Report, p.211)

4. Dependence on resource exports has long-run drawbacks

The harm that LNG exports cause to the rest of the U.S. economy, even in NERA’s model, are consistent with an extensive body of economic literature warning of the dangers of resource-export-based economies.

If NERA’s economic modeling is accepted at face value, it implies that the United States should embrace resource exports, even at the expense of weakening the rest of the economy. GDP, net incomes, and “welfare” as measured by NERA would all rise in tandem with LNG exports. There would be losses in manufacturing and other sectors, especially the energy-intensive sectors of paper and pulp, chemicals, glass, cement, and primary metal (iron, steel, aluminum, etc.) manufacturing (NERA Report, p. 64). But NERA asserts that these would be offset by gains in the natural gas industry. There would be losses of labor income, equivalent to a decline of up to 270,000 average-wage jobs per year. But, according to NERA, these losses would be offset by increased incomes for resource (natural gas) owners.

For those who are indifferent to the distribution of gains and losses—or who imagine that almost everyone owns a share of the natural gas industry—the shift away from manufacturing and labor income toward raw material exports could be described as good for the country as a whole. (So, too, could any shift among types of income, as long as its net result is an increase in GDP.) The rising value of the dollar relative to other currencies would allow affluent Americans to buy more imports, further increasing their welfare, even as the ability of industry to manufacture and export from the United States would decline.

There is, however, a longer-term threat of LNG exports to the U.S. economy: NERA's export scenarios would accelerate the decline of manufacturing and productivity throughout the country, pushing the nation into increased dependence on raw material exports. Developing countries have often struggled to escape from this role in the world economy, believing that true economic development requires the creation of manufacturing and other high-productivity industries. International institutions such as the IMF and the World Bank have often insisted that developing countries can maximize their short-run incomes by sticking to resource exports.

NERA is in essence offering the same advice to the United States: Why strive to make things at home, if there is more immediate profit from exporting raw materials to countries that can make better use of them? Europe, China, Japan, and Korea have much more limited natural resources per capita, but they are very good at making things out of resources that they buy from the United States and other resource-rich countries. In the long run, which role do we want the United States to play in the world economy? Do we want to be a resource exporter, with jobs focused in agriculture, mining, petroleum and other resource-intensive industries? Or do we want to export industrial goods, with jobs focused in manufacturing and high-tech sectors?

Economists have recognized that resource exports can impede manufacturing, even in a developed country; the problem has been called the "resource curse" or the "Dutch disease." The latter name stems from the experience of the Netherlands after the discovery of natural gas resources in 1959; gas exports raised the value of the guilder (the Dutch currency in pre-Euro days), making other Dutch exports less competitive in world markets and resulting in the eventual decline of its manufacturing sector.²⁵ In other countries, the "resource curse" has been associated with increased corruption and inequality; countries that depend on a few, very profitable resource exports may be less likely to have well-functioning government institutions that serve the interests of the majority.²⁶ Protecting an economy against the resource curse requires careful economic management of prospective resource exports.

In particular, it may be more advantageous in the long run to nurture the ability to manufacture and export value-added products based on our natural resources—even if it is not quite as profitable in the short run. The NERA Report is notably lacking in analysis of this strategy; there are no scenarios exploring promotion of, for example, increased use of natural gas in the chemical industry and increased exports of chemicals from the United States. The 25-year span of NERA's analysis provides for scope to develop a longer-term economic strategy with a different pattern of winners and losers. The benefits in this case might extend well beyond the narrow confines of the natural gas industry itself.

5. Unrealistic assumptions used in NERA's N_{ew}ERA model

Despite its sunny conclusions, the NERA Report indicates that LNG exports pose serious challenges to the U.S. economy. It is troubling, then, that the underlying modeling in the report is notably difficult to assess, and is reliant on a number of unrealistic assumptions.

²⁵ "The Dutch Disease." *The Economist*, November 26, 1977, pp. 82-83.

²⁶ Papyrakis and Gerlagh. "The resource curse hypothesis and its transmission channels." *Journal of Comparative Economics*, 2004, 32:1 p.181-193; Mehlum, Moene and Torvik. "Institutions and the Resource Curse." *The Economic Journal*, 2006, 116:508 p.1-20.

The NERA Report relies on NERA Consulting's proprietary model, called N_{ew}ERA. Detailed model assumptions and relationships have never been published; we are not aware of any use of the model, or even evaluation of it in detail, by anyone outside NERA.

According to the NERA Report, N_{ew}ERA is a computable general equilibrium (CGE) model. Such models typically start with a series of assumptions, adopted for mathematical convenience, that are difficult to reconcile with real-world conditions. The base assumptions of the N_{ew}ERA model are described as follows: "The model assumes a perfect foresight, zero profit condition in production of goods and services, no changes in monetary policy, and full employment within the U.S. economy." (NERA Report, p. 103)

Here we discuss the implications of each of these assumptions, together with two additional critical modeling assumptions described elsewhere in the NERA Report: limited changes to the balance of trade, and sole U.S. financing of natural gas investments.

Full employment

The full employment assumption, common to most (though not all) CGE models, means that in every year in every scenario, anyone who wants a job can get one. This assumption is arguably appropriate—or at least, introduces only minor distortions—at times of very high employment such as the late 1990s. It is, however, transparently wrong under current conditions, when unemployment rates are high and millions of people who want jobs cannot find them.

The NERA Report expands on its Pollyannaish vision of the labor market, saying:

The model assumes full employment in the labor market. This assumption means total labor demand in a policy scenario would be the same as the baseline policy projection... The model assumes that labor is fungible across sectors. That is, labor can move freely out of a production sector into another sector without any adjustment costs or loss of productivity. (NERA Report, p.110)

It also includes, in its "Key Findings," the statement that: "LNG exports are not likely to affect the overall level of employment in the U.S." (NERA Report, p.2)

In fact, this is an assumption—baked into the model—and not a finding. N_{ew}ERA, by design, never allows policy changes to affect the overall assumed level of employment. The unemployment rate must, by definition, always be low and unchanging in NERA's model.

For this reason, the potential economic impact that is of the greatest interest to many policymakers, namely the effects of increased LNG exports on jobs, cannot be meaningfully studied with NERA's model. Addressing that question requires a different modeling framework, one that recognizes the existence of involuntary unemployment (when people who want jobs cannot find them) and allows for changes in employment levels. (Despite N_{ew}ERA's full employment assumption, NERA has used the model results to calculate the "job-equivalents" lost to other environmental policies, as discussed above. Had NERA seriously addressed the question, as we discussed earlier, it might have discovered serious job loss potential.)

Perfect foresight

N_{ew} ERA, like other CGE models, assumes that decision-makers do not make systematic errors (that is, errors that bias results) when predicting the future. This is a common assumption in economic modeling and, while more complex theories regarding the accuracy of expectations of the future do exist, they only rarely enter into actual modeling of future conditions.

Zero profit condition

A more puzzling assumption is the “zero profit condition,” mentioned in the quote above. Analyzing fossil fuel markets under the assumption of zero profits sounds like a departure from the familiar facts of modern life. The picture is less than clear, since the N_{ew} ERA model includes calculations of both capital income and “resource” income (the latter is received by owners of resources such as natural gas); these may overlap with what would ordinarily be called profits. Without a more complete description of the N_{ew} ERA model, it is impossible to determine exactly how it treats profits in the fossil fuel industries. In any case, the business media are well aware of the potential for profits in natural gas; a recent article, based in part on the NERA Report, includes the subheading “How LNG Leads to Profits.”²⁷

Invariable monetary policy

N_{ew} ERA also assumes that economy-wide interest rates and other monetary drivers will stay constant over time. Changes to monetary policy could, of course, have important impacts on modeling results, but forecasting these kinds of changes may well be considered outside of the scope of NERA’s analysis. That being said, several of NERA’s classes of scenarios involve supply and demand shocks to the economy as a whole: exactly the kind of broad-based change in economic conditions that tends to provoke changes in monetary policy.

Limited changes to the balance of trade

NERA’s treatment of foreign trade involves yet another unrealistic assumption:

We balance the international trade account in the N_{ew} ERA model by constraining changes in the current account deficit over the model horizon. The condition is that the net present value of the foreign indebtedness over the model horizon remains at the benchmark year level. (NERA Report, p.109)

Although U.S. exports increase in many scenarios, NERA assumes that there can be very little change in the balance of trade. Instead, increases in exports largely have the effect of driving up the value of the dollar relative to other currencies (NERA Report, p. 110). This assumption results in a benefit to consumers of imports, who can buy them more cheaply; conversely, it harms exporters, by making their products more expensive and less competitive in world markets.

²⁷ Ben Gersten, “Five U.S. Natural Gas Companies Set to Soar from an Export Boom,” December 14, 2012. <http://moneymorning.com/tag/natural-gas-stocks/>

Sole U.S. financing of natural gas investments

Finally, NERA assumes that all income from natural gas investments will be received by U.S. residents: “[F]inancing of investment was assumed to originate from U.S. sources.” (NERA Report, p.5) This improbable assumption, discussed in more detail above, means that benefits of investment in U.S. LNG export facilities and extraction services return, in full, to the United States. As discussed earlier, under the more realistic assumption that LNG exports are in part financed by foreign investors, some of the benefits of U.S. exports would flow out of the country to those investors.

6. Use of stale data leads to underestimation of domestic demand for natural gas

An additional important concern regarding the NERA Report is its use of unnecessarily outdated data from the rapidly changing U.S. Energy Information Administration (EIA) *Annual Energy Outlook* natural gas forecasts. Inexplicably, the NERA Report failed to use the EIA’s most recent data, even though it had done so in prior reports.

The following timeline of EIA data releases and NERA reports illustrates this point:

- April 2011: EIA’s Final **AEO 2011**²⁸ published
- December 2011: EIA’s **AEO 2012**²⁹ Early Release published
- June 2012: EIA’s Final **AEO 2012**³⁰ published
- October 2012: NERA’s “Economic Implications of Recent and Anticipated EPA Regulations Affecting the Electricity Sector”³¹ N_{ew}ERA model report published using **AEO 2012** data
- December 3, 2012: NERA’s “Macroeconomic Impacts of LNG Exports from the United States”³² N_{ew}ERA model report published using **AEO 2011** data
- December 5, 2012: EIA’s **AEO 2013** Early Release published³³

NERA’s October 2012 N_{ew}ERA report on regulations affecting the electricity sector used AEO 2012 data, but its December 2012 report on LNG exports used older, AEO 2011 data. Days after NERA’s December 2012 release of its LNG analysis, EIA released its AEO 2013 data.

By choosing to use stale data in its report, NERA changed the outcome of its analysis in significant ways. There have been important changes to EIA’s natural gas forecasts in each recent AEO release. Even between AEO 2011 (used in NERA’s LNG analysis) and AEO 2012 (which was available but not used by NERA), projected domestic consumption, production, and export of

²⁸ EIA, *Annual Energy Outlook 2011*, 2011. <http://www.eia.gov/forecasts/archive/aeo11/er/>

²⁹ EIA, *Annual Energy Outlook 2012 Early Release*, 2012. <http://www.eia.gov/forecasts/archive/aeo12/er/>

³⁰ EIA, *Annual Energy Outlook 2012*, 2012. [http://www.eia.gov/forecasts/aeo/pdf/0383\(2012\).pdf](http://www.eia.gov/forecasts/aeo/pdf/0383(2012).pdf)

³¹ David Harrison, et al., *Economic Implications of Recent and Anticipated EPA Regulations Affecting the Electricity Sector*, October 2012. http://www.nera.com/nera-files/PUB_ACCCE_1012.pdf

³² W. David Montgomery, et al., *Macroeconomic Impacts of LNG Exports from the United States*, December 2012. http://www.fossil.energy.gov/programs/gasregulation/reports/nera_lng_report.pdf

³³ EIA, *Annual Energy Outlook 2013 Early Release*, 2013. <http://www.eia.gov/forecasts/aeo/er/>

natural gas rise, imports fall, and projected (Henry Hub) gas prices take a deeper drop in the next decades than previously predicted.

NERA's use of the older AEO 2011 data results in an underestimate of domestic demand for natural gas. The assumed level of domestic demand for natural gas is critical to NERA's modeling results; higher domestic demand—as predicted by more recent AEO data—would decrease the amount of natural gas available for export and would increase domestic prices. Domestic natural gas prices—both in the model's reference case baseline and its scenarios assuming LNG exports—are a key determinant of U.S. LNG's profitability in the global market.

7. Conclusions and policy recommendations

NERA's study of the macroeconomic impacts of LNG exports from the United States is incomplete, and several of its modeling choices appear to bias results towards a recommendation in favor of opening LNG exports. NERA's imagined future clashes with the obvious facts of economic life.

NERA's own modeling shows that LNG exports depress growth in the rest of the U.S. economy.

- NERA's results demonstrate that when LNG exports are opened, the size of the U.S. economy (excluding these export revenues) will shrink. An example helps to illustrate this point: In some cases, when LNG export revenues are \$9 billion, GDP is \$3 billion larger than in the no-export reference case. This means that GDP excluding gas exports has shrunk by almost \$6 billion.
- Using a methodology adopted by NERA in other N_{ew} ERA analyses, job-equivalent losses from opening LNG exports can be estimated as ranging from 36,000 to 270,000 per year; the median scenario has an average job-equivalent loss of 131,000 per year.
- NERA's assumption that all income from LNG exports will return to U.S. residents is simply incorrect, and results in an overestimate of the benefits that will accrue to U.S.-based resource owners.
- Most American households do not own significant amounts of stock in general, and natural gas stocks represent just a tiny fraction of total stock ownership. The benefits to the typical American household from a booming gas industry are too small to measure.
- Higher prices for natural gas and electricity, and declining job prospects outside of the natural gas industry, would cause obvious harm to people throughout the country.
- NERA's export strategy would have the effect of maximizing short-run incomes at the expense of long-term economic stability. If NERA's export scenarios were to be carried out as federal policy, the result would be an acceleration of the decline of U.S. manufacturing and productivity, and an increased national dependence on raw material exports. Too strong of a dependence on resource exports—a problem often called the “resource curse” or the “Dutch disease”—can weaken the domestic manufacturing sector, even in a developed country.
- In the long run, it may prove more advantageous to nurture U.S. manufacture and export of value-added products made from our natural resources—even if it is not quite as

profitable in the short run. For example, surplus natural gas could be used to increase the U.S. manufacture and export of products, such as chemicals, that use natural gas as a raw material.

- The NERA Report has significant methodological issues. The proprietary N_{ew} ERA model is not available for examination by reviewers outside of NERA. The application of this type of closed-source model to U.S. federal policy decisions seems inappropriate.
- The limited documentation provided by NERA points to several unrealistic modeling assumptions, including: decision-makers' perfect foresight regarding future conditions; zero profits in the production of goods and services; no change to monetary policy, even in the face of economy-wide demand and supply shocks; and constraints on how much the U.S. balance of trade can shift in response to opening LNG exports.
- Full employment—also assumed in NERA's modeling—is not guaranteed, and nothing resembling full employment has occurred for quite a few years. At the writing of this white paper, the U.S. unemployment rate stood at 7.8 percent of the labor force (that is, of those actively employed or seeking work).³⁴ Furthermore, unemployed factory workers do not automatically get jobs in natural gas production, or in other industries.
- The NERA Report used outdated AEO 2011 data when AEO 2012 data were available. These older data underestimate U.S. domestic consumption of natural gas. Accurate modeling of domestic demand for natural gas is essential to making a creditable case for the benefits of opening LNG exports.

The Department of Energy is charged with determining whether or not approving applications—and thus opening U.S. borders—for LNG exports is in the public interest. At this important juncture in the development of U.S. export and resource extraction policy, a higher standard for data sources, methodology, and transparency of analysis is clearly required. Before designating LNG exports as beneficial to the U.S. public, the Department of Energy must fully exercise its due diligence by considering a far more complete macroeconomic analysis, including a detailed examination of distributional effects.

³⁴ December 2012 unemployment rate; U.S. Bureau of Labor Statistics, *Labor Force Statistics from the Current Population Survey*, Series ID: LNS14000000, Seasonal Unemployment Rate. <http://data.bls.gov/timeseries/LNS14000000>.

Appendix A

This appendix contains source information for Figure 2: Applicants for LNG Export Licenses.

Table A-1: Source information for Figure 3

| Company | Status | Publicly traded? | Source | Quantity | FTA Applications (Docket Number) | Non-FTA Applications (Docket Number) |
|---|--------------------|--|--|--|----------------------------------|--------------------------------------|
| Golden Pass Products LLC | Foreign / Domestic | yes: XOM ExxonMobil | Golden Pass Products LLC is a joint venture between ExxonMobil Corp and Qatar Petroleum http://online.wsj.com/article/SB10000872396390444375104577595760678718068.html#articleTabs%3Darticle | 2.6 Bcf/d(d) | Approved (12-88 -LNG) | Under DOE Review (12-156-LNG) |
| Lake Charles Exports, LLC | Foreign / Domestic | yes: SUG Southern Union Company, Foreign: BG Bg Group on London Stock Exchange | Lake Charles Exports LLC is a jointly owned subsidiary of Southern Union Company and BG Group http://www.fossil.energy.gov/programs/gasregulation/authorizations/2011_applications/11_59_lng.pdf | 2.0 Bcf/d (e) | Approved (11-59-LNG) | Under DOE Review (11-59-LNG) |
| Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC (h) | Foreign / Domestic | Foreign: stock 9532:JP (Osaka Gas Co., Japan) | Osaka Gas's subsidiary Turbo LNG, LLC has a 10% stake in FLNG Development, which is a parent company for Freeport LNG Expansion, L.P, which in turn is a parent company of FLNG Liquefaction LP http://www.freeportlng.com/ownership.asp | 1.4 Bcf/d (d) | Approved (12-06-LNG) | Under DOE Review (11-161-LNG) |
| Main Pass Energy Hub, LLC | Domestic | yes: MMR Freeport-MacMoRan Exploration Co. | Freeport-MacMoRan Exploration Co. owns a 50% stake in Main Pass Energy Hub, LLC http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_114_lng.pdf | 3.22 Bcf/d | Approved (12-114-LNG) | n/a |
| Gulf Coast LNG Export, LLC (i) | Domestic | privately held | 97% owned by Michael Smit, 1.5 % each by trusts http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_05_lng.pdf | 2.8 Bcf/d(d) | Approved (12-05-LNG) | Under DOE Review (12-05-LNG) |
| Sabine Pass Liquefaction, LLC | Domestic | yes: CQP Cheniere Energy Partners L.P | Sabine Pass Liquefaction is a subsidiary of Cheniere Energy Partners L.P http://www.cheniereenergypartners.com/liquefaction_project/liquefaction_project.shtml | 2.2 billion cubic feet per day (Bcf/d) (d) | Approved (10-85-LNG) | #N/A |
| Cheniere Marketing, LLC | Domestic | yes: LNG Cheniere Energy Inc. | Cheniere Marketing is a subsidiary of Cheniere Energy Inc. http://www.cheniere.com/corporate/about_us.shtml | 2.1 Bcf/d(d) | Approved (12-99-LNG) | Under DOE Review (12-97-LNG) |

Table A-1: Source information for Figure 3 (Continued)

| Company | Status | Publicly traded? | Source | Quantity | FTA Applications (Docket Number) | Non-FTA Applications (Docket Number) |
|---|--------------------|---|---|---------------|----------------------------------|--------------------------------------|
| Cameron LNG, LLC | Domestic | yes: SRE Sempra Energy | Cameron LNG is a Sempra affiliate http://cameron.sempralng.com/about-us.html | 1.7 Bcf/d (d) | Approved (11-145-LNG) | #N/A |
| Gulf LNG Liquefaction Company, LLC | Domestic | yes: KMI Kinder Morgan and GE General Electric (GE Energy Financial Services, a unit of GE) | KMI owns 50 pct stake in Gulf LNG Holdings http://www.kindermorgan.com/business/gas_pipelines/east/LNG/gulf.cfm . GE Energy Financial Services, directly and indirectly, controls its 50 percent stake in Gulf LNG http://www.geenergyfinancialservices.com/transactions/transactions.asp?transaction=transactions_archholdings.asp | 1.5 Bcf/d(d) | Approved (12-47-LNG) | Under DOE Review (12-101-LNG) |
| Excelerate Liquefaction Solutions I, LLC | Foreign / Domestic | Foreign: stock RWE.DE domestic: privately held | Owned by Excelerate Liquefaction Solutions, source: http://www.gpo.gov/fdsys/pkg/FR-2012-12-06/html/2012-29475.htm . Those are owned by Excelerate Energy, LLC (same source). THAT is owned 50% by RWE Supply & Tradding and 50% by Mr. George B. Kaiser (an individual). George Kaiser is the American \$10B George Kaiser: http://en.wikipedia.org/wiki/George_Kaiser and http://excelerateenergy.com/about-us | 1.38 Bcf/d(d) | Approved (12-61-LNG) | Under DOE Review (12-146-LNG) |
| LNG Development Company, LLC (d/b/a Oregon LNG) | Domestic | privately held | Owned by Oregon LNG source: http://www.gpo.gov/fdsys/pkg/FR-2012-12-06/html/2012-29475.htm | 1.25 Bcf/d(d) | Approved (12-48-LNG) | Under DOE Review (12-77-LNG) |
| Dominion Cove Point LNG, LP | Domestic | yes: D Dominion | source: https://www.dom.com/business/gas-transmission/cove-point/index.jsp | 1.0 Bcf/d (d) | Approved (11-115-LNG) | #N/A |
| Southern LNG Company, L.L.C. | Domestic | yes: KMI Kinder Morgan | KMI owns El Paso Pipeline Partners source: http://investor.eppipelinepartners.com/phoenix.zhtml?c=215819&p=irol-newsArticle&id=1624861 . El Paso Pipeline Partners owns El Paso Pipeline Partners Operating Company source: http://investing.businessweek.com/research/stocks/private/napshot.asp?privcapId=46603039 . El Paso Pipeline Partners Operating Company owns Southern LNG page 2 of http://www.ferc.gov/whats-new/comm-meet/2012/051712/C-2.pdf | 0.5 Bcf/d(d) | Approved (12-54-LNG) | Under DOE Review (12-100-LNG) |

Table A-1: Source information for Figure 3 (Continued)

| Company | Status | Publicly traded? | Source | Quantity | FTA Applications (Docket Number) | Non-FTA Applications (Docket Number) |
|--------------------------|----------|-------------------|---|--|----------------------------------|--------------------------------------|
| Waller LNG Services, LLC | Domestic | privately held | Wholly owned by Waller Marine: http://www.marinelog.com/index.php?option=com_content&view=article&id=3196:waller-marine-to-develop-small-scale-lng-terminals&catid=1:latest-news . Waller Marine private: http://www.linkedin.com/company/waller-marine-inc . | 0.16 Bcf/d | Approved (12-152-LNG) | n/a |
| SB Power Solutions Inc. | Domestic | yes: SEB Seaboard | <u>p. 2 of</u> http://www.fossil.energy.gov/programs/gasregulation/authorizations/Orders_Issued_2012/ord3105.pdf | 0.07 Bcf/d | Approved (12-50-LNG) | #N/A |
| Carib Energy (USA) LLC | Domestic | privately held | http://companies.findthecompany.com/l/21346146/Carib-Energy-Usa-Llc-in-Coral-Springs-FL | 0.03 Bcf/d: FTA 0.01 Bcf/d: non-FTA (f) | Approved (11-71-LNG) | #N/A |