LOOK BEFORE THE LNG LEAP:

Why Policymakers and the Public Need Fair Disclosure Before Exports of Fracked Gas Start

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EXECUTIVE SUMMARY

Exporting American natural gas to the world market would spur unconventional natural gas production across the country, increasing pollution and disrupting landscapes and communities. Deciding whether to move forward is among the most pressing environmental and energy policy decisions facing the nation. Yet, as the Department of Energy (DOE) considers whether to greenlight gas exports of as much as 45% of current U.S. gas production—more gas than the entire domestic power industry burns in a year—it has refused to disclose, or even acknowledge, the environmental consequences of its decisions. In fact, DOE has not even acknowledged that its own National Energy Modeling System can be used to help develop much of this information, instead preferring to turn a blind eye to the problem. DOE needs to change course. Even much smaller volumes of export have substantial environmental implications and exporting a large percentage of the total volume proposed would greatly affect the communities and ecosystems across America. The public and policymakers deserve, and are legally entitled to, a full accounting of these impacts.

Gas exports are only possible because of the unconventional natural gas boom which hydraulic fracturing ("fracking") has unlocked. DOE's own advisory board has warned of the boom's serious environmental impacts. DOE is charged with determining whether such exports are in the public interest despite the damage that would result. To do that, it needs a full accounting of the environmental impacts of increasing gas production significantly to support exports.

These environmental considerations include significant threats to air and water quality from the industry's wastes, and the industrialization of entire landscapes. Gas production is associated with significant volumes of highly-contaminated wastewater and the risk of groundwater contamination; it has also brought persistent smog problems to entire regions, along with notable increases in toxic and carcinogenic air pollutants. Regulatory measures to address these impacts have been inadequate, meaning that increased production very likely means increased environmental harm. Natural gas exports also have important climate policy implications on several fronts: Even if exported gas substitutes for coal abroad (which it may or may not do), it will not produce emissions reductions sufficient to stabilize the climate, and gas exports will increase our investment in fossil fuels. Moreover, the gas export process is particularly carbon-intensive, and gas exports will likely raise gas prices domestically, increasing the market share of dirty coal power, meaning that perceived climate benefits may be quite limited if they exist at all. The upshot is that increasing gas production comes with significant domestic costs.

The National Environmental Policy Act (NEPA) process is designed to generate just such an analysis. NEPA analyses, properly done, provide full, fair, descriptions of a project's environmental implications, remaining uncertainties, and alternatives that could avoid environmental damage. A full NEPA environmental impact statement looking programmatically at export would help DOE and the public fairly weigh these proposals' costs and benefits, and to work with policymakers at the federal, state, and local levels to address any problems. In fact, the U.S. Environmental Protection Agency has repeatedly called for just such an analysis.Without one, America risks committing itself to a permanent role as a gas supplier to the world without determining whether it can do so safely while protecting important domestic interests.

Equally troublingly, even as DOE has thus far failed to fulfill its obligation to protect the public interest

by weighing environmental impacts, it risks losing its authority altogether. A drafting quirk in the export licensing statute intended to speed gas imports from Canada means that DOE must grant licenses for gas exports to nations with which the United States has signed a free trade agreement which includes national treatment of natural gas. This rubber-stamp applies even if the proposed exports would not otherwise be in the public interest. As the U.S. negotiates a massive trade agreement which may include nations hungry for U.S. exports, the Trans-Pacific Partnership, this mandatory rubber-stamp risks undercutting DOE's ability to protect the public.

The bottom line is that before committing to massive gas exports, federal decisionmakers need to ensure that they, and the public, have the environmental information they need to make a fair decision, and the authority to do so. That means ensuring that a full environmental impact statement discloses exports' impacts and develops alternatives to reduce them. It also means defending DOE's prerogatives against the unintended effects of trade pacts. Congress and the U.S. trade negotiators must ensure that agreements like the Trans-Pacific Partnership are designed to maintain DOE's vital public interest inquiry.

Gas exports would transform the energy landscape and communities across the country. We owe ourselves an open national conversation to test whether they are in the public interest. We need to look before we leap.

I. Introduction

For the first time ever, the United States has the ability to become a major natural gas exporter, but that possibility comes with substantial economic and environmental risks. The huge volumes of natural gas proposed for export as liquefied natural gas (LNG) would raise domestic energy prices and require a significant expansion of unconventional gas production using hydraulic fracturing ("fracking").

This shift in the energy landscape raises serious questions: What will export-induced production mean for people living in the gas fields? What will it mean for utilities weighing coal and gas prices as they chart the future of their generation fleets? What it will mean for environmental regulators seeking to manage risk? What will it mean for our air and water quality? What will it mean for climate policy if we increase the extraction and use of this fossil fuel? In the end, are exports worth higher prices and more pollution from fracked gas?

The policy debate continues, but without crucial information: Incredibly, neither the Department of Energy ("DOE")'s Office of Fossil Energy nor the Federal Energy Regulatory Commission ("FERC"), which share responsibility over LNG export proposals under the Natural Gas Act, have completed a full assessment of the environmental risks associated with export and the expanded gas production needed to support it. The agencies could do so using publicly available information and modeling systems, but have so far refused, implausibly insisting that it is impossible to predict *any* upstream impacts from expanded LNG exports.

For more than forty years, Congress has directed federal agencies to use the National Environmental Policy Act (NEPA)'s environmental impact statement process to address environmental decisions like this one. The NEPA process allows agencies to generate comprehensive data, weigh alternatives, and expose assumptions to public scrutiny, so they can base decisions on a fully developed analysis of the impacts of a proposed activity. Amidst the ongoing raucous public debate on export, the information NEPA can provide is not just legally required, but sorely needed.

DOE and FERC have failed to provide this critical analysis. Only one LNG export proposal, for a terminal at Sabine Pass on the Louisiana-Texas border, has moved most of the way through the federal licensing process. FERC, which focuses largely on terminal siting, refused to consider any of the upstream consequences of Sabine Pass's plan to export 2.2 billion cubic feet of gas every day.[2] It did so even though Sabine Pass's export application trumpets that the project intends to "play an influential role in contributing to the growth of natural gas production in the U.S." and relies substantially on this point to argue that the project is in the public interest.[3] DOE followed suit, adopting FERC's analysis to support its own public interest determination, while maintaining that the induced gas production necessary to support export is not

[2] FERC, *Order Granting Section 3 Authorization [to Sabine Pass]*, 139 FERC ¶ 61,039 (Apr. 16, 2012).
[3] Sabine Pass Export Application at 56, DOE/FE Docket 10-111-LNG (Sept. 7, 2010).

"reasonably foreseeable," and so warrants no consideration.[4] DOE recently announced that it would take time to consider whether to stand by this decision, but it has not yet reversed course.[5]

Thus, even while authorizing a proposal which, on its own, would increase U.S. gas exports by more than 50% annually,[6] and which explicitly relies on increased natural gas production to support itself, the federal decisionmakers charged with protecting the public interest were asleep at the switch. Even though export proponents themselves advertise that their projects will drive unconventional natural gas production, DOE and FERC are willfully blind to this major impact. This position is particularly untenable because the National Energy Modeling System (NEMS) which the Energy Information Administration ("EIA") within DOE administers, is designed to project changes in gas production caused by new demand, and could therefore predict precisely the production-level impacts which DOE and FERC insist cannot be foreseen at all.[7]

Instead, applications to export more than ten times the gas which was authorized in the Sabine Pass matter are moving forward in a piecemeal terminal-by-terminal licensing process which has not provided any meaningful analysis of the national and regional environmental challenges linked to export. This ongoing legal and policy failure warrants immediate correction.

Not only have DOE and FERC failed to provide a proper accounting, they may lose even their authority to do so if a controversial trade agreement now under negotiation is finalized. That deal, the Trans-Pacific Partnership ("TPP"), could further liberalize trade with much of the Pacific Rim, including major natural gas importers like Japan. Thanks to a little-known provision of the Natural Gas Act, it could also remove federal oversight of LNG exports. Twenty years ago, in an effort to speed Canadian gas *imports*, Congress provided that LNG shipments between countries with which the U.S. has a free trade agreement were to be automatically granted. Although Congress never anticipated massive LNG exports, that same provision could nonetheless remove DOE and FERC's discretion to weigh whether huge volumes of export are in the public interest, or to meaningfully regulate the process. Yet neither agency has insisted that TPP negotiators protect this critical federal authority.

For communities across the country, therefore, the future is in real question. If LNG export goes forward, they will experience a surge of unconventional new gas production, along with all

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[4] DOE, *Final Opinion and Order Granting Long-Term Authorization to Export Liquefied Natural Gas from Sabine Pass LNG Terminal to Non-Free Trade Agreement Nations*, FE Docket No. 10-111-LNG (Aug. 7, 2012).
[5] *See* DOE, *Order Granting Rehearing for Further Consideration*, FE Docket No. 10-111-LNG (Oct. 5, 2012).
[6] *See* EIA, *U.S. Natural Gas Imports & Exports 2011* (July 18, 2012). The U.S. now exports about 1,500 billion cubic feet "bcf" of natural gas annually, with the vast majority travelling by pipeline to Mexico and Canada. Sabine Pass would export 2.2 bcf/day, or 803 bcf annually.
[7] *See, e.g.*, EIA, *The National Energy Modeling System: An Overview* (2009) at 54-55 (explaining that NEMS contains "play-level" production models for each unconventional natural gas play and projects production based on demand); 59-62 (transmission and distribution module of NEMS allocates demand based through modeling the transmission network and can account for imports and exports).

the environmental burdens of the boom that are outlined below. If DOE and FERC do not analyze and disclose these impacts, neither they or state and local governments can weigh whether they are in the public interest, or take action to lessen them. And if the TPP and pacts like it are signed without due reflection and before a full NEPA environmental impact statement is available, the U.S. will be locked into a future of gas export without ever having considered the cost.

It is not yet too late to change course. DOE has committed not to release any more export licenses until an economic study has been finalized, which will not occur until this winter. Negotiations for the TPP have not concluded. FERC has not sited any more new terminals. So, although the United States has begun to edge into exports, that future has not yet been chosen. Cooler heads can still prevail, and decisionmakers can develop the information we and they so clearly need.

II. The Magnitude of the Export Boom

Even if only some of the 19 export projects now before DOE are approved, they would, once operational, transform the domestic energy market and greatly increase unconventional natural gas production. There is no domestic precedent for changes of the magnitude which DOE is now considering.

Before the shale gas boom began, the U.S. exported almost no gas beyond Canada and Mexico, and even those North American exports were not very large. In 2006, for instance, the U.S. exported a total of 723.9 bcf per year of natural gas, with 663 of that by pipeline.[8] Only the remaining approximately 60 bcf per year are exported as LNG, essentially all of it going to Japan from a single Alaskan terminal, with a few bcf to Mexico by truck.[9] Policymakers largely assumed that this pattern would continue, urging that the U.S. develop gas *import* capacity to accommodate growing domestic demand.[10]

The situation now is very different. Projections of abundant domestic natural gas from unconventional, largely shale, plays has dropped domestic gas prices to record lows while prices abroad remain high. As a result, U.S. pipeline exports have risen, pushing total exports over 1,500 bcf per year (or about 4 bcf per day), and investors have flooded DOE with an ever-growing number of export proposals. As of late October 2012, the 19 different export projects before DOE proposed to export as much as 28.39 bcf *per day* of LNG.[11] Of this, 23.71 bcf per day was proposed for export to countries with which the U.S. has not signed a free trade

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[8] EIA, U.S. Natural Gas Exports by Country, *available at*: http://www.eia.gov/dnav/ng/ng_move_expc_s1_a.htm.
[9] *See id.*
[10] *See, e.g.*, National Petroleum Council, *Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy* at 36-40 (2003)
[11] Department of Energy Office of Fossil Energy, *Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of October 26, 2012)*, available at http://www.fossil.energy.gov/programs/gasregulation/reports/Long_Term_LNG_Export_10-26-12.pdf. Other proposals to export at least 2.5 bcf/d of LNG have also been reported, but have not yet been filed with DOE.

agreement providing for national treatment of natural gas; DOE has clear authority to disapprove such proposals if they are not in the public interest.

How much gas is 28.39 bcf per day? It is equivalent to 10,362 bcf per year. By comparison, the entire country produced just 23,000 bcf in 2011, meaning that exports equivalent to about 45% of domestic production are now before DOE.[13] Exporting this much gas would be bound to strongly affect domestic gas production and consumption patterns. For example, the country consumed 24,316 bcf of gas last year – slightly more than it produced, with imports making up much of the difference.[14] Dedicating forty percent of U.S. gas production to export would, therefore, cause big shifts in the domestic market. The amount of gas slated for export is considerably more than the 7,602 bcf that the entire electric power sector used last year, and nearly twice as much gas as was used for electricity by every home in the country.[15] If this amount of gas is exported, the United States must produce more gas, use less, or do both.

The Energy Information Administration ("EIA") has come to just that conclusion in a DOE-commissioned January 2012 report, which estimated that about two-thirds (63%) of export demand will be met by increased production, rather than by decreases in gas consumption elsewhere in the economy.[16] That new production, in turn, will come almost entirely (93%) from unconventional gas plays, and so will be produced by fracking.[17]

Thus, if the DOE authorizes all of the 10,362 bcf of exports now before it, about 63% of that exported gas, or 6,5282 bcf, would likely be from new production, and 6,397 bcf of that new production would be fracked gas. Total domestic gas production would increase by 27%.

To be sure, there are legitimate questions as to the real scope of the export boom. The global LNG market may be hungry for U.S. gas, but limits on near-term demand and regasification capacity may mean that not every export terminal will be built, or operate at capacity. On the other hand, the scramble for export licenses shows no signs of diminishing. In fact, the pace and intensity of this export boom seems to have caught decisionmakers by surprise. In January 2012, DOE and the EIA assumed that exports of 12 bcf/d were at the high end of possible export futures.[18] Export applications for more than double that volume have now been lodged with DOE. The "high end" scenario now looks decidedly mid-range compared to pending applications.[19]

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[13] EIA, Natural Gas Monthly November 2012, Table 1 (volume reported is dry gas).
[14] *Id.*, Table 2.
[15] *Id.* (electric power sector gas use in 2011 was 7,602 bcf; residential use was 4,730 bcf).
[16] EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* (Jan. 2012) at 6, 10-11.
[17] *Id.* at 11.
[18] EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* at 1.
[19] In its Annual Energy Outlook for 2012, EIA very conservatively projects that only 2.2 bcf/d of LNG will be exported by 2035, noting that this projection is subject to considerable regulatory uncertainty. *See* EIA, *Annual Energy Outlook* (2012) at 94. This amount would correspond to about a 470 bcf annual increase in unconventional natural gas production – about a 2% national increase. Notably, the 2.2 bcf of annual LNG export EIA conservatively projects are equivalent to the export proposed by the Sabine Pass facility which DOE has already all

Moreover, even a much smaller gas export increase would still mean major changes in the U.S. gas market. If only one-quarter of the proposed projects move forward, about 6 bcf/d of gas would still be exported – the equivalent of 2,190 bcf annually. That demand would, in turn, be accompanied by about 1,172 bcf of new unconventional gas production if the EIA is correct, increasing U.S. gas production overall by 5%.

Proposed export terminal sites are on all three U.S. sea coasts. Most applications are focused on the Gulf Coast, but applicants have also filed to export from Atlantic coastal sites in Maryland and Georgia and from Pacific coastal sites in Oregon. Between the terminals themselves, the pipelines required to feed them with gas, the barge traffic they will engender and, of course, the fracking boom they will support and extend, few regions of the United States will be untouched by LNG export.

III. Environmental Implications of Export

Producing and exporting large volumes of natural gas will have significant environmental implications that are best evaluated in the NEPA process with an Environmental Impact Statement. The urgency of a comprehensive look is clear from an examination of a subset of those effects: impacts associated directly with increasing gas production, impacts from changes in the gas market associated with export, and impacts associated with export itself, particularly its implications for climate change.

A. The Environmental Impacts of Increased Unconventional Gas Production

While the DOE's Office of Fossil Energy continues to consider pending export applications, the Secretary of Energy Advisory Board has been sounding the alarm about the fracking process on which export depends. Its Shale Gas Production Subcommittee issued a detailed set of recommendations in late 2011, emphasizing that a substantially enhanced regulatory and research effort is needed to ensure that unconventional natural gas production can move forward safely.

The Subcommittee, composed of nationally-regarded independent experts, wrote that it "believes that if action is not taken to reduce the environmental impact accompanying the very considerable expansion of shale gas production expected across the country – perhaps as many as 100,000 wells over the next several decades – there is a real risk of serious environmental consequences causing a loss of public confidence that could delay or stop this activity."[20] As of late 2011, the Subcommittee warned that "progress to date is less than the Subcommittee

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but approved. The EIA projection thus functionally assumes that *none* of the other projects now before DOE are built. While that might occur, it is obviously prudent to consider the impacts of other projects.

[20] Secretary of Energy Advisory Board Shale Gas Production Subcommittee ("SEAB"), *Second-Ninety Day Report* (Nov. 18, 2011) at 10.

hoped."[21] It cautioned that "some concerted and sustained action is needed to avoid excessive environmental impacts of shale gas production and the consequent risk of public opposition to its continuation and expansion."[22]

As the Subcommittee recognized, the impacts of unconventional gas production stretch across multiple mediums and contexts. Its recommendations identify areas for improvement in managing air pollution, water pollution, subsurface contamination, land use, and community impacts.[23] The Subcommittee also issued an urgent call for improved transparency and disclosure throughout the process, and for greatly enhanced research and development to better understand and improve production processes.[24]

Significant environmental impacts associated with unconventional natural gas production, and hence with export, include the following:

Air Pollution

Natural gas production has significant air quality impacts. As the DOE's Shale Gas Subcommittee summarized the matter last August:

> Shale gas production, including exploration, drilling, venting/flaring, equipment operation, gathering, accompanying vehicular traffic, results in the emission of ozone precursors (volatile organic compounds (VOCs), and nitrogen oxides), particulates from diesel exhaust, toxic air pollutants and greenhouse gases (GHG), such as methane.
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> As shale gas operations expand across the nation these air emissions have become an increasing matter of concern at the local, regional and national level. Significant air quality impacts from oil and gas operations in Wyoming, Colorado, Utah and Texas are well documented, and air quality issues are of increasing concern in the Marcellus region (in parts of Ohio, Pennsylvania, West Virginia and New York).[25]

The tight link between gas production and ground-level ozone, or smog, is a particularly pressing problem. The gas industry is a major source of two major ozone precursors: VOCs and NO_x.[26] Smog harms the respiratory system and has been linked to premature death, heart

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[21] *Id.*
[22] *Id.*
[23] *Id.* at Annex C.
[24] *Id.*
[25] SEAB, *First Ninety Day Report* (August 18, 2011) at 15.
[26] *See, e.g.,* Al Armendariz, *Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements* (Jan. 26, 2009), *available at* http://www.edf.org/documents/9235_Barnett_Shale_Report.pdf (hereinafter "Barnett Shale Report").

failure, chronic respiratory damage, and premature aging of the lungs.[27] Smog may also exacerbate existing respiratory illnesses, such as asthma and emphysema, or cause chest pain, coughing, throat irritation and congestion. Children, the elderly, and people with existing respiratory conditions are the most at risk from ozone pollution.[28]

As a result of significant VOC and NO_x emissions associated with oil and gas development, numerous areas of the country with heavy concentrations of drilling are now suffering from serious ozone problems. For example, the Dallas Fort Worth area in Texas is home to substantial oil and gas development. Within the Barnett shale region, as of July 2012, there were 16,213 gas wells and another 2,764 wells permitted.[29] Of the nine counties surrounding the Dallas Fort Worth area that EPA has designated as in "nonattainment" with national air quality standards for ozone, five contain significant oil and gas development.[30] A 2009 study found that summertime emissions of smog-forming pollutants from gas production in these counties were roughly comparable to emissions from all the cars in those same areas.[31] These nonattainment designations are particularly striking because the current ozone standard is set below the level EPA's own scientific advisors recommend as adequate to protect public health.[32] That gas production emissions can cause violations even of this relatively *lax* standard underlines their severity.

Oil and gas development has also brought serious ozone pollution problems to rural areas, such as western Wyoming.[33] On March 12, 2009, the governor of Wyoming recommended that EPA designate Wyoming's Upper Green River Basin as an ozone nonattainment area under EPA's current ozone.[34] The Wyoming Department of Environmental Quality conducted an extended assessment of the ozone pollution problem and found that it was "primarily due to local emissions from oil and gas . . . development activities: drilling, production, storage, transport, and treating."[35] In the winter of 2010-2011, the residents of Sublette County suffered thirteen

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[27] *See, e.g.*, Jerrett *et al.*, *Long-Term Ozone Exposure and Mortality*, New England Journal of Medicine (Mar. 12, 2009), *available at* http://www.nejm.org/doi/full/10.1056/NEJMoa0803894#t=articleTop.

[28] *See* EPA, *Ground-Level Ozone, Health Effects*, *available at* http://www.epa.gov/glo/health.html; EPA, Nitrogen Dioxide, Health, available at http://www.epa.gov/air/nitrogenoxides/health.html.

[29] Texas Railroad Commission, http://www.rrc.state.tx.us/data/fielddata/barnettshale.pdf (Accessed Sept. 25, 2012).

[30] Barnett Shale Report at 1, 3.

[31] *Id.* at 1, 25-26.

[32] *See,e.g.*, Elizabeth Shogren, NPR, *EPA Seeks to Tighten Ozone Standards* (July 24, 2011) (when EPA set the current standards it "ignored the advice of its own panel of outside scientific advisers"). EPA has since opted not to immediately update the out-dated standards, but revisions may be forthcoming next year.

[33] Schnell, R.C, et al. (2009), "Rapid photochemical production of ozone at high concentrations in a rural site during winter," *Nature Geosci.* 2 (120 – 122). DOI: 10.1038/NGEO415.

[34] *See* Letter from Wyoming Governor Dave Freudenthal to Carol Rushin, Acting Regional Administrator, USEPA Region 8, (Mar. 12, 2009) ("Wyoming 8-Hour Ozone Designation Recommendations"), *available at* http://deq.state.wy.us/out/downloads/Rushin%20Ozone.pdf; Wyoming Department of Environmental Quality, Technical Support Document I for Recommended 8-hour Ozone Designation of the Upper Green River Basin (March 26, 2009) ("Wyoming Nonattainment Analysis"), at vi-viii, 23-26, 94-05, *available at* http://deq.state.wy.us/out/downloads/Ozone%20TSD_final_rev%203-30-09_jl.pdf.

[35] Wyoming Nonattainment Analysis at viii.

days with ozone concentrations considered "unhealthy" under EPA's current air-quality index, including days when the ozone levels exceeded the worst days of smog pollution in Los Angeles.[36]

As oil and gas production moves into new areas ozone problems are likely to follow. For example, regional air quality models predict that gas development in the Haynesville shale will increase ozone pollution in northeast Texas and northwest Louisiana and may lead to violations of ozone air quality standards.[37] Experts also anticipate air quality problems associated with development of the Marcellus shale in the Mid-Atlantic region.[38]

Ozone pollution is not the only danger associated with natural gas production, however. Toxic air emissions are also a significant concern. Emissions from gas fields contain carcinogenic compounds, including benzene, which are associated with significant increases in cancer risk. In fact, Colorado researchers sampling the air near a field there recently determined that residents living within half a mile of from wells were at increased risk of cancer, compared to those living further away, due to long-term exposure to toxic leaks.[39] As the industry expands, this toxic problem will come with it.

In addition to these serious problems, the industry poses a significant threat to the global climate. The natural gas industry is also among the very largest sources of methane pollution in the country. Methane is a potent greenhouse gas, and these emissions rank the industry as the second largest industrial greenhouse gas source, second only to power production.[40] Because fracking operations tend to produce substantially more methane, and are also supporting new well development across the country, unconventional natural gas production is increasing these emissions. EPA has recently estimated annual industry methane emissions as the equivalent of 328 million metric tons of CO_2.[41]

This pollution will remain a serious danger even though EPA has recently finalized its first attempt at comprehensive air pollution controls for the industry.[42] While these standards will

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[36] EPA, *Daily Ozone AQI Levels in 2011 for Sublette County, Wyoming*, *available at* http://www.epa.gov/cgi-bin/broker?msaorcountyName=countycode&msaorcountyValue=56035&poll=44201&county=56035&msa=-1&sy=2011&flag=Y&_debug=2&_service=data&_program=dataprog.trend_tile_dm.sas.; *see also* Wendy Koch, *Wyoming's Smog Exceeds Los Angeles' Due to Gas Drilling*, USA Today, *available at* http://content.usatoday.com/communities/greenhouse/post/2011/03/wyomings-smog-exceeds-los-angeles-due-to-gas-drilling/1.

[37] *See* Kemball-Cook et al., *Ozone Impacts of Natural Gas development in the Haynesville Shale* 44 Environ. Sci. Technol. 9357, 9362 (Nov. 18, 2010).

[38] Elizabeth Shogren, *Air Quality Concerns Threaten Natural Gas's Image*, National Public Radio (June 21, 2011), *available at* http://www.npr.org/2011/06/21/137197991/air-quality-concerns-threaten-natural-gas-image.

[39] *See generally* Lisa McKenzie *et al.*, *Human health risk assessment of air emissions from development of unconventional natural gas resources*, Sci. Total Environment (May 2012), *abstract available at*: http://www.ncbi.nlm.nih.gov/pubmed/22444058.

[40] *See* EPA, Inventory of US Greenhouse Gas Emissions and Sinks 1990-2010 (2012).

[41] *See* 74 Fed. Reg. 52,738, 52,756 (Aug. 23, 2011).

[42] *See* 77 Fed. Reg. 49,490 (Aug. 16, 2012).

play a significant role in reducing air pollution from new infrastructure, many new sources and existing infrastructure escape regulation. Moreover, the standards do not regulate methane directly. As a result, air pollution from production will continue to be a serious problem, despite this important first regulatory effort.

Water Pollution

Much public concern over expanded fracking operations has focused on water pollution, and with good reason. Significant water resource impacts can occur throughout the production process.

Fracking requires large volumes of water per well. While operators have sought to reduce their water demands in some areas, numerous sources indicate that fracturing a single well requires at least 1 to 5 million gallons of water.[43] Water withdrawals can harm aquatic ecosystems and human communities by reducing instream flows—especially in small headwaters streams -- and by harming aquatic organisms at water intake structures.[44] Where water is withdrawn from aquifers rather than surface sources, withdrawal risks permanent depletion.[45] Withdrawals for fracking pose a greater risk than other withdrawals, because fracking is a consumptive use. Fluid injected during the fracking process is ideally deposited below freshwater aquifers and into sealed formations, so much of it never returns to the surface.

The well-site management of fracking fluid and wastes, including flowback water, poses water quality risks throughout the process. Spills at the surface, leaks through well casings, and contaminant migration from the fracking site itself can all contaminate ground and surface water.

Fracturing fluid itself contains many chemicals that present health risks. Diesel fuel and similar compounds pose particularly pressing risks. The DOE Subcommittee singled out diesel for its harmful effects and recommended that it be banned from use as a fracturing fluid additive.[46] The minority staff of the House Committee on Energy and Commerce determined that despite diesel's risks, between 2005 and 2009, "oil and gas service companies injected 32.2 million gallons of diesel fuel or hydraulic fracturing fluids containing diesel fuel in wells in 19 states."[47]

Fracking fluids are not the only source of potential contamination.[48] Fluid naturally occurring in the target formation "may include brine, gases (e.g. methane, ethane), trace metals, naturally occurring radioactive elements (e.g. radium, uranium) and organic compounds." [49] Inadequate

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[43] *See, e.g.*, SEAB, *First Ninety-Day Report* at 19; NY RDSGEIS 6-10.
[44] NY RDSGEIS at 6-3, 6-4.
[45] *Id.* 6-5; SEAB, *First Ninety Day report* at 19 ("[I]n some regions and localities there are significant concerns about consumptive water use for shale gas development.").
[46] *Id.* at 25.
[47] Letter from Reps. Waxman, Markey, and DeGette to EPA Administrator Lisa Jackson (Jan. 31, 2011) at 1.
[48] NY RDSGEIS at 5-75 to 5-78
[49] SEAB *First Ninety-Day Report* at 21.

well cementing, among other faults, can allow these substances to contaminate groundwater resources.[50] Storage, transport, and treatment of produced water on the surface create risks of spills and inadequate disposal, providing another vector for contamination of surface and groundwater resources.[51]

Properly treating these waste products, and other production waste, is essential to protecting water quality. Limited treatment capacity and the challenges of safely using underground injection as an alternative disposal method for large volumes of waste are pressing problems. Treating and discharging extremely salty, highly-contaminated wastewater is energy-intensive and technically difficult, and can put surface streams at risk. Meanwhile, injection also faces challenges, as not all regions have substantial injection capacity and injection wells themselves have been associated with earthquakes of up to 4.0 on the Richter scale.[52]

Finally, sediment contamination associated with the significant land disturbance and construction activities needed to construct and manage a well field is a persistent challenge. Run-off from production sites can readily contaminate streams without careful management.

Incidents of water contamination from various phases of the production process have been widely reported. Although EPA, other federal agencies and some states have begun to move forward with regulatory responses, many of these challenges remain unresolved. Thus, increased gas production for export will be accompanied by increasing risks of water pollution.

Land and Community Impacts

Intense gas production can transform entire regions. The gas boom means hundreds of thousands of new wells, along with the vast infrastructure of roads, pipelines, and support facilities they require. This landscape-level industrialization can transform formerly rural areas into vast construction sites, with thousands of trucks moving down an expanding webwork of gravel roads. This landscape change, too, is a significant environmental impact of increasing gas production.

The scope of potential change is great. Each well pad alone occupies roughly 3 acres, and associated infrastructure (roads, water impoundments, and pipelines) more than doubles this figure.[53] Many of these acres remain disturbed through the life of the well, estimated to be 20 to 40 years.[54] This directly disturbed land is generally no longer suitable as wildlife habitat. *Id.* at 6-68. In addition to this direct disturbance, indirect habitat loss occurs as areas around the directly disturbed land lose essential habitat characteristics. As New York regulators, for

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[50] *Id.* at 20.
[51] *See* NY RDSGEIS at 1-12 (describing risks of fluid containment at the well pad).
[52] *See, e.g.*, Columbia University, Lamont-Doherty Earth Observatory, *Ohio Quakes Probably Triggered by Waste Disposal Well, Say Seismologists* (Jan. 6, 2012); Alexis Flynn, *Study Ties Fracking to Quakes in England*, Wall Street Journal (Nov. 3, 2011).
[53] NY RDSGEIS at 5-5.
[54] *Id.* at 6-13.

instance, report, "[r]esearch has shown measureable impacts often extend at least 330 feet (100 meters) into forest adjacent to an edge."[55]

These effects will harm rural economies and decrease property values, as major gas infrastructure transforms and distorts the existing landscape. United States Geological Survey researchers, reviewing recent patterns of unconventional gas extraction, combined with coalbed methane projects, report that these activities create "potentially serious patterns of disturbance on the landscape."[56]

Pennsylvania presents a particularly striking example of the many ways in which gas production can transform a landscape. A recent state study of drilling in Pennsylvania's hitherto relatively undisturbed forest lands found that the forests have been so thoroughly fragmented and disrupted by the influx of gas activity that "zero" remaining acres of the state forests are suitable for further leasing with surface disturbing activities.[57]

Increased gas production for export can be expected to intensify and extend these impacts to new regions as drilling continues to meet increased demand.

Summary

The environmental impacts of increasing gas production of course extend well beyond those captured by this short summary. There are real environmental risks inherent in every phase of gas's life-cycle, from site preparation to drilling to waste disposal. Greatly increasing gas demand will increase the scope and intensity of these risks. The DOE's Shale Gas Subcommittee has already found that our regulatory infrastructure is not adequate to manage these risks at their current level of intensity. The United States is even less prepared for a greater and more rapid expansion of natural gas extraction.

B. Environmental Impacts Due to Fuel Market Shifts

Increasing demand for gas will necessarily raise gas and energy prices. These price effects have important environmental impacts as well because changing gas prices and availability affects the domestic fuel market. If natural gas is relatively more expensive, utilities, in particular, may be more likely to use competing fuels and generation technologies, each of which has its own environmental implications.

The prospect that LNG exports could incentivize domestic coal-fired generation is particularly important to understand. Coal-fired generation is a major source of many air pollutants,

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[55] *Id.* at 6-75.
[56] E.T. Slonecker *et al.*, USGS, *Landscape Consequences of Natural Gas Extraction in Bradford and Washington Counties, Pennsylvania, 2004–2010* (2012) at 1.
[57] PA DCNR, *Impacts of Leasing Additional State Forest for Natural Gas Development* (2011).

including asthma-inducing SO_2, and among the very largest sources of combustion-related CO_2. Thus, LNG-induced market changes could have important implications for domestic air quality.

The EIA has modeled this fuel-shifting effect for gas exports of up to 12 bcf/d.[58] It reports that as exports rise, domestic gas consumption falls. Utilities largely switch to coal, while also making up a bit of the displaced gas generation with energy efficiency and renewable energy.[59] On balance, this shift results in increased emissions because the bulk of the new energy (72% of the total) comes from coal generation.[60]

More coal generation means greater carbon dioxide emissions from combustion, which are more than sufficient to balance out any emissions savings from greater use of efficiency and renewable energy in most of the scenarios that the EIA considered.[61] In fact, even in the few scenarios where the EIA predicted a larger market share for low carbon sources, LNG exports still resulted in a net increase in CO_2 emissions nationally, once emissions from the liquefaction process itself were accounted for.[62] The size of this increase depends upon the volume and size of exports, and the baseline price of gas and coal under various scenarios, so the EIA analysis estimates it within a broad range of 187 to 1,587 million metric tons of CO_2 over the next twenty years. These are large amounts. Even at the low end, 187 million metric tons is equivalent to the CO_2 emitted in a year by roughly 44 coal-fired power plants.[63] These emissions have the potential to increase as more LNG is exported with commensurate impacts on the market. They would be accompanied by corresponding increases in other coal-generation-related air pollutants, like SO_2.

This market-linked pollution effect could work to disrupt important policy work at the national and local level. Many utilities, public service commissions, and environmental regulators increasingly assume that coal generation's market share will steadily fall, in favor of gas, renewable energy, and energy efficiency. These entities are planning accordingly. Indeed, the EPA's recent proposed carbon pollution standards for fossil-fired generation are premised on EPA's understanding that "in light of a number of economic factors, including the increased availability and significantly lower price of natural gas … few, if any, new coal-fired power plants will be built in the foreseeable future."[64] As policymakers adapt to a world of more readily-available natural gas, export's tendency to make gas *less* available and more expensive will have important environmental implications throughout the country.

C. Impacts from Export Itself: Focus on Climate

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[58] EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* at 17-19.
[59] *Id.*
[60] *Id.* at 18.
[61] *See id.* at 18-19.
[62] *Id.*
[63] Calculated with EPA's *Greenhouse Gas Equivalencies Calculator*, available at http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results.
[64] *See* 77 Fed. Reg. 22,392, 22,399 (Apr. 13, 2012).

Finally, exports themselves have substantial environmental impacts.

Export terminals are large industrial sites. The liquefaction facilities needed to chill natural gas until it condenses into a liquid well below zero are energy-intensive and can produce substantial amounts of air and water pollution. Likewise, the pipeline and compressor networks needed to transport gas to the terminal, and the international shipping system needed to carry it onward all have significant impacts on the environments they traverse. The highly explosive nature of LNG means that carefully mapping out the potential for serious accidents around terminals and ships is an ongoing and important exercise in worst-case scenario analysis.

Looking more broadly, the use of LNG itself has environmental impacts, both positive and negative. Examining the climate implications of LNG is particularly important because LNG proponents have touted the fuel for its supposed potential to substantially reduce greenhouse gas pollution by displacing coal.

This claim is not well-supported. Because of the energy used to liquefy, transport, and re-gasify LNG, its life-cycle climate footprint is greater than that of most gas sources. Indeed, at least one peer-reviewed study has found LNG's life-cycle greenhouse gas emissions approach the low-end of coal life-cycle emissions.[65] Notably, that study was based on emissions from conventionally-produced natural gas, which are considerably lower than those from unconventional gas. Other studies, though concluding that LNG emissions are still lower than those of coal, have likewise documented that LNG life-cycle emissions are on the order of 30% greater than those of ordinary gas.[66] Whichever figures ultimately turn out to be correct, it is clear that LNG is among the most carbon-intensive forms of natural gas.

Further, whether or not LNG produces as much greenhouse gas pollution as coal, increased use of *any* fossil fuel is not consistent with preventing dangerous climate change. Recent climate studies show that increased natural gas use (from whatever source), without aggressive additional carbon control efforts, will not prevent dangerous increases in global temperature. The International Energy Agency, for instance, recently considered a future in which global gas use (including LNG use) sharply increases because of the unconventional gas boom.[67] In this scenario, despite gas's presumed life-cycle emissions advantage over coal, atmospheric CO_2 concentrations nonetheless rise on a trajectory towards 650 ppm, up from near 400 ppm today, pushing towards a 3.5°C temperature increase.[68] As a result, even if LNG emits less greenhouse gas pollution than coal, and even if it displaces some amount of coal power (which may or may not occur), it will not put on a path towards safe climate.

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[65] Jaramillo et al., *Comparative Life-Cycle Air Emissions of Coal, Domestic Natural Gas, LNG, and SNG for Electricity Generation*, 41 Environ. Sci. Technol. 6,290, 6,295 (2007).

[66] *See* European Commission Joint Research Centre, *Liquefied Natural Gas for Europe – Some Important Issues for Consideration* (2009) at 16-17; European Commission Joint Research Centre, *Climate impact of potential shale gas production in the European Union* (2012).

[67] International Energy Agency, *Golden Rules for a Golden Age of Gas* (2012).

[68] *Id.* at 91.

We can only avoid the worst impacts of climate change if emissions fall sharply. As IEA explains, "reaching the international goal of limiting the long-term increase in global mean temperature to 2°C above pre-industrial levels cannot be accomplished through greater reliance on natural gas alone."[69] Thus, expanded natural gas exports may, at best, very slightly slow the pace of warming. In the worst case, they will maintain the status quo, while deepening a national and global investment in climate-disrupting fossil fuels and delaying the transition to renewable energy sources.

D. Conclusions on Environmental Impacts

In sum, the environmental impact of LNG export is large, and stretches from local effects near individual gas wells to significant cumulative impacts on the country as gas production increases and gas prices rise to significant shifts in the international energy market. Some of these impacts are better understood than others, but all are worthy of careful analysis.

That analysis has not been forthcoming. DOE and FERC have prepared no environmental reports studying the impacts of export and, worse, have so far declined to do so, as is explained below. Export proponents, who generally trumpet production increases as a central benefit of their projects, are silent on the environmental costs of these production shifts.

The policy community has not yet seriously engaged these questions either. Two much-discussed recent LNG export papers, which generally favor exports, devote almost no attention to the environmental impacts of exports and the increased gas production that would accompany them. A report from the Brookings Institution, titled *Liquid Markets*, cites the DOE's Shale Gas Subcommittee's serious concerns and reviews ongoing regulatory initiatives, but makes no effort to quantify the likely environmental impacts of increased production.[70] Instead, it settles for predicting only that the "current regulatory environment" – the one which DOE has judged to be inadequate – should not put any insuperable hurdles in the way of new drilling.[71]

A second report, from Michael Levi of the Council on Foreign Relations and the Hamilton Project, also lacks a detailed treatment of these issues.[72] The environmental portion of that analysis also largely considers whether public backlash over environmental damage will be sufficient to derail exports, warning that the EIA projects "that a large part of increased production spurred by export demand would be in the Northeast, where opposition to shale gas development has been strongest."[73] Levi views this possibility as an argument for improved regulation, such as the DOE has called for. He implies, however, that because LNG exports will

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[69] *Id.* at 100.
[70] Brookings Energy Security Initiative, *Liquid Markets: Assessing the Case for U.S. exports of Liquefied Natural Gas* (May 2012) at 6-12.
[71] *Id.* at 11.
[72] Michael Levi, The Hamilton Project, *A Strategy for U.S. Natural Gas Exports* (June 2012).
[73] *Id.* at 20-21.

not commence "for several years," there will be time to put the necessary rules in place before hand.[74] Suffice to say that this is back-to-front thinking: There is no guarantee that rules will be in place to manage a wave of increased fracking. On the contrary, with billions of dollars sunk into export terminals, one might expect export proponents to oppose new regulation.

These two recent reports are representative: There has been a great deal of discussion of the economic potential of LNG exports, but the environmental discussion has lagged dangerously behind. Mere assertions that environmental impacts will not be sufficiently disturbing as to cause a massive public backlash, or that regulations will doubtless be in place by the time exports occur, are not enough to support careful consideration of these transformative changes. The decision to allow substantial LNG exports requires a thorough accounting of the likely impacts and how they can best be managed.

To be sure, a great deal of useful information is being developed on the environmental impacts of unconventional gas production generally, as state and federal regulators grapple with the implications of the boom. That information, however, has not been integrated into an analysis of the impacts of LNG exports or used to inform export decisions. If DOE or FERC began that study, they would find a rich and developing literature to draw upon and synthesize. The export licensing system, supported by the NEPA process, should produce just an analysis. That information is long overdue.

IV. The Regulatory Infrastructure

The Natural Gas Act and NEPA provide a framework under which DOE and FERC must weigh the environmental impacts of export, and then ensure that exports, if any, are regulated to protect the public interest. Thus far, this fundamental oversight machinery has not been fully used.

Natural gas imports and exports have been regulated under the Natural Gas Act since the late 1930s. Until very recently, however, large-scale exports of LNG were not in the picture. The two core regulatory bodies, DOE's Office of Fossil Energy, and FERC, dealt largely with pipeline shipments to Canada and Mexico and with LNG import terminals. Although they occasionally handled periodic permit renewals for a sole, small, LNG export terminal in Alaska that has served the Asian market off and on since the 1960s, this minor project does not remotely compare to the enormous export proposals now before them. This striking shift underlines the importance of proceeding carefully now.

A. The Public Interest Determination and Siting Process

The Natural Gas Act provides that "no person" may export or import natural gas without a license.[75] Such a license will be granted unless the proposal "will not be consistent with the

[74] *See id.* at 21.
[75] 15 U.S.C. § 717b(a).

public interest."[76] This public interest standard is broad and invites careful analysis. Among other points, it includes "the authority to consider conservation, environmental, and antitrust questions."[77] The Supreme Court has made clear that environmental considerations, in particular, are due close attention in this analysis.[78] DOE has recently affirmed that it is required to examine a "wide range of criteria" to best understand the public interest, "including… U.S. energy security… [i]mpact on the U.S. economy… [e]nvironmental considerations… [and] [o]ther issues raised by commenters and/or interveners deemed relevant to the proceeding."[79]

DOE and FERC share responsibility for Natural Gas Act determinations, with DOE taking, in many ways, the more fundamental role. Under their current division of authority, FERC is charged with location-specific concerns: Its primary responsibility is to investigate how to safely site and operate export and import terminals themselves.[80] DOE, by contrast, is charged with more broadly considering whether the project should move forward at all: It must make the public interest determination, and so must survey the information before it in order to discern how a given export or import proposal will affect the many considerations relevant to the public interest.[81] Although DOE reads its governing statute to afford export applicants a rebuttable presumption that their project is in the public interest, this presumption is not dispositive and a detailed public interest analysis is required in each case.[82]

NEPA analysis supports this public interest determination by providing the environmental information which DOE must weigh under the Natural Gas Act. The NEPA process, described in detail below, is the joint responsibility of DOE and FERC, and must be completed before either one issues a final order. Since 2005, FERC has been charged by statute as the "lead" agency for NEPA compliance, meaning that it coordinates the environmental assessment process.[83] DOE, however, must contribute to and review the documents which FERC prepares, and must independently determine whether they are sufficient to support its public interest determination, or whether more analysis is needed.[84] Only once DOE determines that it has NEPA documents which fully analyze the environmental impacts of the decision before it does it weigh those impacts and make its final public interest decision.

This process applies to all the export applications now before FERC and DOE with one important exception, which is discussed in more detail in the final section of this paper. In the 1992

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[76] *Id.*
[77] *Nat'l Ass'n for the Advancement of Colored People v. Federal Power Commission*, 425 U.S. 662, 670 n.4 & n.6 (1976).
[78] *See Udall v. Federal Power Comm'n*, 387 U.S. 428, 450 (1967).
[79] Testimony of Christopher Smith, Deputy Assistant Secretary of Oil and Gas Before the Senate Committee on Energy and Natural Resources (Nov. 8, 2011).
[80] Department of Energy Delegation Order No. 00-004.00A § 1.21 (May 16, 2006).
[81] *See* Department of Energy Redelegation Order No. 00-002.04E § 1.3 (Apr. 29, 2011).
[82] *See Panhandle Producers and Royalty Owners Ass'n v. Economic Regulatory Administration*, 822 F.2d 1105, 1110-1111 (D.C. Cir. 1987).
[83] *See* 15 U.S.C. § 717n.
[84] *See* 40 C.F.R. § 1501.6.

Energy Policy Act, Congress amended DOE's Natural Gas Act authority to provide that DOE *must* grant applications for export to (or import from) nations with which the United States has signed a free trade agreement providing for national treatment in natural gas.[85] In those cases, FERC still oversees terminal siting, but DOE loses its broad oversight role as to whether export is wise in the first place. This loophole was created to support natural gas imports from Canada – rather than massive LNG *exports* from the U.S. – but it has been relatively unimportant until recently. Significant export projects generally must go through the usual public interest process because the United States does not have free trade agreements with most major LNG importers. The 2010 free trade agreement with South Korea, a large LNG importer, changed this picture somewhat, but the South Korean market is still relatively limited and the free-trade "loophole" has not short-circuited DOE's usual process in most cases. That situation highlights, however, the importance of maintaining the public interest determination process as trade negotiations continue with other importers.

Accordingly, though most exporters do secure the "free" license to export to free-trade-agreement nations, the license to export to non-free-trade-act nations remains more valuable, and is often essential to doing business. Of the 19 projects now before DOE, only 4 rely exclusively on a free-trade-agreement license.[86] The remaining proposals are proceeding through the full public interest determination process.

B. The NEPA Process

The NEPA phase of this process must provide DOE and the public with a full and fair understanding of the environmental implications of export.

NEPA is our bedrock environmental statute.[87] It is rooted in democratic decisionmaking informed by excellent information. NEPA directs federal agencies to look before they leap: by requiring the preparation of environmental impact statements (EISs) for major federal actions, it helps ensure sound decisions before bulldozers roll. Policymakers have a pressing need for the information the NEPA process can provide as they consider whether and how to permit LNG export. NEPA analysis, accordingly, is not just a legal mandate but a prudent measure.

NEPA requires all federal agencies to "utilize a systematic, interdisciplinary approach" to make decisions, ensuring that their decisions are fully informed before they act with a goal of maintaining "the environment for succeeding generations."[88] The core of this obligation is the EIS, which must be prepared for every major Federal action which could significantly affect "the quality of the human environment."[89]

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[85] *See* 15 U.S.C. 717b(c).
[86] Those four are the SB Power Solutions, Golden Pass Productions, Main Pass Energy Hub, and Waller LNG Services proposals.
[87] It is codified at 42 U.S.C. §§ 4321 *et seq.*
[88] 42 U.S.C. §§ 4332(A) & 4331(b)(1).
[89] 42 U.S.C. § 4332(C).

An EIS is designed to develop information describing the environmental impact of a proposed action, alternatives to the proposal, and the relationship between the short-term proposal and "the maintenance and enhancement of long-term [environmental] productivity."[90] NEPA, in other words, helps prompt agencies to look more broadly than the immediate matter at hand, to understand how their actions fit within a larger environmental context. As the first court to review the statute explained, "NEPA, first of all, makes environmental protection a part of the mandate of every federal agency and department."[91]

This is not a paper exercise. The Council on Environmental Quality, the high-level body which administers NEPA across the government, explains in its regulations that "[u]ltimately, of course, it is not better documents but better decisions that count. NEPA's purpose is not to generate paperwork--even excellent paperwork--but to foster excellent action."[92] This means that "[t]he NEPA process is intended to help public officials make decisions that are based on an understanding of environmental consequences, and take actions that protect, restore, and enhance the environment."[93]

This process proceeds in several steps, designed to build a strong platform for the final decision. It is to begin as early as possible in order to ensure that the EIS can "serve practically as an important contribution to the decisionmaking process and will not be used to rationalize or justify decisions already made."[94] After an initial "scoping" phase during which the agency gathers comments from stakeholders to identify key issues,[95] the agency prepares a draft and then a final EIS.

The "heart of the environmental impact statement" is a careful discussion of the proposal and all relevant alternatives, "sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public."[96] With regard to each option, the agency must develop a careful description of its environmental consequences.[97]

These consequences are generally divided between direct, indirect, and cumulative impacts.[98] Direct impacts are simply those immediately caused by the action at issue; indirect impacts are those which may occur a bit further afield, but which are still causally linked to the federal action.[99] The agency must cast a wide net, analyzing all "reasonabl[y] foreseeable" impacts, including those "induced" by its action – think, for instance, of the "growth inducing" impacts of building a highway, or, for that matter, an export terminal inducing drilling with its attendant

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[90] *Id.*
[91] *Calvert Cliffs' Coordinating Committee, Inc. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109, 1112 (D.C. Cir. 1971).
[92] 40 C.F.R. § 1500.1(c).
[93] *Id.*
[94] 40 C.F.R. § 1502.5.
[95] 40 C.F.R. § 1501.7.
[96] 40 C.F.R. § 1502.14.
[97] 40 C.F.R. § 1502.16.
[98] 40 C.F.R. §§ 1508.7 & 1508.8.
[99] 40 C.F.R. § 1508.8.

effects on "air and water and other natural systems."[100] The analysis must also include the "cumulative" impacts of federal action – the "incremental impact of the action when added to other past, present, and reasonably foreseeable future actions."[101] For instance, in the LNG context, the cumulative production inducing effects of all relevant LNG terminals should be considered together. It would also make sense to consider the cumulative impact of new production from export along with the impact of existing gas production.

The EIS, in short, ultimately presents a full accounting of all the reasonably foreseeable impacts of the agency's proposed course of action, along with alternatives to that course of action. It is designed to bring information to light and to generate syntheses of formerly scattered information.

Congress recognized, in this regard, that some uncertainty will always be present in any prediction of environmental impacts. Such uncertainty does not excuse agencies from complying with NEPA – if it did, NEPA analyses would never succeed in developing the new research agencies need to inform their decisions. Rather, the NEPA process is designed to limit uncertainty, while carefully characterizing remaining questions. Where information is incomplete, the agency must gather it (expending reasonable funds to do so) to fill in key aspects of the picture.[102] If costs are truly exorbitant, or it is very difficult to generate a particular piece of information, an agency must still do its best, providing a careful description of what it believes to be missing from its evaluation, a "summary of existing credible scientific evidence" relevant to its problem, and the agency's best "evaluation" of the impacts before it based upon what it knows.[103] In all cases, the goal is to develop the best-informed analysis possible, advancing the public's understanding, even of uncertainties, before the final decision is made.

Uncertainties can also be managed by beginning at a higher level of generality with a special form of EIS known as a "programmatic" environmental impact statement, and then filling in more specific information down the road as individual projects are considered. As the name suggests, programmatic EISs are intended to provide a broad overview of entire programs, or classes of activity.[104] Such documents are particularly useful as road maps. They provide an overview of how a class of decisions – such as granting many different export applications – will affect the environment. As the D.C. Circuit Court of Appeals has explained, this process has "a number of advantages" which recommend it here:[105] A programmatic EIS, the court explained, "provides an occasion for a more exhaustive consideration of effects and alternatives than would be practicable in a statement on an individual action. It ensures consideration of

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[100] *See id.*
[101] 40 C.F.R. § 1508.7.
[102] 40 C.F.R. § 1502.22(a).
[103] 40 C.F.R. § 1502.22(b)(1).
[104] *See* 40 C.F.R. § 1502.14(b)-(c).
[105] *Scientists' Institute for Public Information, Inc. v. Atomic Energy Comm'n*, 481 F.2d 1079, 1087 (D.C. Cir. 1973).

cumulative impacts that might be slighted in a case-by-case analysis. And it avoids duplicative reconsideration of basic policy questions."[106]

To facilitate this broad overview, the NEPA regulations in turn explain that agencies can structure programmatic EISs by looking, for instance, geographically at "actions occurring in the same general location"; generically, by looking at actions with, for instance, "common timing, impacts, alternatives, methods of implementation, media, or subject matter"; or even by "stage of technical development" as processes and technologies mature.[107] Once such an overview is in hand, an agency is free to rely upon it to guide more specific analyses of particular projects, thereby saving work and time down the road.[108]

Whether an EIS is programmatic or project-specific, as the Supreme Court has explained, by ensuring that agencies take a "hard look" at the environmental consequences of their decisions, NEPA is "almost certain to affect the agency's substantive decision."[109] In this sense, NEPA reflects a fundamentally democratic approach to decisionmaking, a faith that putting the best information forward transparently will help policymakers and the public navigate uncertainty and make difficult choices. The Supreme Court identifies these two purposes this way:

> First, [NEPA] ensures that the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts. Second, it guarantees that the relevant information will be made available to the larger audience that may also play a role in both the decisionmaking process and the implementation of that decision.[110]

With this process in place, the goal is that "the most intelligent, optimally beneficial decision will ultimately be made."[111]

There is a pressing need for such careful, deliberate, decisionmaking in the LNG export context.

V. Applying NEPA to LNG Exports

DOE affirms in its governing regulations that it will "follow the letter and spirit of NEPA" and will "apply the NEPA review process early in the planning stages" of its projects.[112] These rules are clear that DOE must base its final decisions on matters with significant environmental impacts on a carefully developed environmental impact statement.[113] But DOE has refused to prepare

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[106] *Id.* (internal quotations and citation omitted).
[107] 40 C.F.R. § 1502.14(c)(1)-(3).
[108] *See, e.g.*, 40 C.F.R. § 1502.20
[109] *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989).
[110] *Dep't of Transp. v. Public Citizen*, 541 U.S. 752, 767 (2004) (internal quotations omitted).
[111] *Calvert Cliffs*, 449 F.2d at 1114.
[112] 10 C.F.R. § 1021.102.
[113] *See, e.g.*, 10 C.F.R. §§ 1021.210 (affirming that DOE will complete NEPA review "before making a decision"); 1021.214 (affirming that this standard applies for adjudicatory proceedings, such as licensing processes).

an environmental impact statement to help it wrestle with the weighty export decisions now before it. Worse, it has refused even to acknowledge that it has the tools to do so, even though its own modeling system could go far to help answer the vital questions now before it.

DOE *should* have approached NEPA compliance in a far more considered way. It should have begun by preparing a national programmatic environmental impact statement – either on its own or as a partner with FERC, the usual NEPA lead agency -- that would have considered the cumulative effect of the export proposals before it and ways to mitigate those effects. Such an analysis would be a natural counterpart to a national economic study it is now preparing. In fact, the U.S. Environmental Protection Agency (EPA) has now twice filed formal comments making clear that just such an analysis is necessary.[114] With both such studies in hand, DOE and FERC could then have developed shorter, subsidiary studies for each proposal before it, considering their particular circumstances in the context of its comprehensive public disclosures.

The unwise course the agencies have thus far taken in the environmental arena contrasts sharply with DOE's far wiser commitment to consider national economic impacts before moving forward on any further export applications. These two approaches are irreconcilable. DOE must undertake a full EIS for LNG export, including the effects of increased gas production, if it is to make prudent decisions and satisfy its legal mandates.

A. DOE's Failure to Properly Apply NEPA Thus Far

DOE has assured Congress that it recognizes that the cumulative impact of "future LNG export authorizations could affect the public interest."[115] Unfortunately, though DOE is attempting to better understand some of the economic implications of LNG export, it has thus far actively refused to consider the environmental implications.

The only nearly-complete example of DOE's deliberative process thus far is its handling of the Sabine Pass LNG export project proposed for southern Louisiana. Sabine Pass was the first LNG export application filed in the current wave of proposals, and proposed to export 803 bcf of gas annually. This volume of export, alone, would increase *total* U.S. gas exports by more than 50%.[116] One might have expected DOE to analyze this historic application in detail, but it did not.

Instead, applying the rebuttable presumption-based approach to export, DOE did not develop significant independent analyses when considering the application. It relied almost entirely on Sabine Pass's own assertions. In spring 2011, it "conditionally" approved the Sabine Pass's request to export up to 2.2 bcf/d of natural gas, largely on the ground that no opposing party

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[114] Letter from Christine B, Reichgott, EPA Region 10 to FERC (Oct. 29, 2012) at 12-13; Letter from Jeffrey D. Lapp, EP Region 3 to FERC (Nov. 15, 2012) at 2.

[115] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey (Feb. 24, 2012) at 3.

[116] *See* n. 3, *supra*.

had shown that the project was *not* in the public interest.[117] DOE thus approved the beginning of the export boom largely on the export proponents' say-so, without preparing its own analysis.

The "conditional" part of the approval referred in large part to DOE's decision to defer its consideration of environmental matters pending FERC's work on NEPA documents for Sabine Pass as the lead agency for NEPA compliance. Because FERC had not yet prepared an environmental analysis or environmental impact statement, DOE opted not to weigh any environmental factors in its public interest analysis. Instead, it stated that FERC, with DOE's cooperation, would undertake the environmental study for both agencies as part of FERC's facility siting process.[118] DOE stated that it would review FERC's final product before finally signing off on Sabine Pass.

But FERC did not prepare an EIS for Sabine Pass and did not consider the national implications of the application, including its implications for production. FERC recognized that Sabine Pass itself identified the purpose and need of the facility as to "provide a market solution to allow the further development of unconventional (particularly shale gas-bearing formation) sources in the United States."[119] Nonetheless, it instead prepared only a more limited document called an environmental assessment (an "EA"), which focused only on the environmental impacts of the facility siting decision before it.[120]

FERC justified this decision on the grounds that the impacts from increased gas development were not "reasonably foreseeable" because "no specific shale-gas play is identified."[121] It did so even though Sabine Pass itself affirmed that the "most likely" sources of supply for its project were "the historically prolific Gulf Coast Texas and Louisiana onshore gas fields, the gas fields in the Permian, Anadarko, and Hugoton basins, and the emerging unconventional gas fields in the Barnett, Fayetteville, Woodford, and Bossier basins."[122] FERC apparently felt that the applicant's own assurances that export would spur production, and would likely do so in specific places, provided no ground for analysis. Because FERC believed that it could not identify precisely where Sabine Pass would catalyze gas production, it refused to consider these impacts at all.[123]

But NEPA analyses are not dependent on this sort of location-specific analysis. Instead, a programmatic EIS, for instance, could readily have presented the environmental choices before DOE on a national level, with particular attention to potential production patterns in prolific shale plays. Even a project-specific EIS could have addressed pressing environmental issues directly. FERC could have evaluated the sorts of pollution risks and ecosystem threats

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[117] DOE, Order 2961 (May 20, 2011) at 42.
[118] *Id.* at 40-41.
[119] *Id.* at 1-10.
[120] *See* FERC, *Environmental Assessment for the Sabine Pass Liquefaction Project* (December 2011).
[121] FERC, Order Granting Section 3 Authorization, 139 FERC ¶ 61,039 at ¶¶ 96-97 (Apr. 16, 2012).
[122] Sabine Pass Export Application (Sept. 7, 2010) at 16.
[123] *Id.* at ¶¶ 98-100.

associated with increased fracking. It could have described the likely cumulative impacts of the many proposed LNG projects, including those at Sabine Pass, and could have estimated the scale of environmental disruption that they may cause. Instead, FERC provided none of this information. Perversely, because it concluded that Sabine Pass might promote gas production "in any of the numerous shale plays that exist in most of the eastern United States," and hence could have nationwide impacts, FERC decided that these impacts swept too broadly to be analyzed.[124]

DOE did not have to accept this blinkered view, but it nonetheless did so, declaring, on its review of FERC's EA, that FERC had "examined all reasonably foreseeable impacts" of the project.[125] DOE therefore accepted FERC's EA as a "complete picture for purposes of meeting DOE's NEPA responsibilities and fulfilling its duty to examine environmental factors as a public interest consideration under the [Natural Gas Act]."[126] In doing so, DOE also accepted FERC's reasoning that because it was "impossible" to know precisely how much new production Sabine Pass would cause, or exactly where this production would occur, there was no way to discuss these impacts at all.[127]

Thus, though DOE affirmed that it was "fully aware of concerns of the environmental effects of shale gas production," it insisted that it could not provide a "meaningful analysis" of Sabine Pass – or of the cumulative impacts of LNG export as a whole.[128] Sierra Club petitioned for rehearing of this decision, and DOE has announced that it continues to consider whether its decision was correct.[129]

DOE has not moved forward on any other LNG export applications (with the exception of licenses for export to countries with which the U.S. has a free trade agreement, discussed below), so the Sabine Pass order stands as its current word on the subject. If DOE does not change course, huge volumes of natural gas will be produced and exported without any consideration of how this massive production increase will affect communities across the country. Far from working to protect the public interest, DOE will not acknowledge, much less address, the challenge before it.

B. How NEPA Should Be Applied to LNG Exports

The Sabine Pass decisions made a bad beginning, but they need not determine the rest of the story. DOE may yet reconsider its Sabine Pass order. Moreover, many other LNG export applications have been filed with DOE and, as it considers them, it may still treat this environmental challenge with the seriousness it deserves. Before granting any further licenses,

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[124] FERC, Order Denying Rehearing and Stay, 140 FERC ¶ 61,076 at ¶ 12 (July 26, 2012).
[125] DOE, Order 2961-A (Aug. 7, 2012) at 27.
[126] *Id.*
[127] *Id.* at 28.
[128] *Id.*
[129] DOE, *Order Granting Rehearing for Further Consideration*, FE Docket No. 10-111-LNG (Oct. 5, 2012).

DOE should ensure that the NEPA process develops the information it needs to make a sound public interest determination.

For purposes of this discussion, DOE or FERC could undertake the tasks described below. FERC would be the most likely coordinator, given its lead agency role under the Natural Gas Act, but it is ultimately DOE's responsibility to ensure that the final NEPA analysis is sufficient to support a careful public interest determination, whether it is prepared entirely by FERC or later supplemented by DOE. For ease of reference, this section therefore refers to "DOE" as conducting the analysis, though FERC would play an important coordinating role.

In this context, a programmatic EIS makes a great deal of sense. By looking first at the common questions inherent in export, DOE could help develop a fundamental shared understanding of their impacts before turning to the particular impacts of specific proposals.

i. Determining Foreseeable Production Associated with Export

The most important first question for DOE is to determine a "reasonably foreseeable" range of natural gas which may be exported and the corresponding range of reasonably foreseeable increases in production. So far, DOE and FERC have insisted that *no* production impacts are reasonably foreseeable, as the Sabine Pass decisions state. This conclusion is simply wrong. The DOE's own NEMS program can forecast these production impacts. DOE's failure to develop such projections is unjustifiable.

NEMS is a very well-established modeling system designed to model the economy's energy use through a series of interlocking "modules" that represent different energy sectors on regional and national levels.[130] Relevant here, NEMS has an "Oil and Gas Supply Module"[131] and a "Natural Gas Transmission and Distribute Module."[132] Rhese modules jointly represent the entire domestic natural gas sector, and describe how production responds to demand across the country. They can be used, therefore, to model the effects of increased export demand on gas production. In fact, they *have* been used for this purpose by DOE already: The January 2012 EIA special report on LNG, which included production forecasts, relies on NEMS, as does the summer 2012 Annual Energy Outlook, which contains LNG projections.[133]

EIA's formal documentation for NEMS is available online, and thoroughly describes the system. That documentation demonstrates that DOE/FE is in error when it states that the implications of LNG export demand for the production and supply of domestic gas are not foreseeable. In fact, NEMS's natural gas sub-models are explicitly designed to project how supply will respond to demand on a national and a regional basis; indeed, they *must* do so for the model to

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[130] *See* EIA, *The National Energy Modeling System: An Overview* (2009) at 1-2 ("NEMS Overview").
[131] *See* EIA, *Documentation of the Oil and Gas Supply Module* (2012 ("OGSM Documentation").
[132] *See* EIA, *Model Documentation: Natural Gas Transmission and Distribution Module of the National Energy Modeling System* (2012) (TDM Documentation).
[133] *See, e.g.*, EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* at 3 (EIA used NEMS for this forecast); EIA, . *See* EIA, *Annual Energy Outlook* (2012) at App. E (describing NEMS).

generate predictions. As such, NEMS could (and in fact has) be used to project likely production increases in response to increased demand caused by LNG exports. NEMS therefore provides the analysis of "when, where, and how shale-gas development will be affected" that the DOE has so far stated it would be impossible to produce.

To begin with, the Supply Module is built on detailed state-by-state reports of gas production across the country.[134] These reports allow the EIA to develop regionally differentiated models of the costs of production in each gas field, and how readily production can be increased in those fields. As the EIA explains, "production type curves have been used to estimate the technical production from known fields" as the basis for a sophisticated "play-level model that projects the crude oil and natural gas supply from the lower 48."[135] The module reports its results for regions throughout the United States, including the Northeast, the Gulf Coast, and areas in Texas and Arkansas with large gas plays.[136] It also distinguishes coalbed methane, shale gas, and tight gas from other resources, allowing for specific predictions distinguishing unconventional gas production from conventional natural gas production.[137] The module further projects the number of wells drilled each year, and their likely production; these are important figures for estimating environmental impacts.[138]

In short, this module "includes a comprehensive assessment method for determining the relative economics of various prospects based on future financial considerations, the nature of the undiscovered and discovered resources, prevailing risk factors, and the available technologies. The model evaluates the economics of future exploration and development from the perspective of an operator making an investment decision."[139] Thus, for each play in the lower 48 states, the EIA is able to predict future production based on existing data. Importantly, the EIA makes clear that "the model design provides the flexibility to evaluate … environmental, or other policy changes in a consistent and comprehensive manner."[140] Those policy changes include permitting LNG export.

LNG export creates new demand and transmission needs. The next NEMS module, the Transmission and Distribution Module, can address these impacts. It integrates supply projections with regional and national demand to help determine how gas will flow to areas experiencing increased demand. As EIA explains, the module "represents the transmission, distribution, and pricing of natural gas" using a national module of the transmission system, which, in turn, is divided by region.[141] The module "links natural gas suppliers (including importers) and consumers in the lower 48 States and across the Mexican and Canadian borders via a natural gas transmission and distribution network, while determining the flow of natural

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[134] *See* OGSM Documentation at 2-2.
[135] *Id.* at 2-3.
[136] *Id.* at 2-4.
[137] *Id.* at 2-7.
[138] *See id.* at 2-25 -2-26
[139] *Id.*
[140] *Id.*
[141] TDM Documentation at 2.

gas and the regional market clearing prices between suppliers and end-users."[142] Because the Transmission Module represents demand regionally, it can distinguish, for instance, between LNG export demand on the Gulf Coast and demand in the Northeast.[143] For each region, the module then links supply and demand annually, taking transmission costs into account, in order to project how demand will be met by the transmission system.[144] Thus, it interacts with the Supply Module to develop projections for how supply in each production region will evolve in response to demand.[145]

Importantly, the Transmission Module already is designed to model LNG imports and exports, and contains an extensive modeling apparatus to do so.[146] The Module includes import/export pipelines and the sole existing LNG export terminal in Alaska.[147] There is, thus, no technical barrier to modeling increased export demand going forward.[148] One source of demand is much like any other, so additional export terminals can simply be modeled as additional demand centers in the regions in which terminals are proposed. The Module could, for instance, readily model additional demand along the Gulf Coast or other coasts, and translate that demand back to the Supply Module. Again, this process is essentially what the EIA already did in the context of its January 2012 LNG export study, which relied on NEMS to forecast the production and price impacts of export.

In short, NEMS is already set up to do the sort of work which DOE needs to do here.[149] In response to a given demand in a particular region, it projects transmission system flows and

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[142] *Id.*
[143] *See id.* at 12-14.
[144] *See id.* at 15-16.
[145] *See id.* at 16-20.
[146] *See id.* at 22-32.
[147] *Id.* at 3.
[148] *See id.* at 30-31.
[149] As are several models used by private consultants. For instance, the Deloitte consultancy regularly makes such predictions. *See, e.g.*, Deloitte, *Made in America: The Economic Impact of LNG Exports from the United States* (2011) at 6 (explaining that if LNG is "exported from one particular geographic point, the entire eastern part of the United States reorients production and flows and basis differentials change substantially"); *see also id.* at 6 (explaining that the reference case for the model predicts increased production in the Marcellus and Haynesville shales) & 8 (explaining that Deloitte considers how producers will "develop more reserves in anticipation of demand growth, such as LNG exports" and forecasting different prices depending on where exports occur).

According to Deloitte, its "World Gas Model" and its component "North American Gas Model" are designed precisely to provide this sort of finer-grained analysis. Deloitte explains that "[t]he North American Gas Model is designed to simulate how regional interactions of supply, transportation, and demand determine market clearing prices, flowing volumes, storage, reserve additions, and new pipelines throughout the North American natural gas market." *See* Deloitte, *Natural Gas Models.* The model "contains field size and depth distributions for every play, with a finding and development cost model included. This database connects these gas plays with other energy products such as coal, power, and emissions." *Id.* According to Deloitte, its modeling thus allow it to predict how gas production, infrastructure construction, and storage will respond to changing demand conditions, including those resulting from LNG export: "The end result is that valuing storage investments, identifying maximally effectual storage field operation, positioning, optimizing cycle times, demand following modeling, pipeline sizing and location, and analyzing the impacts of LNG has become easier and generally more accurate." *Id.* The point here is that linking exports to production is plainly possible.

production responses at the level of individual plays across the country. Thus, DOE is fully capable of analyzing the production impacts of particular levels of LNG export. Its failure to do so – and its insistence that such projections are somehow impossible to make – is inexplicable.

Given this capability, DOE should look at a range of possible export volumes and timing, just as the EIA did in the economic study that DOE commissioned. It should then consider the amount of natural gas (either produced or diverted from other uses) necessary to meet this demand, and can, using the same analysis EIA applied, predict how much of this gas is likely to come from new production.

Because NEPA is rooted in the alternatives analysis, DOE should also develop alternative approaches to the range of possible exports. It might, for instance, look at the impacts of allowing the maximum and minimum volumes of exports it thinks are plausible, along with its projection of the most likely scenario. It also makes sense to look at variations in export timing and volume driven by public interest concerns. For instance, DOE could consider permitting exports only after the environmental safeguards the Shale Gas Subcommittee identified are in place, or only permitting exports at a volume that would not cause serious price disruptions or economic harm domestically. And, of course, DOE must consider a "no action" alternative baseline, in which exports do not move forward at all. The point of the analysis, as always, is to ensure that the agency thoroughly explores the possible solution space, rather than simply pursuing its preconceived plans.

DOE, in short, has many options before it open for analysis. The only option which it simply may not pursue, however, is the one that it has picked: It cannot and must not refuse to use its *own models* to help inform the public as to the vital choices ahead.

ii. Estimating the Impacts of Production

With this array of options in mind, the next task for DOE is to identify the environmental impacts associated with each of the reasonable alternatives it has developed. EPA has twice instructed FERC (in its role as the lead agency) that just such an analysis is necessary.

EPA's formal comments put the matter well. As EPA explained in comments on a proposal to export LNG from Oregon:

> The 2012 report from the Energy Information Administration states that[] "natural gas markets in the United States balance in response to increased natural gas exports largely through increased production." That report goes on to say that about three-quarters of that increase[d] production would be from shale resources. We believe it is appropriate to consider available information about the extent to which drilling activity might be stimulated

> by the construction of an LNG export facility on the west coast, and any potential environmental effects associated with that drilling expansion.[150]

EPA made a similar point in comments on another, Maryland-based, export facility. It wrote:

> We also recommend expanding the scope of analysis to include indirect effects related to gas drilling and combustion. … Th[e EIA] report also indicated that about three-quarters of that increase[d] production would be from shale gas resources and that domestic natural gas prices could rise by more than 50% if permitted to be exported. We believe it is appropriate to consider the extent to which implementation of the proposed project, combined with implementation of other similar facilities nationally, could increase the demand for domestic natural gas extraction and increase domestic nautral gas prices.[151]

EPA, in short, recognizes that the important national debate needs to be informed by careful environmental analysis. Because this analysis may best be done at the programmatic level, DOE should look at the impacts of export-linked production across the country, before applying this programmatic analysis to informed consideration of particular project proposals. The NEMS system and similar models will help DOE to project national impacts and to regionalize them. As it considers these options, it will need to answer several key questions. These include, but are certainly not limited to, the following:

What is the magnitude and timing of the increased natural gas production associated with a range of export scenarios?

This is the most fundamental question that the NEPA process should answer. The EIA has already developed models linking export to increased production. A NEPA analysis could use this starting point to investigate the magnitude of production needed to support a range of export volumes. This inquiry, on its own, would meaningfully assist decisionmakers. If they know, for instance, that permitting 1 bcf/d of export means that some dozens, hundreds, or thousands, of additional wells will need to be drilled, that consideration should be balanced transparently in the public interest analysis. Again, NEMS should be able to supply this analysis and, indeed, to do so on play-by-play and regional levels, as well as nationally.

What incremental air pollution risk is associated with increased natural gas production generally, and with increased unconventional gas production in particular?

The air pollution impacts of both conventional and unconventional gas production are serious and need to be better understood – especially if exports significantly increase production, as they are likely to do. The DOE can use the NEPA process to better describe these impacts. For instance, the Environmental Protection Agency has developed

[150] Letter from Christine B, Reichgott, EPA Region 10 to FERC (Oct. 29, 2012) at 12.
[151] Letter from Jeffrey D. Lapp, EP Region 3 to FERC (Nov. 15, 2012) at 2.

increasingly accurate emissions figures corresponding to processes through the natural gas production system, from well drilling to gas transport.[152] By estimating the amount production is likely to increase, DOE can evaluate the approximate range of new air pollution likely to be associated with increased production. Likewise, it can assess the likely emissions associated with any upgrades to pipeline transmission networks required to get natural gas to export terminals. DOE can, in other words, forecast whether a given export scenario is likely to be associated with many thousands of tons of additional air pollution, or a more limited amount.

Going further, DOE can predict where this pollution is most likely to occur. Although exported gas can be produced in many places, some natural gas basins are declining or stable, while others – such as those near the Texas Gulf coast and the Marcellus shale of the east coast -- are rapidly growing and are near proposed export terminal sites, reducing transportation costs. DOE can and should forecast the most likely targets for additional development in response to increasing gas demand; these locations are, in turn, the most likely to suffer from increased air pollution and to have to invest in appropriate control efforts. NEMS will it allow it do so.

In short, DOE can map out the air pollution control challenge ahead under various export scenarios. It can also forecast which regions are most likely to have to manage this increased pollution, and some of its likely public health and environmental impacts.

What incremental water pollution risk is associated with increased natural gas production generally, and with increased unconventional gas production in particular?

As with air pollution, water pollution risk increases with increased gas production. Here, too, an overview of pollution risk and response needs with substantially higher production will assist policymakers and the public. Although many other questions should be answered here, two areas of investigation within this general field jump out for investigation at the programmatic level.

First, increased gas production will generate a predictable amount of waste for treatment. Looking at the national scale, a proper EIS would consider the adequacy of treatment available for this increase in wastewater and other substances. Does existing treatment plant capacity correspond to the likely increased volume and can those plants properly treat all pollutants from the industry? Do injection wells appear ready to take up the slack? If not, where is waste likely to go? Before licensing exports, it makes sense to make sure that the nation is ready to handle the waste they leave behind.

Second, water *quantity* issues also deserve a close look. A substantial increase in fracking means a substantial increase in water use. Even though water use varies among gas

[152] *See generally*, EPA, *Regulatory Impact Analysis: Final New Source Performance Standards and Amendments to the National Emissions Standards for Hazardous Air Pollutants for the Oil and Natural Gas Industry* (Apr. 2012).

fields, DOE can calculate a range of water demand likely to be associated with increased gas production. That range will help to determine whether gas export will add substantially to water stress in the nation's gas fields.

DOE's task here, as in the air pollution analysis, will thus generally be to forecast the likely scope of increased threats to water quantity and quality. Because both waste and water can be transported significant distances, this analysis does not depend on knowing precisely which fields will increase their production, but such forecasts will be helpful in assessing the most likely impacts. That said, where DOE can localize these impacts, as NEMS allows, it will be able to provide extremely important information to policymakers working to protect particular watersheds and aquifers.

What degree of land and community disturbance will be associated with increased gas production for export?

A given volume of export will be associated with an approximate number of new wells, well pads, roads, and associated infrastructure. In some gas fields, this infrastructure is already causing serious conflicts and challenges for communities and for wildlife. For instance, DOE might answer questions like these: What acreage of new disturbance is necessary to meet the increased demand for gas? How many new truck trips and how many new miles of pipeline are likely to be necessary? How many people are living in areas likely to see increased production? And how able are the already disrupted communities and ecosystems in the most likely areas for new production to absorb these impacts without excessive damage? This area of inquiry should prompt DOE to think seriously about the degree of landscape transformation that export will drive.

What are the domestic energy and environmental policy implications of export?

As we have discussed above, gas exports will likely raise gas and energy prices. These market shifts have the potential to change the electrical generation mix and also have implications for domestic industry. DOE is already analyzing these economic questions and is beginning to chart their implications. EIA's initial look at shifts in CO_2 emissions from the utility sector is a good example of this analysis. DOE should extend it to consider, at a range of export volumes and timings, what changes in emissions from other sources are likely. If price increases from export, for instance, prompt increased use of highly polluting coal plants, DOE should carefully address the impacts resulting from that shift.

What are the international energy and environmental policy implications of export?

The atmosphere does not respect national boundaries. Accordingly, if LNG exports lead to changes in climate-disrupting pollution – by replacing either cleaner or dirtier energy sources or simply by increasing the load of carbon in the atmosphere – the United States will feel the effects. The country will also experience changes in transboundary transport

of other chemicals and pollutants. To the extent possible, DOE can help forecast these impacts by considering which energy sources LNG is most likely to replace, and the extent of any such replacement.

What alternatives are available to reduce these impacts?

The alternatives analysis is the heart of the EIS. Developing a range of export policies – from permitting all exports, to only a subset of exports; from giving the green light now to waiting until protective regulations are in place – will allow DOE to test these alternatives against their impacts. The EIS should produce a map of possible trade-offs, showing how export decisions affect the environment and which export plans will best protect communities and ecosystems.

With answers to these and other questions in hand, DOE will be far better placed to understand the trade-offs inherent in LNG export and to decide whether export are in the public interest (and, if so, the proper volumes and timing which can best protect the public). This information is, in fact, necessary to properly conclude that process. Moreover, if the NEPA process reveals pressing risks from LNG export, DOE will be able to address them in advance or help other federal or state agencies do so. It will also have contributed to a crucial public conversation on a matter of vital national importance. When and if DOE does license exports, in this future, it will do so with its eyes wide open and will able to develop appropriate mitigation strategies.

Not all of the questions above are easy to answer. Many of them are difficult to address with complete precision, though DOE modeling and publicly available data will provide useful projections and estimates. But residual uncertainty is not a reason to shirk the task. The alternative, after all, is not safe inaction: It is blindly permitting a major change in the nation's energy system, committing to billions of dollars in LNG export infrastructure, and licensing a major increase in fracking activity across the country without any proper analysis. That course should not be undertaken casually. The nation will discover the answers to these questions with or without NEPA compliance, but without NEPA, the answers will come directly from suffering communities and ecosystems. NEPA ensures that decision-makers instead discover them in advance, "at a stage where real environmental protection may come about [rather] than at a stage where corrective action may be so costly as to be impossible."[153]

Forecasts of this sort are thus extraordinarily helpful, even if they are not entirely precise. As the D.C. Circuit Court of Appeals explained in a seminal NEPA case, the statute is designed to help outline crucial questions and answers early on, in order to guide continued decisionmaking and inquiry:

> The agency need not foresee the unforeseeable, but by the same token neither can it avoid drafting an impact statement simply because describing the environmental effects of and alternatives to particular agency action involves some degree of forecasting. And

[153] *Calvert Cliffs*, 449 F.2d at 1129.

> one of the functions of a NEPA statement is to indicate the extent to which environmental effects are essentially unknown. *It must be remembered that the basic thrust of an agency's responsibility under NEPA is to predict the environmental effects of proposed action before the action is taken and those effects are known.*[154]

The point is not that NEPA analysis at this phase will answer every question about export definitively and completely. Instead, "[r]easonable forecasting and speculation is… implicit in NEPA."[155] What DOE can, at a minimum, do now is to map out the fundamental environmental implications of LNG export. It can identify the scope and magnitude of likely impacts, and it can point to key unknowns that warrant more research. It can underline key concerns (such as the availability of treatment capacity to manage the waste associated with increased production for export) and offer alternatives that could address them. It can consider which regions are most likely to bear the costs of export, and where the benefits are most likely to fall. It can offer the sort of well-balanced, comprehensive, projections for which NEPA is designed.

Such an analysis, at an appropriate level of generality, is plainly required. There is absolutely no serious question that increased unconventional gas production is a "reasonably foreseeable" consequence of licensing LNG exports. Export proponents themselves predict such production increases; indeed, they premise their arguments that their projects are in the public interest in large part on the economic growth which they contend will follow from increased gas production.

For instance, Sabine Pass's promoters promised that their project would "play an influential role in contributing to the growth of natural gas production in the U.S."[156] The proponents of the Freeport project, likewise affirmed their project was "positioned to provide the Gulf Coast region and the United States with significant economic benefits by increasing domestic gas production."[157] Likewise, the Lake Charles project's backers maintained that their export would "spur[] the development of new natural gas resources that might not otherwise make their way to market."[158] The Gulf Coast LNG project's supporters asserted that their project will "allow the U.S. to benefit now from the natural gas resources that may not otherwise be produced for many decades, if ever."[159]

The litany goes on: In Oregon, the investors behind the Jordan Cove project assured DOE that it would be "instrumental in providing the increased demand to spur exploration and development of gas shale assets in North America."[160] And in Maryland, the Dominion Cove Point's project's supporters proclaimed that "[t]he most basic benefit of the proposed LNG exports will be to encourage and support increased domestic production of natural gas…. The

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[154] *Scientists' Institute*, 481 F.2d at 1092 (emphasis added).
[155] *Id.*
[156] Sabine Pass Application at 56 (Sept. 7, 2010).
[157] Freeport LNG Application at 14-15 (Dec. 19, 2011).
[158] Lake Charles Application at 20 (May 6, 2011).
[159] Gulf Coast Application at 11 (Jan. 10, 2012).
[160] Jordan Cove Application at 19 (Mar. 23, 2012).

steady new demand associated with LNG exports can spur the development of new natural gas resources that might not otherwise be developed."[161]

The bottom line is that increased domestic gas production is a necessary consequence of export. It is not just foreseeable: It is a principal *justification* for gas export projects. As such, its environmental impacts must be disclosed under NEPA and weighed in the Natural Gas Act public interest determination.[162]

Programmatic analyses of this sort are not unfamiliar to DOE. DOE, in fact, recognizes the importance of the NEPA process as a support for its decisionmaking, and has deep experience with programmatic EISs. Secretary Chu has written that he "cannot overemphasize the importance" of building NEPA compliance into DOE project management.[163] DOE has regularly done so. Over the years, the department has prepared draft and final programmatic EISs and environmental assessments for a nationwide effort to promote energy efficiency,[164] a solar energy promotion program in six western states,[165] energy "corridors" in 11 different states,[166] a global program supporting nuclear power,[167] and a national coal power research and development initiative.[168] Plainly, DOE has had no difficulty developing national-level environmental surveys of large-scale energy decisions, even when the precise location and nature of all site-specific impacts were not yet known. Instead, such broad overviews informed policy. An EIS for LNG export would fit well into this tradition and is certainly entirely possible using DOE's own modeling capacity, as is discussed above.

The courts have made clear, as well, that NEPA requires agencies to take a hard look at the upstream consequences of their decisions. In one recent decision, the Ninth Circuit Court of Appeals rejected the Surface Transportation Board's assertion that, when permitting a new train line serving a coal-producing area, it did not need to consider the coal production the line would doubtless make possible.[169] The agency insisted that such development was not "reasonably foreseeable," even though it relied on the coal production to determine that the train line would be financially viable.[170] The court rightly held that the agency could not permit an infrastructure project justified in large part on increasing fossil fuel production without considering those impacts in a NEPA analysis. The same analysis applies here. LNG export

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[161] Dominion Cove Point Application at 35 (Oct. 3, 2011).

[162] *See also Center for Biological Diversity v. National Highway Traffic and Safety Administration*, 538 F.3d 1172, 1200 (9th Cir. 2008) (where the impact of an agency action is uncertain, agency may not simply given that impact zero weight and fail to address it).

[163] DOE Memorandum, "Improved Decisionmaking Through the Integration of Program and Project Management with [NEPA] Compliance" (June 12, 2012).

[164] *See* DOE, Programmatic Environmental Assessment for the State Energy Conservation Program (1996).

[165] *See* 77 Fed. Reg. 44,267 (July 27, 2012).

[166] *See* 73 Fed. Reg. 72,477 (Nov. 28, 2008).

[167] *See* 73 Fed. Reg. 61,845 (Oct. 17, 2008).

[168] *See* DOE, Final Programmatic Environmental Impact Statement Clean Coal Technology Demonstration Program (1996).

[169] *Northern Plains Resource Council v. Surface Transportation Board*, 668 F.3d 1067, 1081-82 (9th Cir. 2011).

[170] *Id.*

terminals will drive new gas production and, in fact, depend upon that new production to justify their existence.

In the end, it should come as no surprise that DOE's own NEPA regulations provide that large LNG export projects will "normally require EISs."[171] When a project involves either "major operational changes (such as a major increase in the quantity of liquefied natural gas imported or exported)" or the "construction of major new facilities or the significant modification of existing facilities," an EIS is appropriate.[172] These rules, which have been in place since DOE first issued its NEPA regulations,[173] set a clear course for the agency. The applications before it now uniformly involve major increases in the quantity of LNG set for export – by many times over – and also require multi-billion dollar construction projects to create new facilities to support these facilities. An EIS, in these circumstances, is plainly mandated by DOE's own regulations.

C. DOE's National Economic Analyses Demonstrate That It Can Approach Environmental Impacts On A National Level

DOE's abdication of its environmental responsibilities is illegal and unwise. It is unjustifiable based on DOE's own modeling capabilities. It is also strikingly inconsistent with DOE's own approach to the national *economic* implications of LNG export. There, DOE has invested considerable effort in developing a comprehensive general understanding of the economic implications of LNG export, including the impacts of new production. That it can generate such an analysis at a national scale demonstrates that it can pursue the same course for environmental considerations. It should do so to ensure that policymakers and the public have a balanced view of *both* the economic and environmental impacts of exports.

The national economic analysis began, as DOE has explained to Congress, with DOE's realization, after the Sabine Pass conditional approval had issued and more LNG export applications were flooding in, that LNG exports could have real effects on the public interest.[174] DOE did not attempt to avoid grappling with these impacts just because it did not know with complete certainty exactly where production would occur. But, unlike in the environmental context, DOE correctly recognized that such uncertainties were not fatal to a proper national overview.

Instead, DOE immediately and responsibly embarked on two national studies, which were intended to help bring the national economic impacts of export into sharper focus. The first of these was the EIA report discussed above. At DOE's behest, EIA modeled a range of possible export and production scenarios, exploring combinations of different exports rate and timing

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[171] 10 C.F.R. Pt. 1021 App. D to Subpart D, § D8 & D9.
[172] *Id.*
[173] *See* 45 Fed. Reg. 20,694, 20,700 (Mar. 28, 1980).
[174] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey (Feb. 24, 2012) at 3.

and possible variations in gas supply and economic demand.[175] As a result, EIA was able to generate a range of well-supported impact predictions for these varying scenarios. This analysis uncovered important effects for DOE's consideration, including the prospect of sharp domestic gas and electricity price increases with some export scenarios. Rather than allowing uncertainty to defeat the analysis, EIA considered a range of reasonable outcomes to help better inform policy – just as NEPA requires in the environmental context.

The second study will build further on these results. According to DOE, it will look at sixteen different hypothetical export scenarios to investigate:

> (1) [t]he potential impacts of additional natural gas exports on domestic energy, consumption, production, and prices; (2) the cumulative impact on the U.S. economy, including the effect on gross domestic product, job creation balance of trade; and (3) the impact on the U.S. manufacturing sector (especially energy intensive manufacturing industries).[176]

Rather than dismissing this analysis as "impossible" because it involves some degree of uncertainty, DOE sensibly embraced the task of investigating likely national impacts under varying production scenarios. Although there is, of course, some uncertainty as to the precise effects a particular proposal will have on the economy, the major wave of export proposals will have a predictable effect which can be investigated despite uncertainty as to particular production patterns. Indeed, as noted above, export proponents rely upon induced gas production to help justify their projects.

It is thus not at all surprising that DOE felt it to be both possible and necessary to analyze the economic ramifications of these changes. Of course, such an analysis is appropriate. The surprising point, instead, is that DOE nonetheless has blinded itself to the environmental impacts of the very same production increases it is analyzing.

D. DOE Must Look at Environmental Impacts With the Same Rigor With Which It Examines Economic Impacts

This double-vision – with economics in sharp focus and environmental impacts blurred to invisibility – impermissibly skews the choice before DOE. Both economic impacts and environmental costs weigh in the public interest determination. If DOE is only willing to look at one side of the ledger, it cannot properly fulfill its obligations because it cannot understand the all the aspects of the public's interest which are implicated by export. Without a full NEPA analysis, it cannot make a sound final decision.

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[175] *See* EIA, *Effects of Increased Natural Gas Exports on Domestic Energy Markets* at 1-2.

[176] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey at 4.

The courts have made this point clear. Very early in NEPA's history, the Atomic Energy Commission insisted that it could not forecast the environmental impacts of a power plant research program for which it had already developed an economic analysis.[177] The D.C. Circuit Court of Appeals held this position had a "hollow ring" given that the Commission was happy to use its economic analyses in "convincing Congress" to support its plans.[178] As the court held, if economic analyses can be prepared, then "in turn … parallel environmental forecasts would be accurate for use in planning how to cope with and minimize the detrimental effects attendant upon" the course the agency wishes to pursue, "and in evaluating the program's overall desirability."[179] Agencies cannot skew their analyses, or mask the costs of their actions, by examining only one side of a problem while refusing to consider the other.

The Ninth Circuit Court of Appeals corrected the same error in its coal train line case, discussed above. There, too, while insisting that coal mines triggered by a new train line were too speculative to analyze under NEPA, the agency nonetheless "relied on the coal mine development … to justify the financial soundness of the proposal" which it approved.[180] Once again, the court held that an agency may not rely on economic predictions while simultaneously refusing to acknowledge the environmental impacts of the economic activity it is permitting.

The same analysis applies, with great force, to DOE's situation here. The agency has proven willing and able to analyze the economic impacts of LNG export and is in the process of expending considerable funds to improve its forecasting. Further, in individual licensing proceedings, it is clearly open to relying on predictions of increased economic activity from gas production to justify the licensing export. The very same drilling and production forecasts it is now working up in that context could, and should, inform an analysis of the environmental impacts of those decisions. There is nothing inherently harder in saying that ten thousand new wells will produce *x* dollars in tax revenue or *y* tons of pollution than in predicting they will produce *z* new jobs. DOE cannot conduct one analysis while neglecting the other.

DOE cannot embrace sunny economic predictions while ignoring real environmental costs. Such a course is not only contrary to NEPA, but will render the public interest determination process fundamentally unreliable. DOE must tally up the benefits of export, but it must also count the costs.

E. The Need for NEPA

DOE has thus far refused to give any weight to the landscape-level changes large-scale LNG export would produce. This error is serious. Uncorrected, it will distort policy by masking the domestic consequences of export.

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[177] *See Scientists' Institute*, 481 F.2d at 1096-97.
[178] *Id.* at 1097.
[179] *Id.*
[180] *Northern Plains*, 668 F.3d at 1082.

Export proponents would, of course, prefer that these consequences go unremarked. Even as they tout the large increases in fracking that their projects will support, they insist that DOE must not and cannot even begin to account for the environmental consequences of their projects. But even if DOE ignores these impacts, American communities will feel the impacts of this production as exports ramp up. Rather than proceeding blindly while locking in these future harms, NEPA charges DOE with accounting for those impacts now, and the Natural Gas Act makes clear that it must take these harms into account as it considers the public interest.

DOE has the time it needs to do the right thing. It has already committed to Congress not to issue any further export licenses for export to non-free-trade-agreement nations until its second economic study is complete.[181] (Its decision to nonetheless finalize the in-process Sabine Pass license is a disturbing anomaly). DOE has recently announced that this economic study, originally slated for release in spring 2012, will not be released until this coming winter. It is taking the time it needs to gather meaningful economic information. It can and should do the same for environmental information.

There is no statutory deadline to issue licenses, and every reason to ensure that DOE's final decisions are as well-reasoned as possible. LNG export terminals represent billions of dollars in investment capital, and export licenses often last for decades. Before committing to this near-irrevocable investment, DOE owes it to itself and the public to take the time it needs to develop as full and careful analysis as possible.

VI. Preserving DOE's Authority to Protect the Public Interest

DOE must use its authority to prepare a proper EIS for LNG export. But, thanks to ongoing trade negotiations, this is not the only challenge DOE faces in order to protect the public interest. It must also act quickly, in coordination with Congress and the Executive, to ensure that its regulatory ability to protect the public is not inadvertently destroyed.

The problem confronting DOE is an unintended consequence of Congress's 1992 decision to speed LNG imports from Canada. To protect those imports, Congress directed that DOE *must* license LNG imports *and exports* from nations with which the U.S. has signed a free trade agreement providing for national treatment of natural gas.[182] Up to this point, this rubber stamp process has not been at issue, but that may be about to change.

The proposed Trans-Pacific Partnership (TPP) is a massive trade agreement currently under negotiation between the United States and ten other Pacific Rim nations.[183] Its influence could be even broader, however. The TPP is intended to be a "docking station" for new signatories,

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[181] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey at 4.
[182] *See*15 U.S.C. § 717b(c).
[183] *See* http://www.ustr.gov/tpp.

permanently open for expansion, so it could establish an ever-expanding web of countries to which LNG *must* be exported if the market can sustain the demand.

Already, several potential signatories, including Chile and Singapore, are LNG importers and so would be able to take imports from the United States without any public interest oversight. And, critically, there is a very real possibility that Japan may join the talks and the final agreement.[184] Japan is the largest LNG importer in the world.[185]

If Japan is included in the TPP, with national treatment of natural gas, DOE will lose its discretion to condition any exports to Japan on the public interest. Such exports would be automatically licensed. Because Japan has the potential to absorb large amounts of U.S. gas, the loss of DOE's ability to carefully examine the consequences of those exports before licensing them is a serious concern. Regardless of the results of the NEPA analysis we recommend here, or of the economic studies DOE is conducting, exports would be legally mandated.

This result is not what Congress intended when it inserted the free-trade-agreement exception language in 1992. At that time, LNG export from the United States was neither possible nor contemplated. Instead, Congress was focused on removing barriers to natural gas imports from Canada.

The 1992 amendments, in fact, did not even reference export when proposed. Congressman Phil Sharp (D-IN), Chairman of the House Subcommittee on Energy and Power (and H.R. 776's original sponsor) stated that the amendments' purpose was only "deregulating Canadian natural gas imports."[186] Likewise Congressman Norman Lent (R-NY), Ranking Member of the House Committee on Energy and Commerce, explained that the amendments were "vital to assuring that U.S. regulators do not interfere with the importation of natural gas to customers in the United States."[187]Congressman Edward Markey (D-OR), who is a current skeptical voice on export, strongly supported the provisions, describing them as "important new statutory assurances that U.S. regulators will not discriminate against *imported* natural gas."[188]

Language providing for automatic approval of export applications as well as import applications in the free trade context was added in the final conference on the bill, with no recorded debate. The conference report does not justify this discussion, noting only that the final bill "includes an

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[184] *See, e.g.*, Paul McBeth, National Business Review, "Pressure on Japan as Canada joins TPP talks" (June 20, 2012); ICIS Heren, "Japan Warms to U.S. Liquefaction Prospects" (Mar. 12, 2012).
[185] *See* EIA Country Statistics for Japan, http://www.eia.gov/countries/country-data.cfm?fips=JA#ng.
[186] 138 Cong. Rec. 32,075 (Oct. 5, 1992).
[187] 138 Cong. Rec. 32,083 (Oct. 5, 1992)
[188] Extension of Remarks, Cong. Rec. (Oct. 9, 1992), "Concerning Gas Import Provisions in H.R. 776, The Energy Policy Act of 1992) (emphasis added).

amended section… regarding fewer restrictions on certain natural gas imports and exports."[189] Whatever the justification for this expansion, it seems very clear that large-scale LNG exports were not on Congress's mind. The debate to this point had focused on Canadian imports, and, large-scale LNG exports were, in any event, not possible at the time. Indeed, Chairman Sharp described the final amended language as concerning "exports of natural gas *to Canada* from the United States" and affirmed (despite the seemingly open-ended final language) that "as drafted, the new fast task track process would not be available for LNG exports to, for example, Pacific rim nations other than Canada."[190]

At bottom, as DOE explained in a recent letter to Congress, "Congress's attention [in 1992] was focused on North American trade, not on the potential impact of the amendment on United States trade with other countries overseas."[191] Yet, the TPP, and the prospect of other such agreements, threatens to expand this exemption into a wholesale roll-back of DOE's regulatory discretion to protect the public interest. Should this occur, both the careful NEPA process and the public interest determination themselves would be suddenly and inappropriately truncated. In essence, the U.S. would see as much fracking activity as is necessary to support exports for the Asian market, with no direct domestic oversight of these exports.

This serious unintended consequence argues for swift remedial action. Several courses could be available. It may, first, be possible for the U.S. Trade Representative to draft the TPP to include exceptions for national treatment in natural gas, which could preserve DOE's authority. Second, Congress could certainly modify the provision to remove fast track authority for exports. Third, at a minimum, agreements that would remove DOE's discretion to regulate exports certainly should not be concluded until a full environmental impact statement for export has been completed. That report will help policymakers determine how exports should be managed – critically important information for U.S. trade negotiators before they finalize any deal that would commit the nation to exports without any further oversight.

So far, however, DOE has not taken any of these steps, and neither has the U.S. Trade Representative. In meetings and phone conversations with the Sierra Club, the Trade Representative has insisted that DOE, not the Representative, must address the issue. DOE, in turn, has placed responsibility for protecting the public interest review process back on the Trade Representative. The result is that both agencies are pointing fingers at each other, and neither is taking responsibility for addressing this serious matter. Unless they change course,or Congress or the Executive act to insist that they do so, the result may be that the U.S. gives up its ability to manage LNG exports without even thinking about it.

VII. Conclusion: A Full EIS is Needed to Inform Policymakers and the Public

[189] H.R. Conf. Rep. 102-1018, 1992 USCCAN 2472, 2477 (Oct. 5, 1992); *see also* 138 Cong. Rec. 34,043 (Oct.8. 1992) (statement of conferees, explaining only that the final bill "has been expanded to include fewer restrictions on exports of natural gas to countries with which the United States has a Free Trade Agreement.").
[190] 38 Cong. Rec. 32,076 (Oct. 5, 1992) (emphasis added).
[191] Letter from Christopher Smith, Deputy Assistant Secretary of Oil and Gas to Representative Edward Markey (Feb. 24, 2012) at 1.

The United States is sleepwalking through one of the biggest energy policy decisions of our time. Even as billions of dollars in investment capital are marshaled to support an ever-growing wave of export proposals, the federal agencies in charge of protecting the public interest have failed even to consider the environmental implications of exporting a large amount of the domestic gas supply – including the intensified fracking needed to support exports. Meanwhile, trade negotiators risk stripping away DOE's discretion ever to properly manage these problems, even if it does finally analyze and disclose them.

No matter where one stands on the ultimate wisdom of LNG exports, it is clear that this sort of blind, piecemeal, decisionmaking is what NEPA was designed to prevent. For more than 40 years, NEPA has reflected a national commitment to transparent, democratic, and careful decisionmaking to protect communities and our environment. That commitment applies with great force to DOE's decisionmaking now, and the agency should honor it. The possible conversion of the United States into one of the world's largest LNG exporters is a matter of national importance and a key shift in environmental and economic policy. If a full NEPA analysis of all the consequences, upstream and downstream, of an agency's decisions were ever appropriate for any agency action, then an EIS is surely appropriate now, when the nation's energy future is profoundly implicated by DOE's decisions. It is time for a full programmatic environmental impact statement for LNG export.

DOE has the time and the duty to do the right thing and begin the open, public, environmental impact statement process it should have initiated at the outset. It must retreat from its dereliction of duty in the Sabine Pass environmental process, and instead extend its national review process from the economic studies it has already begun to the environmental studies it also plainly needs. Before issuing another license on a piecemeal basis, it should change course, acknowledge its responsibilities, and begin the national conversation we urgently need to have.

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Table 1. Summary of natural gas supply and disposition in the United States, 2007-2012
(billion cubic feet)

Year and Month	Gross Withdrawals	Marketed Production	Extraction Loss[a]	Dry Gas Production[b]	Supplemental Gaseous Fuels[c]	Net Imports	Net Storage Withdrawals[d]	Balancing Item[e]	Consumption[f]
2007 Total	**24,664**	**20,196**	**930**	**19,266**	**63**	**3,785**	**192**	**-203**	**23,104**
2008 Total	**25,636**	**21,112**	**953**	**20,159**	**61**	**3,021**	**34**	**2**	**23,277**
2009 Total	**26,057**	**21,648**	**1,024**	**20,624**	**65**	**2,679**	**-355**	**-103**	**22,910**
2010									
January	R2,210	R1,824	R87	R1,737	5	291	822	R-46	R2,810
February	R2,048	R1,683	R80	R1,603	5	236	628	R9	R2,481
March	R2,277	R1,865	R89	R1,776	5	219	34	R109	R2,143
April	R2,190	R1,813	86	R1,727	5	223	-364	R102	R1,692
May	R2,237	R1,886	90	R1,797	5	212	-416	R19	R1,617
June	R2,139	R1,802	86	R1,717	5	192	-326	R61	R1,650
July	R2,209	R1,896	R90	R1,806	R5	243	-231	R2	R1,826
August	R2,235	R1,918	R91	R1,827	6	221	-190	R16	R1,879
September	R2,238	R1,861	89	R1,772	5	202	-363	R21	R1,637
October	R2,357	R1,956	93	R1,863	6	199	-360	R-42	R1,665
November	R2,277	R1,893	90	R1,802	5	150	77	R-61	R1,973
December	R2,400	R1,984	R95	R1,890	6	217	675	R-73	R2,714
Total	**R26,816**	**R22,382**	**R1,066**	**R21,316**	**65**	**2,604**	**-13**	**R115**	**R24,087**
2011									
January	R2,299	R1,953	92	R1,861	R5	R236	R811	R-31	R2,882
February	R2,104	R1,729	R82	R1,647	R4	R186	R594	R16	R2,448
March	R2,411	R2,002	R95	R1,908	R5	R171	R151	R-3	R2,232
April	R2,350	R1,961	R93	R1,868	5	R151	R-216	R20	R1,828
May	R2,411	R2,031	R96	R1,935	R5	139	R-405	R-10	R1,663
June	R2,313	R1,954	R92	R1,862	5	R147	R-346	R-15	R1,653
July	R2,340	R2,033	R96	R1,937	5	R180	R-248	R3	R1,877
August	R2,370	R2,057	R97	R1,960	5	R169	R-249	R-7	R1,878
September	R2,358	R1,987	R94	R1,893	5	R125	R-404	R27	R1,646
October	R2,502	R2,119	R100	R2,019	5	R173	R-391	R-65	R1,741
November	R2,476	R2,076	R98	R1,978	5	R121	R-41	R-50	R2,014
December	R2,544	R2,135	R101	R2,034	R5	R163	R390	R-69	R2,524
Total	**R28,479**	**R24,036**	**R1,134**	**R22,902**	**R60**	**R1,962**	**R-354**	**R-185**	**R24,385**
2012									
January	R2,573	RE2,149	109	RE2,041	6	R151	545	R8	R2,750
February	R2,378	RE1,989	102	RE1,887	5	R140	459	R10	R2,501
March	R2,537	RE2,123	109	RE2,014	6	124	-39	R19	R2,124
April	R2,445	RE2,065	105	RE1,960	R4	120	-137	R8	R1,956
May	R2,530	RE2,139	108	RE2,031	4	R126	-283	R-8	R1,871
June	R2,420	RE2,061	103	RE1,958	5	134	-230	R0	R1,868
July	R2,456	RE2,137	106	RE2,031	5	162	-134	R7	R2,071
August	R2,372	RE2,128	107	RE2,021	5	R142	-168	R1	R2,001
September	R2,428	RE2,086	109	RE1,978	5	R121	R-291	R-14	R1,798
October	2,571	E2,172	114	E2,058	5	113	-241	-46	1,888
2012 10-Month TD	**24,710**	**E21,051**	**1,073**	**E19,978**	**51**	**1,332**	**-520**	**-14**	**20,827**
2011 10-Month TD	**23,459**	**19,825**	**936**	**18,890**	**50**	**1,677**	**-704**	**-65**	**19,847**
2010 10-Month TD	**22,139**	**18,505**	**882**	**17,623**	**53**	**2,238**	**-765**	**250**	**19,399**

[a] Monthly extraction loss is derived from sample data reported by gas processing plants on Form EIA-816, "*Monthly Natural Gas Liquids Report*," and Form EIA-64A, "*Annual Report of the Origin of Natural Gas Liquids Production*."

[b] Equal to marketed production minus extraction loss.

[c] Supplemental gaseous fuels data are collected only on an annual basis except for the Dakota Gasification Co. coal gasification facility which provides data each month. The ratio of annual supplemental fuels (excluding Dakota Gasification Co.) to the sum of dry gas production, net imports, and net withdrawals from storage is calculated. This ratio is applied to the monthly sum of these three elements. The Dakota Gasification Co. monthly value is added to the result to produce the monthly supplemental fuels estimate.

[d] Monthly and annual data for 2007 through 2010 include underground storage and liquefied natural gas storage. Data for January 2011 forward include underground storage only. See Appendix A, Explanatory Note 5, for discussion of computation procedures.

[e] Represents quantities lost and imbalances in data due to differences among data sources. Net imports and balancing item for 2007-2009 excludes net intransit deliveries. These net intransit deliveries were (in billion cubic feet): 44 for 2011; -9 for 2010; -14 for 2009; -31 for 2008; and -6 for 2007. See Appendix A, Explanatory Note 7, for full discussion.

[f] Consists of pipeline fuel use, lease and plant fuel use, vehicle fuel, and deliveries to consuming sectors as shown in Table 2.

[R] Revised data.

[E] Estimated data.

[RE] Revised estimated data.

Notes: Data for 2007 through 2010 are final. All other data are preliminary unless otherwise indicated. Geographic coverage is the 50 States and the District of Columbia. Totals may not equal sum of components because of independent rounding.

Sources: 2007-2010: Energy Information Administration (EIA), *Natural Gas Annual 2011*. January 2011 through current month: Form EIA-914, "*Monthly Natural Gas Production Report*"; Form EIA-857, "*Monthly Report of Natural Gas Purchases and Deliveries to Consumers*"; Form EIA-191M, "*Monthly Underground Gas Storage Report*"; EIA computations and estimates; and Office of Fossil Energy, "*Natural Gas Imports and Exports*." See Table 7 for detailed source notes for Marketed Production. See Appendix A, Notes 3 and 4, for discussion of computation and estimation procedures and revision policies.

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Before the

Committee on Energy and Natural Resources
United States Senate

The Department of Energy's Role in Liquefied Natural Gas Export Applications

November 8, 2011

Thank you Chairman Bingaman, Ranking Member Murkowski, and members of the Committee; I appreciate the opportunity to be here today to discuss the Department of Energy's (DOE) program regulating the export of natural gas, including liquefied natural gas (LNG).

DOE's Statutory Authority

DOE's authority to regulate the export of natural gas arises under section 3 of the Natural Gas Act, 15 USC 717b, and section 301(b) of the DOE Organization Act, 42 USC 7151. That authority is vested in the Secretary of Energy and has been delegated to the Assistant Secretary for Fossil Energy.

Section 3(a) of the Natural Gas Act sets forth the standard for review of most LNG export applications:

> – [N]o person shall export any natural gas from the United States to a foreign country or import any natural gas from a foreign country without first having secured an order of the [Secretary of Energy] authorizing it to do so. The [Secretary] shall issue such order upon application, unless after opportunity for hearing, [he] finds that the proposed exportation or importation will not be consistent with the public interest. The [Secretary] may by [the Secretary's] order grant such application, in whole or part, with such modification and upon such terms and conditions as the [Secretary] may find necessary or appropriate.

Section 3(a) thus creates a rebuttable presumption that a proposed export of natural gas is in the public interest, and requires DOE to grant an export application unless DOE finds that the record in the proceeding of the application overcomes that presumption. Section 3(a) also authorizes DOE to attach terms or conditions to the order that the Secretary finds are necessary or appropriate to protect the public interest.

In the Energy Policy Act of 1992 (EPAct 92), Congress introduced a new section 3(c) to the Natural Gas Act. Section 3(c) created a different standard of review for applications to export natural gas, including LNG, to those countries with which the United States has in effect a free trade agreement requiring the national treatment for trade in natural gas. Section 3(c) requires such applications to be deemed consistent with the public interest, and requires such applications to be granted without modification or delay.

There are currently 15 countries with which the United States has in place free trade agreements that require national treatment for trade in natural gas. These 15 countries include:

- Australia, Bahrain, Canada, Chile, Dominican Republic, El Salvador, Guatemala, Honduras, Jordan, Mexico, Morocco, Nicaragua, Oman, Peru, and Singapore.

There also are two countries—Israel and Costa Rica—that have free trade agreements with the United States that do not require national treatment for trade in natural gas. Additionally, there are three more countries—South Korea, Colombia, and Panama—that have negotiated free trade agreements with the United States. While these three free trade agreements have recently been ratified by the U.S. Senate, the agreements have not yet taken effect. However, as negotiated, the agreements require national treatment for trade in natural gas, which will have the effect of bringing applications to export LNG to those three countries under section 3(c) of the Natural Gas Act.

Because applications under section 3(c) must be granted without modification or delay and are deemed to be in the public interest, DOE does not conduct a public interest analysis of those applications and cannot condition them by the insertion of terms which otherwise might be considered necessary or appropriate.

For applications requesting authority to export LNG to countries that do not have free trade agreements requiring national treatment for trade in natural gas, DOE conducts a full public

interest review. A wide range of criteria are considered as part of DOE's public interest review process, including:

- Domestic need for the natural gas proposed for export
- Adequacy of domestic natural gas supply
- U.S. energy security
- Impact on the U.S. economy (GDP), consumers, and industry
- Jobs creation
- U.S. balance of trade
- International considerations
- Environmental considerations
- Consistency with DOE's long-standing policy of promoting competition in the marketplace through free negotiation of trade arrangements
- Other issues raised by commenters and/or interveners deemed relevant to the proceeding

DOE's review of applications to export LNG to non-free trade agreement countries is conducted through a publicly transparent process. Upon receipt of an application, DOE issues a notice of the application in the *Federal Register*, posts the application and all subsequent pleadings and orders in the proceeding on its website, and invites interested persons to participate in the proceeding by intervening and/or filing comments or protests. Section 3(a) applicants are typically given an opportunity to respond to any such comments or protests and, after consideration of the evidence that has been introduced into the record, DOE issues an order

either granting the application as requested, granting with additional terms or conditions, or denying the application.

Under the Natural Gas Act, DOE's orders are subject to a rehearing process that can be initiated by any party to a proceeding seeking to challenge DOE's determinations. Court review is available as well after the rehearing process is exhausted.

Recent Developments in LNG Exports

Over the last several years, domestic natural gas production has increased significantly, primarily due to the development of improved drilling technologies, including the ability to produce natural gas trapped in shale gas geologic formations. The most recent data and analysis prepared by the Energy Information Administration (EIA) within DOE shows an increasing volume of shale gas production. Specifically, EIA indicates that domestic gross gas production from shale increased to 3.4 trillion cubic feet (Tcf) in 2009, compared to 2.3 Tcf in 2008.[1] Further, in the Annual Energy Outlook 2011 (AEO 2011), EIA projected that, by 2015, annual dry shale gas production will increase to 7.2 Tcf and, by 2035, to 12.2 Tcf. Natural gas prices have declined and imports of LNG have significantly declined. Recently, the domestic price of natural gas at the Henry Hub for November 2011 delivery was $3.60 per million Btu.[2] International prices of LNG are significantly higher. Due in part to these changing market economics, DOE has begun to receive a growing number of applications to export domestically produced lower-48 natural gas to overseas markets in the form of LNG.

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[1] EIA, *Natural Gas Gross Withdrawals and Production, Release Date: October 29, 2011 http://www.eia.gov/dnav/ng/ng_prod_sum_dcu_NUS_a.htm*

[2] The November 2011 contract price as of October 24, 2011, was $3.60 per million Btu.

Insofar as these applications have involved exports to free trade agreement countries, they are by statute, deemed consistent with the public interest and DOE is required to grant them without modification or delay. To the extent the applications involve non-free trade agreement countries, as I have indicated above, DOE conducts a thorough public interest analysis and attaches terms and conditions which are necessary or appropriate to protect the public interest.

Sabine Pass Liquefaction, LLC

DOE received the first application for long-term (greater than 2 years) authority to export LNG produced in the lower-48 States to non-free trade agreement countries on September 7, 2010, from Sabine Pass Liquefaction, LLC (Sabine Pass), a subsidiary of Cheniere Energy, Inc. This followed on DOE's earlier issuance of authority to Sabine Pass to export a like volume of natural gas to free trade agreement countries on September 7, 2010. A notice of the non-free trade agreement export application was published in the *Federal Register* and the public was provided 60 days to intervene and/or protest the application.

Sabine Pass' non-free trade agreement export application sought authority to export the equivalent of up to 2.2 billion cubic feet per day (Bcf/d) of natural gas, equivalent to about 3.3 percent of current domestic consumption. In its application, Sabine Pass pointed to several economic and public benefits likely to follow on a grant of the requested authorization, including:

- Creation of several thousand temporary and permanent jobs, both through direct and indirect job formation; and

- Improvement in U.S. balance of payments valued at approximately $6.7 billion from LNG exports and the impact of increased production of natural gas liquids.

Additionally, Sabine Pass addressed the question of the domestic need for the gas to be exported; the volume of domestic supplies; and the likely impact of the proposed exports on natural gas prices. To this end, it included with its application several economic and technical reports indicating that any increase in natural gas prices from the proposed exports would be relatively modest and not detrimental to domestic energy security.

Sabine Pass's application was opposed by the Industrial Energy Consumers of America and the American Public Gas Association. Those groups challenged Sabine Pass' claims of economic benefits and no detrimental impact on domestic energy security. However, neither opponent of the application introduced economic or technical studies to support their allegations.

DOE closely analyzed the evidence introduced by the applicant and by those opposing the application. Mindful of the statutory presumption favoring a grant of the application, the agency found that:

- The studies introduced by applicant indicated LNG exports will result in a modest projected increase in domestic market price for natural gas, which reflects the increasing marginal costs of domestic production; and

- The public record supported the conclusion that the requested authorization will yield tangible benefits to the public whereas the allegations of negative impacts submitted by interveners opposing the application were not substantiated on the record. In particular,

the interveners failed to offer any rebuttal studies of natural gas supply, demand and/or price analysis to support their claim the application was not consistent with the public interest.

Following a review of the record in this proceeding, DOE concluded that the opponents of the application had not demonstrated that a grant of the requested authorization would be inconsistent with the public interest, and DOE granted the requested authorization subject to several terms and conditions.

Pending LNG Export Applications

As indicated above, applicants are increasingly seeking authorization from DOE to export domestic supplies of natural gas as LNG to higher priced overseas markets. The Natural Gas Act favors granting applications to export to non-free trade agreement countries unless it can be demonstrated that a proposed export is inconsistent with the public interest. In the case of exports of LNG to free trade agreement countries that require national treatment for trade in natural gas, DOE is without any authority to deny, condition, or otherwise limit such exports.

Mindful of the growing interest in exporting domestically produced LNG, DOE recognized in the Sabine Pass order that the cumulative impact of Sabine Pass and additional future LNG export authorizations could pose a threat to the public interest. DOE stated that it would monitor the cumulative impact and take such action as necessary in future orders.

DOE presently has before it four long-term applications to export lower-48 domestically produced LNG to countries with which the United States does not have a free trade agreement

that requires national treatment for trade in natural gas. The volumes of LNG that could be authorized for export in these non-free trade agreement applications, including the 2.2 Bcf/d authorized for export in Sabine Pass, would total 6.6 Bcf/d, which represents 10 percent of total current domestic natural gas daily consumption in the United States. Consistent with the Natural Gas Act, DOE already has granted authorization from these five facilities to export this same volume to free trade agreement countries.

In order to address the potential cumulative impact of a grant of the pending applications, DOE has commissioned two studies: one by the EIA and the other by a private contractor. Taken together, these studies will address the impacts of additional natural gas exports on domestic energy consumption, production, and prices, as well as the cumulative impact on the U.S. economy, including the effect on gross domestic product, jobs creation, and balance of trade, among other factors. We anticipate that these studies will be completed in the first quarter of calendar year 2012. In this regard, we are mindful of the need for prompt action in each of the proceedings before us. However, we believe that a sound evidentiary record is essential in order to proceed to a decision and that the studies being undertaken are important elements of such a record.

Conclusion

I am happy to answer any questions that you may have.

Synapse
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Will LNG Exports Benefit the United States Economy?

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Appendix A 20

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 Gains[3]

Scenario	Exports as Percent of GDP Gains					
	2015	2020	2025	2030	2035	average
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.

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[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					
	2015	2020	2025	2030	2035	average
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 liquefactions 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]

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[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]

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[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

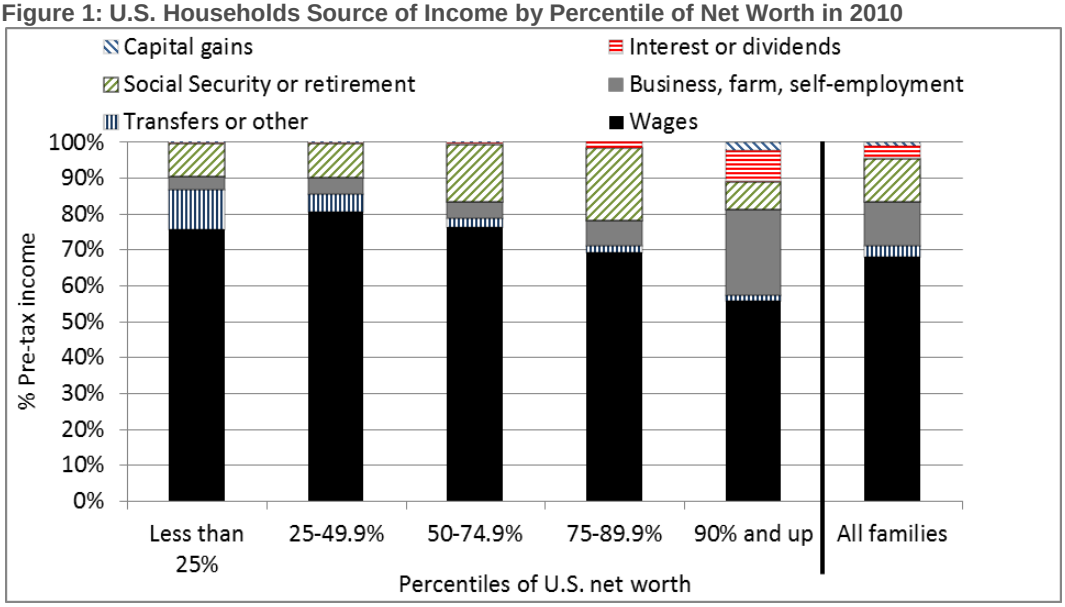
There is no evidence to support NERA's implication that the benefits of stock ownership are broadly shared among U.S. families across the economic spectrum—and therefore no evidence that they will "participate" in benefits secured by LNG exports.

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,

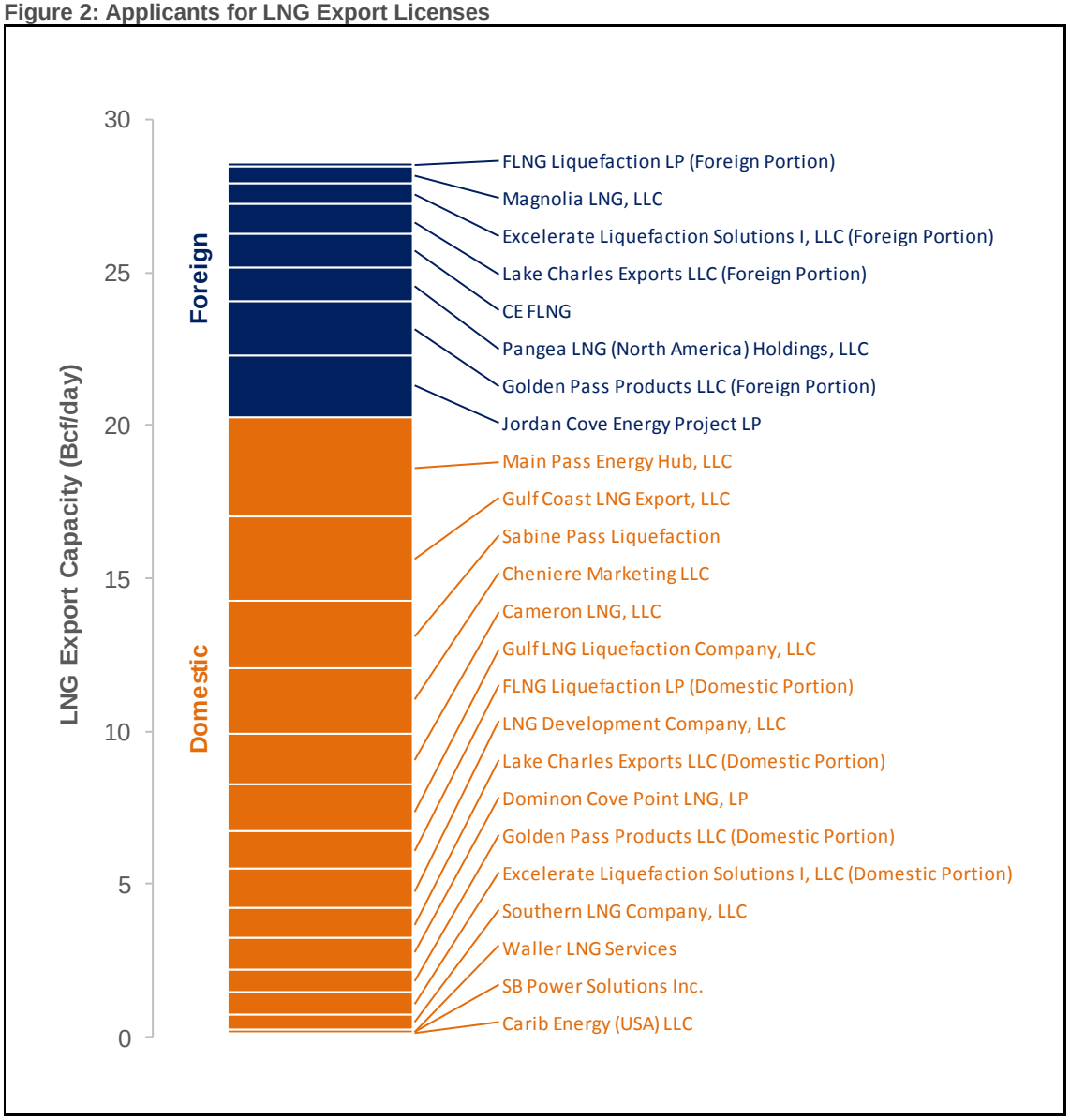
[20] NYSE companies involved in LNG export applications account for 5.8 percent of the total market capitalization, but this includes the value of shares from Exxon Mobil—by itself 2.9 percent of the NYSE market cap—as well as several other corporations with diverse business interests, such as General 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 published[33]

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
[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 Liquafaction 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_archoldings.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/snapshot.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	p. 2 of 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

Foreign Invested:

- **Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC (1.4 Bcf/d)**
  - Freeport LNG Expansion, LP, (FLNG) is a Delaware limited partnership and a wholly owned subsidiary of Freeport LNG Development, LP. FLNG Liquefaction is a Delaware limited liability company and a wholly owned subsidiary of FLNG Expansion. The principal place of business for both is TX.
    - FLNG Development is a Delaware limited partnership with 4 limited partners: (1) Freeport LNG investments, LLLP, a Delaware limited liability limited partnership, which owns a 20% limited partnership interest in FLNG Development; (2) ZHA FLNG Purchaser LLC, a Delaware limited liability company and wholly owned subsidiary of Zachary American Infrastructure, LLC which owns a 55% limited partnership interest in FLNG Development; (3) Texas LNG Holdings LLC, a Delaware limited liability company and wholly owned subsidiary of The Dow Chemical Company, which owns a 15% limited partnership interest in FLNG Development; and (4) Turbo LNG, LLC, a Delaware limited liability company and wholly owned subsidiary of Osaka Gas Co., Ltd. (Japanese gas company traded on the Tokyo Stock Exchange), which owns a 10% limited partnership interest in FLNG Development.
    - In addition to the limited partners, FLNG Development has one general partner that manages the company, Freeport LNG-GP, Inc., a Delaware corporation, which is owned 50% by an individual, Michael S. Smith, and 50% by ConocoPhillips Company.
  - **http://www.freeportlng.com/ownership.asp**

- **Lake Charles Exports, LLC (2.0 Bcf/d)**

  Lake Charles Exports, LLC, is a jointly-owned subsidiary of Southern Union Company (NYSE: SUG) and BG Group.
  - Southern Union Group: Headquartered in Houston, a subsidiary of ETP Holdco.
  - BG Group: Headquartered in the UK. BG Group is a publicly listed company on the London Stock Exchange and is also listed on the US over-the-counter market known as "International OTCQX".
  - http://www.energytransfer.com/ownership_overview.aspx
  - http://www.bg-group.com/AboutBG/Profile/Pages/BGProfile.aspx

- **Jordan Cove Energy Project, L.P. (1.2 Bcf/d: FTA; 0.8 Bcf/d: non-FTA)**
  - Jordan Cove Energy Project is being developed by Veresen Inc.(formerly Fort Chicago Energy L.P.)
    - Veresen is a Calgary, Alberta based company listed on the Toronto Stock Exchange (TSE: VSN) active in the energy infrastructure investment sector.
  - http://www.jordancoveenergy.com/about.htm

- **Golden Pass Products LLC (2.6 Bcf/d)**
  - Golden Pass Products, is a partnership of foreign state owned Qatar Petroleum International (70%) and ExxonMobil affiliates (30%).
  - http://goldenpassproducts.com/

- **CE FLNG, LLC (1.07 Bcf/d)**
  - CE FLNG is a subsidiary of Cambridge Energy Holdings, LCC (CEH) which is owned by Cambridge Energy Group Limited (CEGL). CE FLNG's affiliate Cambridge Energy, LCC (CE) is a marketer of natural gas.
  - Cambridge Energy Group Limited (CEGL) is a Bermuda-incorporated energy company listed on the Bermuda Stock Exchange (BSX) at CEGL.
  - http://www.bsx.com/CompanyDisplay.asp?CompanyID=1099937826

- **Pangea LNG (North America) Holdings, LLC (1.09 Bcf/d)**
  - The exact legal name of Pangea is Pangea LNG (North America) Holdings, LLC. Pangea is a wholly owned subsidiary of Pangea LNG B.V., a Netherlands-based company that is developing floating LNG liquefaction and storage solutions around the globe. Pangea LNG B.V.'s ordinary shares are owned by DSME (70%), D&H Solutions AS (20%) and NextDecade International Coöperatief U.A. ("NextDecade International") (10%).
  - DSME is a South Korea-based company whose major shareholders consist of Korea Development Bank (31.27%) and Korea Asset Management Corporation (19.11%), with the remaining shares being widely-held (with no individual entities holding five (5) percent or more of DSME's shares). Treasury shares comprise 1.2% of the total shares of DSME. D&H Solutions AS is a Norwegian-based joint venture company that is owned by Hemla II AS (50%) and DSME (50%). NextDecade International is a Netherlands based cooperative and has six (6) individual investors from the United States, Spain and The Netherlands.
  - Consistent with an executed Letter of Intent, Pangea is working closely with Statoil North America, Inc. ("Statoil") on the development of the ST LNG Project. Statoil North America, Inc. operates as a holding company. The company, through its subsidiaries, engages in the exploration and development of oil and gas deposits in the Gulf of Mexico. It offers crude oil, petrol, propane, and butane. The company was incorporated in 1987 and is based in Stamford, Connecticut. Statoil North America, Inc. operates as a subsidiary of Statoil ASA.
  - Statoil ASA (NYSE: STO) , trading as Statoil and formerly known as StatoilHydro, is a Norwegian oil and gas company. The Government of Norway is the largest shareholder in Statoil with 67% of the shares.
  - Statoil and Pangea are in active negotiations with respect to Statoil North America procuring up to a 50% equity stake in the ST LNG Project and utilizing up to 50% of the liquefaction and export capacity of the ST LNG Project.

- http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_174_lng.pdf
- http://en.wikipedia.org/wiki/Statoil
- http://www.nyse.com/listed/sto.html

- **Magnolia LNG, LLC (0.54 Bcf/d)**
  - Magnolia LNG, LLC, a limited liability company organized under the laws of Delaware, and a wholly owned indirect subsidiary of Liquefied Natural Gas Limited ("LNG Limited"). Magnolia LNG's principal place of business is in Perth Western Australia. LNG Limited is a publicly listed Australian company with the objective of identifying and developing LNG projects in Australia and overseas.
  - http://www.lnglimited.com.au/IRM/Company/ShowPage.aspx/PDFs/1815-78684834/PositionSecuredintheDynamicUSALNGMarket
  - http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_183_lng.pdf

Domestically Owned:

- **Sabine Pass Liquefaction, LLC (2.2 Bcf/d)**
  - Sabine Pass Liquefaction LLC is a subsidiary under Cheniere Energy Partners, L.P.
  - Cheniere Energy Partners, L.P (NYSE: CQP) is a Delaware limited partnership formed by Cheniere Energy, Inc. Through its wholly owned subsidiary, Sabine Pass LNG, Cheniere LP owns and operates the Sabine Pass LNG receiving terminal.
  - Cheniere Energy, Inc. (NYSE Amex Equities: LNG), a Delaware corporation, is a Houston-based energy company primarily engaged in LNG-related businesses. Owns and operates the Sabine Pass LNG receiving terminal in Louisiana through its 89.3% ownership interest in and management agreements with Cheniere Energy Partners, L.P. (NYSE: CQP), which is a publicly traded partnership created in 2007.
  - References: http://www.cheniereenergypartners.com/liquefaction_project/liquefaction_project.shtml
  - http://www.cheniere.com/corporate/about_us.shtml

- **Carib Energy (USA) LLC (0.03 Bcf/d: FTA; 0.01 Bcf/d: non-FTA)**
  - Carib is a Delaware limited liability company, with principal base of business in Coral Springs, Florida. Stock in Carib is held equally by Everything for Gas International LLC d/b/a EFG Industries, a Florida limited liability company based in Coral Springs, Florida, and Argosy Transportation Group, Inc., a Texas limited liability company based in Bellaire Texas.
  - http://www.fossil.energy.gov/programs/gasregulation/authorizations/2011_applications/11_141_lng.pdf

- **Dominion Cove Point LNG, LP (1.0 Bcf/d)**
    - DCP is a limited partnership organized in Delaware with its principal place of business in MD and VA. DCP currently owns the Cove Point LNG Terminal. DCP is a subsidiary of Dominion Resources, Inc., one of the nation's largest producers and transporters of energy. Dominion Resources, Inc. is a publically traded company organized in VA and traded on the NYSE with ticker D.
    - **http://www.fossil.energy.gov/programs/gasregulation/authorizations/2011_applications/11_115_lng.pdf**

- **Cameron LNG, LLC (1.7 Bcf/d)**
    - Affiliate of Sempra LNG, subsidiary of Sempra Energy, (NYSE: SRE), an American natural gas utilities holding company based in San Diego, California.
    - http://cameron.sempralng.com/

- **Gulf Coast LNG Export, LLC (2.8 Bcf/d)**
    - Gulf Coast LNG Export, LLC is a Delaware limited liability company. 97% of Gulf Coast stock is owned by Michael Smith, an individual. The Kaily Morgan Smith Irrevocable Trust and the Tara Marielle Smith Irrevocable Trust each own 1.5%. Mr. Smith is the founder and former Chairman and CEO of Basin Exploration Company. Mr. Smith is also the founder and current Chairman and CEO of Freeport LNG Development, LP.
    - http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_05_lng.pdf

- **Gulf LNG Liquefaction Company, LLC (1.5 Bcf/d)**
    - GLLC is a wholly owned subsidiary of Gulf LNG Holdings Group, LLC ("Gulf LNG Holdings"). El Paso LLC (acquired by U.S. publically owned Kinder Morgan , NYSE: KMI), through its directly-owned subsidiary, Southern Gulf LNG Company, LLC, owns a 50% interest in Gulf LNG Holdings.
    - GE Energy Financial Services, a unit of GE (U.S. public, NYSE: GE), directly and indirectly owns a (46%) interest in Gulf LNG Holdings. Other investors, including, Atlas Energy, LP (a publicly traded master limited partnership NYSE: ATLS), Magnetar Capital (private company headquartered in IL), Tortoise Capital Resources Corp. (publically traded at the NYSE under TTO, changed to CORR in 12/2012) and Triangle Peak Partners Private Equity, LP, as well as funds and accounts under management by BlackRock Investment Management, LLC, (publically traded as NYSE: BLK) indirectly own the remaining four percent interest of Gulf LNG Holdings.
    - http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_47_lng.pdf
    - http://www.atlasenergy.com/about-atlas-energy/
    - http://www.tortoiseadvisors.com/tto.cfm

- **LNG Development Company, LLC (d/b/a Oregon LNG) (1.25 Bcf/d)**
    - Oregon LNG has its principal place of business in Warrenton, Oregon and is headquartered in Vancouver, Washington.
    - http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_48_lng.pdf
    - http://www.oregonlng.com/index.php

- **SB Power Solutions Inc. (0.07 Bcf/d)**
    - SPS is a Delaware corporation with its principal base of business in Merriam, Kansas. Stock in SPS is held wholly by Seaboard Corporation, a corporation incorporated in the State of Delaware.
    - http://www.fossil.energy.gov/programs/gasregulation/authorizations/Orders_Issued_2012/ord3105.pdf

- **Southern LNG Company, L.L.C (0.5 Bcf/d)**
    - SLNG is a wholly owned subsidiary of El Paso Pipeline Partners Operating Company, LLC. El Paso Pipeline Partners Operating Company, LLC is a wholly owned subsidiary of El Paso Pipeline Partners, LP (EPB). EPB is a Delaware master limited partnership publically traded on the NYSE as EPB. El Paso Pipeline Partners is a Kinder Morgan Company (NYSE: KMI).
    - http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_54_lng.pdf
    - http://www.eppipelinepartners.com/

- **Excelerate Liquefaction Solutions I, LLC (1.38 Bcf/d)**
    - Excelerate Liquefaction Solutions I, LLC, is a limited liability company organized under the laws of Delaware and a wholly-owned subsidiary of Excelerate Liquefaction Solutions, LLC. Principal place of business of ELS is TX.

- **Cheniere Marketing, LLC (2.1 Bcf/d)**
    - Cheniere Marketing, LLC is an indirect subsidiary of Cheniere Energy, Inc. and is affiliated with the developers of the CCL Project. Cheniere Energy, Inc. (NYSE Amex Equities: LNG), a Delaware corporation, is a Houston-based energy company primarily engaged in LNG-related businesses.

- **Main Pass Energy Hub, LLC (3.22 Bcf/d)**
    - Main Pass Energy Hub, LLC is jointly owned (50%) by New Orleans, LA based Freeport-McMoRan Energy, LLC (FME) a subsidiary of McMoRan Exploration Co. (NYSE: MMR) and (50%) by Houston, TX based United LNG, LP (ULNG).
    - http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_114_lng1.pdf

- http://www.unitedlng.com/mpeh-llc/

- **Waller LNG Services, LLC (0.16 Bcf/d)**
  - Waller LNG Services, LLC is doing business as Waller Point LNG. Waller Point LNG is a limited liability company formed under the laws of TX and authorized to transact business in Louisiana. Waller Point LNG is a wholly owned subsidiary of Waller Energy Holdings, LLC, a TX limited liability company. Waller Energy Holdings, LLC is a wholly owned subsidiary of Waller Liquefaction, L.P, a TX limited partnership, of which the General Partner is Waller LNG GP, LLC, a TX limited liability company wholly owned by Waller Marine, Inc., a TX corporation. Waller Marine is a developer of LNG terminals and LNG storage and transportation vessels, and is the developer of the Waller Point LNG Terminal. Waller Point LNG is authorized to do business in the States of TX and LA.
  - http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_applications/12_152_lng.pdf
  - http://www.wallermarine.com/index.php

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Article

*1 RISK EQUITY: A NEW PROPOSAL

Matthew D. Adler [FNa1]

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Introduction

How does distributive justice--for short, "equity"--bear on the regulation of health and safety risks? And what are the analytical tools that risk regulators should use to incorporate equity concerns into their decisionmaking? This Article proposes an answer to these vital questions which is novel, but also firmly grounded in the social-welfare-function tradition in welfare economics. The distributive impacts of risk regulation policies should be evaluated with reference to a social welfare function, with the status quo and each possible policy conceptualized as a probability distribution across population profiles consisting of lifetime income-health-longevity histories for each member of the population.

No clear paradigm for equity analysis has yet emerged in governmental practice. The contrast with risk assessment and cost-benefit analysis is stark. Highly sophisticated procedures for risk assessment and cost-benefit analysis currently exist. These procedures are employed by regulators, carefully ***2** monitored by oversight bodies, and supported by large bodies of scholarly work. ~~[FN1]~~ Equity analysis, on the other hand, is inchoate and haphazard. ~~Executive Order 12,866~~, the chief legal instrument governing agency policy analysis, states that agency regulations should maximize net benefits and then proceeds to explain that

benefits include "distributive impacts" and "equity." [FN2] But the net-benefits-maximization test of traditional cost-benefit analysis is insensitive to distributional considerations. Executive Order 12,866 provides no guidance about the meaning of "distributive impacts" and "equity," nor about how these considerations should be incorporated into cost-benefit analysis. The Office of Management and Budget ("OMB") guidance document regarding compliance with Executive Order 12,866 is lengthy and, on many issues, quite specific. When it comes to distributive analysis, however, the OMB guidance is brief and vague. [FN3]

Equity considerations are more specifically discussed by a different presidential directive. Executive Order 12,898, the Environmental Justice order, states that: "[t]o the greatest extent practicable and permitted by law, . . . each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States." [FN4] This order adopts a particular conception of risk equity: namely, a social-gradient conception of equity, which sees an inequitable policy as one whose impacts on socially disadvantaged groups are less favorable than its impacts on socially advantaged groups. Further, Executive Order 12,898 is quite specific in identifying low-income and minority status as the relevant markers of social disadvantage. [FN5]

However, techniques for implementing an environmental justice/social gradient conception of risk equity in agency decisionmaking remain unsettled. The scholarly literature on environmental justice, which is now quite substantial, has focused on testing factual hypotheses about whether waste dumps, hazardous waste processors, sources of air pollution, or other risk ***3** sources tend to be located in minority or low-income areas, and whether such skews are caused by racial or socioeconomic bias. [FN6] Less work has been done creating tools to measure the degree of inequality between members of advantaged and disadvantaged groups with respect to the effects of health and safety hazards, and for measuring the equity impact of policies that mitigate these hazards. [FN7] EPA, the largest of the federal agencies that regulate health and safety risks, and generally the most advanced in the development of policy tools, has given some attention to implementing environmental justice. There is an environmental justice office within EPA, and a number of guidance documents and letters have been issued. [FN8] Yet environmental justice analysis still plays a very small role within EPA decisionmaking--as compared to cost-benefit analysis, let alone risk assessment, which is pervasive. [FN9] Nor has the agency resolved upon a set of concrete procedures and metrics for structuring the analysis. [FN10]

***4** Academic scholarship about risk equity has also failed to advance very far. An important exception, already mentioned, is the literature on environmental justice. The social-gradient model, developed in that literature, does provide a relatively clear conception of distributive justice. However, as I shall argue below, the conception is a problematic one. Relatively little academic work has been done to develop and make workable competing conceptions of risk equity. At least in the United States, neither economists nor the toxicologists and other scholars who write about risk assessment have done so to any substantial degree.

Health economists abroad, particularly in Britain, have discussed the possible use of equity weights in QALY-based policy analysis. [FN11] This work has had no influence on U.S. governmental bodies, and appears to have had little influence on academic economists in the United States. Economists in this country have done some work quantifying the "incidence" of the costs of environmental policies on different groups, and have also written about the possible use of "distributional weights" within cost-benefit analysis. [FN12] But the volume of economic writing on these equity matters is fairly small compared to the vast U.S. literature on cost-benefit analysis. Finally, some scholarship within risk assessment does address equity issues, in particular suggesting that regulatory attention to "individual risk" rather than population risk (total deaths) is required by equity. [FN13] However, scholarship of this sort represents a small fraction of the corpus of work produced by risk assessment scholars, and has not succeeded in producing an influential conception of equity.

The inattention to risk equity by U.S. economists may reflect the old and still lingering view that welfare economics becomes

subjective and inappropriately value-laden once it goes beyond endorsing Pareto-efficiency. The risk assessors' inattention may reflect their self-understanding as scientists who make no normative claims whatsoever. Whatever the cause, risk equity as a topic of scholarly discourse remains something of a vacuum.

This Article is intended to help fill that vacuum by advancing a new conception of risk equity. I suggest that health and safety agencies might evaluate the equity impacts of their policies by applying a variety of plausible utility functions and equity-regarding social welfare functions ("SWFs"), with the recognition that health, longevity and income are all important determinants of individual well-being, and the understanding that both the status quo and any given policy have an uncertain effect on individuals' longevity, health, and income. The status quo should be understood as a probability distribution across population profiles, each consisting of a lifetime health and income history for each member of the population. A policy ***5** would perturb this distribution and lead to a different set of probabilities for possible profiles. A utility function assigns a lifetime utility to each individual's longevity-health-income history. With this utility function in hand, the equity analyst can convert each population profile of individual longevity-health-income histories into a population profile of individual lifetime utilities. The status quo, and each policy, become probabilistic packages of population utility profiles. Plausible SWFs are then applied to these packages.

I will call this conception of risk-equity analysis "probabilistic population profile analysis" ("PPPA"). This conception is firmly grounded in the notion of an SWF: a construct that has been developed within a branch of welfare economics which is comfortable making normative claims about equity, and that has been mainly applied to questions of optimal tax policy. The contribution of this Article is to explain how the SWF notion might be operationalized in the domain of risk regulation, through PPPA, and to defend that approach as feasible (at least in the foreseeable future) and normatively attractive.

Part I of the Article criticizes existing approaches to risk equity: the environmental-justice or social-gradient paradigm; the notion that equity concerns the distribution of individual risks; QALY-based analysis with equity weights; incidence analysis; "inclusive" equality measurement; and cost-benefit analysis with distributional weights.

Part II defends the PPPA approach. I summarize the notion of an equity-regarding SWF, which grounds the approach. I then describe PPPA in detail and argue that the approach is foreseeably, if not immediately, feasible. Techniques would need to be developed to predict the impact of policies on each individual's lifetime "holdings" of both income and health/longevity. However, such techniques represent an incremental, not radical, extension of existing risk assessment and incidence analysis methodologies. Optimal tax scholarship has already provided a range of plausible SWFs. In particular, PPPA should rely on the so-called Atkinsonian family of SWFs, as well as the rank-weighted SWF, in analyzing risk policies.

Existing scholarly literatures do not contain the information needed to calibrate the utility function that would map individuals' longevity-health-income histories onto utility numbers--the utility numbers that are the arguments for the SWF. This gap can and should be filled through survey research. Until such research takes place, one possibility is to ignore health as a component of utility, and to employ the "constant relative risk aversion" utility function to attach utilities to life histories (now understood as lifetime income sequences). The constant relative risk aversion functional form has been extensively studied by economists, and estimates of the coefficient of relative risk aversion are available. Another possibility is to assume that lifetime utility as a function of health and income is additive across periods and multiplicative within periods, i.e., takes the form of

TABULAR OR GRAPHIC MATERIAL SET FORTH AT THIS POINT IS NOT DISPLAYABLE

***6** where $h_{i,t}$ is individual i's health in period t, $y_{i,t}$ is her income in period t, and $q(h_{i,t})$ and $v(y_{i,t})$ are "subutility" functions measuring the value of health and income, respectively, in each period. ~~[FN14]~~ It could then be assumed that $v(y_{i,t})$ takes the constant relative risk aversion form. Existing data about individual willingness-to-pay and willingness-to-accept for health could

be used to estimate the within-period health function $q(h_{i,t})$.

PPPA represents a social-welfare-function approach to equity analysis that is quite general and can extend beyond risk regulation--for example, to estimate the equity impacts of tax-and-transfer policies, or of spending to fund public goods. But decision-cost and measurement considerations mean that the general approach will be developed differently in different areas. For example, in the case of a policy that funds or defunds national parks, it would be crucial to include individuals' recreational activities as a determinant of their utilities. In the case of risk regulation, where the main effects on individual well-being occur via changes in health, longevity, and income, recreational activities as an input to individual utility, and therewith the SWF, can (plausibly) be ignored. The Article therefore focuses on risk regulation and risk equity, elaborating the application of a social-welfare-function approach to that particular policy domain in the form of PPPA.

I. Existing Approaches to Risk Equity

A. Environmental Justice

~~Executive Order 12,898~~, as well as much of the scholarly writing under the heading of environmental justice, adopts a social-gradient conception of risk equity. ~~[FN15]~~ A policy implicates environmental justice insofar as it has a disproportionately negative impact on certain socially disadvantaged groups. The policy (1) imposes costs on at least some group members; and (2) those costs are disproportionately larger than the costs it imposes on non-members. ~~[FN16]~~

***7** In focusing on disadvantaged groups and disparate impact, this social-gradient conception of risk equity is similar to the view that the Equal Protection Clause of the U.S. Constitution proscribes laws that have a disparate impact on racial minorities--a view which the Supreme Court has not incorporated into its justiciable doctrines enforcing that Clause, ~~[FN17]~~ but is arguably reflected in employment discrimination statutes. ~~[FN18]~~ The social-gradient conception is also adopted in much of the literature on health equity. ~~[FN19]~~ Environmental justice scholars typically focus their attention on toxic hazards or environmental disamenities, while the health equity literature typically concerns social skews in health generally or in health care. But these two literatures share, as their basic normative concern, the principle that members of socially disadvantaged groups ought not to fare especially badly with respect to health or longevity.

A fundamental difficulty with the environmental justice/social gradient approach is that it overlooks inequalities among individuals who are not members of the groups counted as socially disadvantaged. Consider the framework of ~~Executive Order 12,898~~, which enjoins agencies to address disproportionately high health effects on minority populations and low-income populations. Under this framework, the distribution of health and longevity among non-impoverished white individuals--those who fall into neither of the two categories highlighted by the Executive Order--is not seen as an equity concern.

For example, a deregulatory policy that raises air pollutant levels might increase death and morbidity among individuals with respiratory diseases, including some individuals who are neither racial minorities nor have low incomes. Another example: permitting a dangerous product might cause some children to die, including some non-impoverished white children. These look like potential inequities, simply by virtue of the impact of the policies within the subpopulation of non-impoverished white individuals, and quite apart from their effect on poor individuals or racial minorities.

***8** This is not to say that a policy's impact on poor individuals or racial minorities is not an equity concern. Of course it is. It is rather to say that there is an additional equity concern in these examples, which ~~Executive Order 12,898~~--framed in terms of disparate impact on minority and low-income groups--does not capture. In the pollution example, some non-impoverished whites have the further advantage of good health; others in this group do benefit from being white and having adequate incomes, but have the misfortune to suffer chronic diseases. The gap between their well-being and that of their luckier counterparts is increased by the deregulatory policy. Similarly, in the dangerous product example, some non-impoverished whites have the further advantage of living a full lifespan while others suffer the misfortune of premature death. Permitting the dangerous product has the effect of expanding the size of this unfortunate group.

The objection might be framed as follows. There are various measurable dimensions of well-being, from D_1 to D_K. The benefit of being white in a society with a history of oppression of non-whites is one such "dimension." So is income. So is health. So is longevity. The disparate-impact analysis set forth by ~~Executive Order 12,898~~ focuses on a subset of these dimensions, D_1 to D_J, where $J<K$. That analysis takes a dimension D_i within the subset and asks whether a hazard increases skews in well-being or aspects of well-being between those who are at a high level with respect to D_i and those who are at a low level. What this approach ignores are inequalities among those individuals who are all at a reasonably high level for each D_i with $i <= J$, but some of whom are at a low level for some D_i with $i > J$.

The environmental justice theorist has two possible responses to this objection. The first is to expand the set of dimensions along which policy skews are measured. We might say that a policy triggers environmental justice concerns if it has a disparate impact on racial minorities, low-income groups, or women, disabled individuals, those in poor health, children, or the aged. Indeed, some of the scholarly literature pushes in this direction. ~~[FN20]~~ The problem here is how to aggregate a policy's equity effects along these multiple dimensions to arrive at an overall equity evaluation of the project. Imagine that we have some measure, S, of disparate impact. (The existing literature on health equity offers a variety of proposals as to what S might be.) ~~[FN21]~~ A policy might have a high S score with respect to D_1, a low S score with respect to D_2, and so forth. That is to say, it might impose costs on individuals with low D_1 levels that tend to be much greater, in absolute or proportional terms, than its costs for individuals with higher D_1 levels; but also impose costs on individuals with low D_2 levels that tend to be the same or even lower (in absolute or proportional terms) than its costs for individuals with higher D_2 levels. The policy has a highly disparate impact along the ***9** D_1 axis, but a zero or reverse disparate impact along the D_2 axis--and so forth for axes D_3 through D_K.

If all the measurable dimensions of well-being are included as potential axes for disparate impact, the straightforward answer to this inter-axis aggregation problem is to move away from dimension-specific disparate-impact measures to a single population-wide measure of inequality. Since a skew in well-being or aspects of well-being between those at a low and those at a high level with respect to any one of the D_i raises a distributive concern, why not ask how each individual fares, all things considered, as a consequence of her various attainments along the various dimensions D_1 through D_K; and then apply some metric of inequality to the population distribution of these overall attainments? The environmental-justice approach thereby morphs into the PPPA approach.

But the environmental justice theorist need not be led down this path. Instead, she might insist that the attributes highlighted by ~~Executive Order 12,898~~ are distinctive. Being a racial minority, or lacking an adequate income, are not merely determinants of well-being. These characteristics are socially salient and have a particular social function that renders them uniquely important as a matter of distributive justice. As Paula Braveman, a leading health-equity scholar, and a co-author explain:

> [e]quity in health . . . [is] the absence of systematic disparities in health . . . between social groups who have different levels of social advantage/disadvantage--that is, different positions in a social hierarchy.

. . . .

Underlying social advantage or disadvantage refers to wealth, power, and/or prestige--that is, the attributes that define how people are grouped in social hierarchies. [FN22]

Being black or low-income is socially disadvantaging; these characteristics lower social status. And, in Braveman's view, it is health disparities between high-social-status and lower-social-status individuals that health-equity measures should seek to capture. [FN23]

Perhaps the fullest elaboration and defense of this view is provided by the philosopher Iris Marion Young. She argues that "claims about social justice that invoke equality usually require comparison of groups on measures of well-being or advantage . . . . Assessment of inequality in terms of the comparison of individuals yields little basis for judging injustice." [FN24] Young's argument rests on two premises about the connection between distributive justice and inequality. The first is that unjust inequalities involve ***10** an absence of choice and responsibility on the part of the worse-off individuals. "If the causes of an inequality lie in the uncoerced and considered decisions and preferences of the less well-off persons, for example, then the inequality is probably not unjust." [FN25] The second premise is that inequalities which are not socially caused are also not unjust, or at least not as seriously unjust as socially caused inequalities. "To the extent that injustices are socially caused, . . . [the correct] conception of justice claims that democratic political communities are responsible collectively for remedying such inequalities, perhaps more than they are obliged to remedy the effects of so-called 'brute luck.'" [FN26] These two premises lead Young to conclude that an inequality must be a "structural inequality"--a difference in well-being or advantage as a result of social hierarchy--to be a central concern of distributive justice. Such differences are, clearly, both socially caused and not the responsibility of the low-status individuals.

> Structural inequality . . . consists in the relative constraints some people encounter in their freedom and material well-being as the cumulative effect of the possibilities of their social positions, as compared with others who in their social positions have more options or easier access to benefits. . . . Unlike the individualized attributes of native ability that often concern equality theorists, . . . structural inequalities are socially caused. [FN27]

Further, "individuals alone are not responsible for the way they are enabled or constrained by structural relations." [FN28]

On the issue of individual choice and responsibility, Young's analysis involves a non sequitur. The fact that some individuals are worse off than others by virtue of differing ranks in the social hierarchy is a sufficient condition for the worse-off individuals to lack responsibility for the inequality. But it is not a necessary condition. Individuals who have a high place in the social hierarchy--they are white, male, and have decent incomes-- can surely suffer "brute luck" with respect to other determinants of well-being, for example by ingesting a toxin or being thrown from an automobile, and end up worse off than others through no fault of their own. [FN29]

***11** The second aspect of Young's argument, one I cannot fully address here, involves the distinction between social and nonsocial causation. [FN30] If an asteroid containing extraterrestrial carcinogens strikes Missouri without warning, then the inequality between those Missourians who incur cancer as a result of the asteroid, and healthy residents of Missouri or the other forty-nine states, is not (it would seem) socially caused. Does that mean that society has no moral obligation to redress the inequality? Imagine that the bark of a rare tree turns out to be uniquely effective in combating the extraterrestrial toxins, and is also

effective for some widespread, nonserious symptom (an annoying rash). Is the choice of how to use the bark simply a matter of overall well-being or efficiency?

A plausible answer is no. One might agree that (1) morally significant inequality involves an absence of responsibility on the part of the affected individuals; and that (2) the moral obligation to redress such inequality falls on governmental bodies and other powerful actors, rather than individuals who are powerless to redress it ("ought implies can"); without accepting the further proposition that (3) governmental bodies and other powerful actors lack a moral obligation to redress inequalities that are not socially caused. A different response to Young's argument is to accept this last proposition--to accept the moral importance of social causation--but also insist that social causation is present for most of the health and safety impacts that risk regulators address, even if it is not for the Missouri asteroid. For example, deaths to high-status individuals because of chemical toxins in a waste dump are not caused by the social hierarchy, or by the individuals' position in it, but these deaths are partly caused by a legal regime (a kind of social product) that permitted the establishment of the dump in the first place.

In sum, the environmental justice/social gradient account of risk equity is surely correct to insist that differences in well-being flowing from differences in social position are a major concern of distributive justice. Where the account goes awry is in suggesting that these differences are the sole concern of distributive justice. Differences between individuals who have the same social status can also be unfair--for example, differences in health or longevity among equal-status individuals. Environmental justice is therefore an incomplete conception of risk equity.

B. "Individual Risk" Thresholds and Distributions

An "individual risk" test measures the risk of fatality, disease, or injury imposed on some specified person by a hazard. Such tests are a key component of the regulation of carcinogens and radiation by U.S. agencies. [FN31] For example, EPA's criteria for mitigating the risks of abandoned waste sites ***12** require that a clean-up occur if the incremental lifetime cancer risk to the person maximally at risk from a site exceeds 1 in 10,000, and that any clean-up bring that risk to within the range of 1 in 10,000 to 1 in 1 million. [FN32] FDA regulates carcinogens in food additives by refusing to license an additive which imposes an incremental lifetime cancer risk on the person consuming a large amount of the additive (specifically, the 90th percentile consumer) exceeding 1 in 1 million. [FN33] The Clean Air Act requires that EPA set pollution levels for carcinogenic pollutants by first using a technology-based approach and then considering a lower level if the incremental lifetime cancer risk to the maximally exposed individual exceeds 1 in 1 million. [FN34] OSHA will not intervene to reduce the levels of a toxin currently present in the workplace unless the incremental lifetime cancer risk to a worker exposed to the toxin for his entire working life exceeds (or at least is not too far below) 1 in 1,000. [FN35] One of the Nuclear Regulatory Commission's principal safety goals for structuring the licensure and regulation of nuclear plants has been that individuals living close to plants not incur an annual risk of dying in a reactor accident that exceeds 1 in 2 million. [FN36] Many similar examples could be provided.

Risk assessment scholars sometimes suggest that regulatory attention to "individual risk" levels is justified by equity considerations. [FN37] The current regime, as just described, typically incorporates "individual risk" thresholds. These require or preclude regulation, or require further regulatory deliberation, depending on whether the "individual risk" of some person in the exposure distribution is above or below a numerical cut-off such as 1 in 1,000, 1 in 10,000, or 1 in 1 million. A different sort of regime might attempt to equalize "individual risk" levels. We might characterize the distribution of individual fatality risks imposed by a toxic hazard, and apply an inequality metric to that distribution. A large literature in economics seeks to measure the inequality of income, using metrics such as the Gini coefficient, the coefficient of variation, the Theil index, or the Atkinson index. [FN38] A "distributional" variant of the "individual risk" conception of risk equity ***13** could apply some such inequality metric to the distribution of "individual risk." [FN39]

There are serious difficulties with the “individual risk” conception of risk equity, whether in the threshold form or in the distributional form. To begin, the “individual risk” levels that currently figure in regulatory decisionmaking are incremental fatality risks. [FN40] EPA, in cleaning up waste dumps, is concerned with the risk to nearby residents of dying as a result of carcinogens in the dump. FDA, in licensing toxic food additives, is concerned with the risk to consumers of dying as a result of carcinogens in their food. The incremental fatality risk to person P from toxins of type X during period T (a year, a lifetime) is the probability that X-type toxins cause P's death during T--or some such construct. [FN41] X-type toxins could be all toxins in a particular dump, air pollutants from a particular industrial category, a particular food additive or additives generally, and so forth.

Incremental fatality risks are the wrong currency for risk equity. This is true whether or not the appropriate time-slice for distributive justice is a whole lifetime or a temporal fraction of a lifetime. My own view is a whole-lifetime view, and that view will provide part of the philosophical foundation for PPPA. [FN42] On the whole-lifetime view, the difficulty with incremental fatality risk tests is that P's incremental risk from X-type toxins during any period, even a whole lifetime, may have very little connection to P's total lifetime risk package. For example, the individual maximally exposed to a ***14** dump, a particular kind of air pollution, a food additive, a radiation source, or a workplace carcinogen may have a low lifetime risk of dying from cancer or a high life expectancy, even though his incremental risk from the dump, air pollution, etc. is above a stipulated threshold or higher than the incremental risks imposed on others in the population.

But even if we shift to a sublifetime account of distributive justice--for example, a view which tries to equalize how individuals fare during each year-- there clearly can be slippage between an individual's total risk package during the sublifetime and his incremental sublifetime fatality risk from a particular source. P's risk of dying during a given year could be low even though his risk of dying during the year as a result of exposure to X-type toxins is above a stipulated threshold, or high relative to the risk of dying from X-type toxins suffered by the rest of the population.

This problematic, incrementalist feature of the “individual risk” conception of equity could be cured by construing the category of X-type toxins very expansively, to encompass all carcinogens or all toxins to which individuals might be exposed from any source (rather than toxins in a given dump, air pollution from a particular industrial category, a particular food additive, or a particular workplace toxin). “Individual risk,” thus construed, would come closer to focusing on an individual's total sublifetime or lifetime risk package. But two difficulties would remain with the “individual risk” approach.

First, “individual risks” are fatality risks. They ignore other important and measurable components of individual well-being, in particular income and health. Consider a test for risk equity which looks at how a policy intervention changes the distribution of life expectancy or the distribution of the chance of dying within the coming year, within the population generally or in particular age cohorts. These approaches are appropriately holistic rather than incremental with respect to the sources of fatality. Yet they remain problematic in presupposing that an individual's redistributive claim is just a function of his longevity. Individuals with chronic non-fatal diseases, or low but above-subsistence incomes, can have comparatively high life expectancies or low probabilities of dying in the next year, but poor prospects for annual or lifetime well-being, all things considered. An overweight and physically inactive high-income white male in his 50s can have a relatively short life expectancy but relatively high expected lifetime well-being.

Second, a conception of equity that focuses on the “individual risk” of fatality from particular sources, or overall, adopts an ex ante rather than ex post approach to equity. Chris Sanchirico and I have argued at length elsewhere for an ex post conception of egalitarianism under uncertainty. [FN43] The basic idea is this; given some component Z of individual well-being or advantage (which might be income, health, longevity, or utility as a function of all three), plus some measure M of equality, plus uncertainty about individual***15** attainments with respect to Z, we might (1) apply M to individual expectations with respect to Z; or instead

(2) determine the expectation of M, applied to individuals' actual attainments with respect to Z. Formally, if Z_i is a random variable representing the attainment of individual i with respect to Z, and there are N individuals, and E(.) is the expected value, we might (1) calculate $M(E(Z_1), E(Z_2), \ldots, E(Z_N))$ or instead (2) calculate $E(M(Z_1, Z_2, \ldots, Z_N))$. The first approach is the ex ante approach, while the second is the ex post approach.

To see how the "individual risk" approach to equity involves an ex ante conception of equality under uncertainty, and to understand how this difficulty is distinct from the problem of incrementalism versus holism, let us consider an appropriately holistic version of the "individual risk" approach--for example, measuring the distribution of the chance of dying within the coming year within an age cohort. [FN44] Z is then an indicator variable which takes the value 1 if the individual dies within the following year and 0 if she does not. Assume that M is the coefficient of variation, i.e., the standard deviation divided by the mean--a very standard measure of inequality. Then the "individual risk" approach determines whether a policy improves equity by comparing the coefficient of variation of $(E(Z_1), E(Z_2), \ldots, E(Z_N))$ in the status quo and given the policy, where $E(Z_i)$ is individual i's chance of dying in the following year. The problem here is that a policy can reduce the coefficient of variation of $(E(Z_1), E(Z_2), \ldots, E(Z_N))$, but leave unchanged or increase the expected coefficient of variation, that is, $E(M(Z_1, \ldots, Z_N))$. If, for example, the policy does not change the number of individuals who die in the following year in any given state of the world, but simply shifts around the identity of those individuals, $M(E(Z_1), E(Z_2), \ldots, E(Z_N))$ may decrease, but $E(M(Z_1, \ldots, Z_N))$ will stay the same. A similar deviation between ex ante and ex post approaches characterizes other standard inequality metrics, such as the Gini coefficient, the Theil index, or the Atkinson index, and indeed any metric M which is not just a linear function of the Z_i. [FN45]

The argument for the ex post approach to the measurement of equality under uncertainty hinges on the "sure thing" principle, which many theorists take to be a compelling principle of both individual and social rationality. The argument also appeals to a principle of dynamically consistent choice. I will not try to summarize the argument for the ex post approach here, but refer the reader to my work with Sanchirico. [FN46] If one accepts the argument, an "individual risk" conception of equity is inexorably flawed--not only ***16** in its incrementalist versions, but also in more "holistic" versions that consider a wider range of causes of death.

C. QALY-Based Equity Analysis

The QALY (quality adjusted life year) approach to health policy decisionmaking employs a single measure of health that incorporates both morbidity and longevity. Surveys are used to rank health states on a zero-to-one scale, with 1 corresponding to perfect health and 0 corresponding to death. The QALY value of an individual's health history during some stretch of time or over a lifetime can then be calculated as

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where $l(h_{i,t})$ is the quality of individual i's health in period t on a zero-to-one scale. [FN47] Policy-analytic tools that incorporate QALYs are widely used in the literature on health economics and by governments abroad, and have garnered increasing interest in the United States, particularly at the FDA. QALY-based analysis often takes the form of cost-effectiveness analysis, but can also take other forms. [FN48]

Health economists, particularly in Britain, have discussed at length the possibility of inequality measures, or distributively-sensitive policy-analytic tools, that make use of QALYs. [FN49] One suggestion is to apply the Gini coefficient, coefficient of variation, Theil index, Atkinson index, or some other inequality metric to the population distribution of expected QALYs. [FN50]

Another is to evaluate policies by using an SWF that takes individuals' QALY levels, rather than income levels, as its arguments. [FN51] Yet another is to incorporate equity weights into QALY-based cost-effectiveness analysis. [FN52]

***17** QALY-based equity analysis improves upon the deficiencies of the environmental justice and "individual risk" approaches. Unlike the environmental justice approach, it is not committed to a social-gradient conception of equity. Inter-individual differences in QALYs or expected QALYs can be counted as an inequality even if the individuals involved have the same social position. Unlike the "individual risk" approach, QALY-based equity analysis is sensitive to inequalities in health as well as longevity. Furthermore, unlike that approach, QALY-based equity analysis is not committed to an ex ante conception of egalitarianism under uncertainty. Many of the health economists who write about QALYs and equity do, in fact, adopt an ex ante conception; [FN53] but the basic construct of a QALY, as an integrated measure of health and longevity, is just as amenable to the ex post approach. If M is an inequality metric--for example, the Gini coefficient--and Z_i is a random variable representing an individual's lifetime QALYs, one could calculate $E(M(Z_1, \ldots Z_N))$: the expected inequality of the distribution of lifetime QALYs, as calculated considering various possible states of the world and the Gini coefficient of the population distribution of QALYs in each state. The same is true, of course, for other inequality metrics.

However, QALY-based equity analysis is problematic because it overlooks inequalities arising from differences in income. It shares this flaw with the "individual risk" approach. Consider, first, the variant of QALY-based analysis just discussed: calculating the value of $E(M(Z_1, \ldots Z_N))$ for the status quo and for policy alternatives, with M an inequality metric and Z_i a random variable representing individual i's lifetime QALYs. In this format, individuals are solely characterized in terms of their lifetime QALYs, which subsume their health and longevity but not their incomes. A policy might reduce the expected Gini coefficient of lifetime QALYs, but increase the expected Gini coefficient of lifetime income or of lifetime utility (defined as a function of health, longevity and income). A parallel critique applies to the proposal to use QALYs as arguments for a social welfare function. [FN54]

What about the proposal to incorporate equity weights in QALY-based cost-effectiveness analysis? QALY-based cost-effectiveness analysis evaluates policies by measuring health or longevity impacts in QALYs, and by measuring other impacts in dollars. Cutoff ratios are specified (such as $100,000 per QALY), and the decision rule is to implement a policy if its cost/QALY ratio is below the cutoff. [FN55] Normally, the QALY benefits of a policy are calculated by determining the expected increase in total QALYs. ***18** Equity weights would adjust this calculation by giving greater weight to QALY changes affecting those at a lower level of lifetime or sublifetime QALYs.

Income impacts are not completely ignored by this framework. The income-reduction effect of a policy will show up as dollar costs; ceteris paribus, a policy that produces a larger reduction in incomes will have a higher cost/QALY ratio. The difficulty, rather, is that the framework ignores inequalities in income. Imagine two policies which have identical health impacts and which also have the same aggregate monetary costs. In one case, those costs are borne by high-income individuals. In the other case, they are borne by low-income individuals. QALY based cost-effectiveness analysis, both in the traditional form and in the equity-weighted form, will not distinguish between the policies. The equity weights are a function of individual QALY levels and come into play in determining the denominator of the cost/QALY ratio for a policy; they are not a function of individual income levels and do not change the numerator of that ratio.

D. Incidence Analysis

The framework of "incidence analysis" characterizes taxes as progressive, regressive, or proportional, depending on whether

the tax burden as a proportion of income increases, decreases, or remains the same as individual income increases. [FN56] Some scholarly work employing this framework has been undertaken in the area of risk regulation. [FN57] It has typically focused on the incidence of environmental taxes; but incidence analysis is also applicable to other sorts of policy measures, and indeed in a few cases has been undertaken for non-tax environmental measures, such as tradeable emissions permits. A non-tax measure that raises or lowers firms' costs of production will affect employee wages, shareholder incomes, and consumer surplus. The income equivalent of these changes can be calculated for representative members of different income groups (defined by annual or lifetime income), [FN58] and that burden as a fraction of the individual's total income can be calculated.

Incidence analysis in the environmental area has typically ignored health and longevity impacts. The burden of a tax or non-tax measure on a given individual has typically been understood as the income equivalent of the change in her tax payments, wages, consumer surplus, and/or profits received as a firm shareholder, excluding the benefits or costs resulting from a change in her fatality risk or health state. The flaw here is reciprocal to the flaw in QALY-based equity analysis. The equity impact of a risk regulation ***19** is a function both of its impact on the distribution of income (which the QALY-based approaches ignore), and of its impact on the distribution of health and longevity (which incidence analysis, as just described, ignores).

This flaw is not an inevitable feature of incidence analysis. The analyst could characterize the total effect of an environmental measure on members of different income groups, including its effect on their health, longevity, wages, shareholder earnings, and any other measurable aspect of well-being. The income equivalent of that effect could then be determined. The measure could be characterized as progressive, regressive, or proportional depending on whether this inclusive burden as a proportion of income increases, decreases, or remains the same with increasing income. [FN59]

However, this inclusive template for incidence analysis remains problematic. One large problem is that the approach provides no guidance in balancing equity against the improvement of overall well-being. A measure may be regressive but still morally justified, all things considered, if the gain to overall welfare is sufficiently large. Second, although it seems feasible to make incidence analysis inclusive in measuring burdens (the “numerator” for determining progressivity/regresssivity), it is much less clear how incidence analysis would be rendered inclusive with respect to the “denominator” for incidence analysis. What if a measure creates burdens that increase as a fraction of incomes as individual incomes increase (thus is progressive using this denominator), but decrease as a fraction of lifetime QALYs as lifetime QALYs increase (thus is regressive using this denominator)? In this sort of case, the incidence analyst either uses income as the denominator (in which case the analysis overlooks the possibility that some individuals at a relatively high level of income are at a relatively lower level of well-being, given poor health or short longevity, or vice versa), or she uses something like utility as a function of health, longevity, and income as the denominator (in which case it is unclear why the analyst doesn't simply move beyond the incidence-analysis framework, and use utility numbers as inputs for an inequality metric [FN60] or PPPA).

E. Inclusive Equality Measurement

As already discussed, inequality metrics such as the Gini coefficient, coefficient of variation, Theil index, or Atkinson index might be used in the risk regulation domain. [FN61] One possibility is to measure the inequality of “individual risks”; another possibility is to measure the inequality of individuals' expected QALYs or (even better) the expected inequality of individuals' QALYs.

We have seen that these particular proposals are problematic because they ignore incomes. But inequality metrics are not necessarily focused on ***20** health and longevity to the exclusion of incomes, or on incomes to the exclusion of health and longevity. An inclusive inequality-measurement tool sensitive to the distribution of health, longevity, and income could be

developed using “utility functions”--a device elaborated below, in connection with PPPA. [FN62] The status quo and the policy could be seen as probability distributions across population profiles of individual utilities, where each individual's utility is in turn a function of her longevity, health, and income. We could calculate the expected Gini coefficient (for example) of individual utility, for both the status quo and the policy; if the policy has a lower value, it reduces expected inequality.

The inclusive inequality-measurement approach to risk equity, thus structured, would seem to be an improvement on the incidence-analysis approach. Unlike incidence analysis, it readily yields an overall verdict about the equality impact of policies whose fractional burdens move in one direction as individuals are made better off with respect to some dimensions of well-being (e.g., income), but a different direction as individuals are made better off with respect to other dimensions (e.g., health).

However, inclusive inequality measurement shares an important flaw with incidence analysis. Inequality metrics can tell us whether a proposed policy's distribution of individual well-being is more or less equal than the status quo distribution. Inequality metrics cannot tell us whether the policy is better or worse than the status quo, all things considered. They cannot yield a final verdict concerning the policy, given its impacts both on the distribution of well-being and on overall well-being. A policy analyst might find that cost-benefit analysis (a good proxy for overall well-being) favors the status quo, while the policy reduces the expected degree of inequality as measured by some inequality metric. Inequality metrics provide no guidance in making this sort of choice--in balancing distributive and aggregative concerns. [FN63]

By contrast, PPPA does provide the requisite guidance. PPPA subsumes both a concern for overall well-being and a concern for the equal distribution of well-being. At the same time, PPPA can provide exactly the sort of information provided by inequality metrics, if we find that information useful: namely how policies compare purely as a matter of equality. These points will be elaborated below. [FN64]

F. Cost-Benefit Analysis with Distributive Weights

Cost-benefit analysis (“CBA”) compares a policy to the status quo by summing the monetary amounts that individuals who are benefited by the policy are willing to pay (“WTP”) for it, and subtracting the amounts that ***21** individuals made worse off by the policy are willing to accept (“WTA”) in return for it. [FN65] Economists have periodically suggested that cost-benefit analysis could be sensitized to equity by multiplying individual WTP/WTA amounts by a weighting factor that decreases with greater individual income. [FN66] Although this approach has not been adopted by U.S. governmental bodies, it has been adopted in Britain and, in the past, at the World Bank. [FN67]

At first blush, distributively-weighted CBA seems to provide a very attractive approach to risk equity. It takes a “population” rather than a social gradient approach: individuals with different incomes but identical social positions will receive different weights. It is inclusive with respect to the determinants of well-being: one can calculate individual WTP/WTA amounts, not merely for changes that directly affect income (such as changes in prices, wages, or earnings received as a firm shareholder), but also for changes in health and in longevity risks. Similarly, it is possible in principle to make the weighting factor for a given individual's WTP/WTA amounts a function of her health and longevity as well as her income. Finally, by contrast with incidence analysis and inequality measurement, distributively-weighted CBA provides guidance in balancing equity with overall welfare. The sum of weighted WTP/WTA amounts is meant to indicate whether, on balance, a policy should be pursued, given both distributive and aggregative considerations.

However, the proponents of distributively weighted CBA must confront a number of difficult issues involving the

identification and application of weights. To begin, what determines the choice of weights? Consider the simplest sort of case, in which individuals are all healthy and long-lived, and differ only in their incomes. In the status quo, there are equal numbers of rich and poor individuals: the rich with annual incomes of $100,000, the poor with annual incomes of $20,000. A policy benefits the poor but makes the rich worse off. Each poor individual is WTP $250 for the policy, while each rich individual is WTA $300. From the perspective of unweighted CBA, the policy is a net social loss. From the perspective of weighted CBA, it will be a net social gain, if the weighting factor applied to poor individuals' WTP/WTA amounts is more than 6/5 (300/250) the weighting factor applied to rich individuals' WTP/WTA amounts. But should the ratio of the weighting factors be larger or smaller than 6/5?

Second, the straightforward procedure of assigning each individual a weight depending on her level of welfare-relevant characteristics in the status quo (her status quo income, health, longevity, etc.) must be revised for policy choices that involve large changes in some of those characteristics. ***22** Again, assume healthy and equally long-lived individuals and imagine that the status quo and the policy each, with certainty, produce a given distribution of annual income. In one case, the policy produces a small change in each individual's annual income; in the second case, it produces a large change in the annual income of some individuals.

"Small" Policy

Individual	Status Quo Income	Income with Policy	WTP/WTA FN [FN68]
1	$100,000	$98,000	-$2,000
2	$100,000	$98,000	-$2,000
3	$ 20,000	$21,000	$1,000
4	$ 20,000	$21,000	$1,000

"Large" Policy

Individual	Status Quo Income	Income with Policy	WTP/WTA
1	$100,000	$98,000	-$ 2,000
2	$100,000	$50,000	-$50,000
3	$ 20,000	$21,000	$ 1,000
4	$ 20,000	$70,000	$50,000

Assume that we have somehow developed a set of weights for WTP/WTA amounts as a function of annual income. The weight w_{100K} is the weight for an annual income of $100,000. In addition, assume (as seems plausible) that w_{100K} w_{98K}, and that w_{20K} w_{21K}. It is then straightforward to evaluate the small policy. The $2,000 annual losses of individuals 1 and 2 can be weighted by either w_{100K} or w_{98K} (which are approximately equal), and then subtracted from the $1,000 gains of individuals 3 and 4, weighted by either w_{20K} or w_{21K} (once more, approximately equal). But it is not straightforward to evaluate the large project. Should we weight individual 2's WTP/WTA amount ($50,000) by the weight for his annual income in the status quo, w_{100K}, or by the weight for his annual income in the policy outcome, w_{50K}? Similarly, should we weight individual 4's WTP/WTA amount (also ***23** $50,000) by the weight for his annual income in the status quo, w_{20K}, or by the weight for his annual income in the policy outcome, w_{70K}?

A third and related problem concerns the application of weights under conditions of uncertainty. It is highly unrealistic to assume that the policymaker knows for sure which outcome would result from each choice available to her. More realistically, each choice leads to a probability distribution across outcomes rather than a particular, certain outcome. But then the problem of identifying a weight for each individual becomes yet thornier. With respect to income, for example, each choice leads to an array of state-dependent incomes for each individual. Even with a function from income levels to weights in hands, how are we to apply this function under conditions of uncertainty, given that neither the status quo nor the policy produces a single income level for any given individual?

In short, the proponent of distributively-weighted CBA needs a normative account of equality, sufficient to provide answers to these sorts of questions about the specification and application of weights. The only plausible such account which has been proposed in the literature on distributive weighting is the SWF account: distributive weights should be attached to WTP/WTA amounts so as to mimic the application of a social welfare function. [FN69]

Is it true that for any given SWF we can calculate WTP/WTA amounts and assign distributive weights so as to replicate the choices of the SWF? The answer is not obvious. Further, even if a particular SWF can be mimicked through weighted WTP/WTA amounts, it is far from clear why SWFs should be applied indirectly via the mediating device of weighted CBA, rather than directly. One argument for indirect application, that distributively-weighted CBA is a simpler procedure, is undercut by the above examples. For any given individual, her weighted WTP/WTA amount for a policy choice will be a function of the array of state-dependent determinants of well-being (income, health, longevity) that she would face if the policy were chosen, and the array of these state-dependent determinants that she would face if the status quo were chosen. This is just the information that the direct application of an SWF requires. Finally, even if weighted CBA does ultimately prove to be a simpler and more administrable decision procedure for incorporating equity, we should experiment with the direct application of SWFs, to help build the social knowledge base regarding the workings of SWFs that would be needed to develop a functioning system of weighted CBA.

A different difficulty, specifically relevant to distributively weighted CBA as a conception of risk equity, concerns the way in which CBA values longevity. In current practice, CBA translates longevity impacts into WTP/***24** WTA amounts using the "value of statistical life" ("VSL") approach, which asks what individuals are willing to pay or accept for changes in their risk of premature death. [FN70] If social choice under uncertainty should follow the ex post rather than ex ante approach, then the VSL approach is problematic. There will be cases where CBA using the VSL approach will fail to track the judgments of any social welfare function applied in an ex post manner. [FN71]

The following example illustrates the point. In one case a population of N individuals is exposed to a toxin in the status

quo. The individuals are identical, except that only one unknown individual is susceptible to the toxin and will die prematurely for sure if it is not eliminated. In the second case, a small subpopulation of L within this broader population is exposed to the toxin. In this second case, one unknown individual in the subpopulation is susceptible to the toxin and will die prematurely for sure if it is not eliminated. In each case, there is a policy to eliminate the toxin, with costs TC borne by T taxpayers who (for simplicity) are identical and external to the population of N individuals. Imagine that each individual's WTP not to be exposed to a 1-in-N risk of dying from the toxin is V and that each individual's WTP not to be exposed to a 1-in-L risk of dying from the toxin is V*.

Unweighted CBA using the VSL approach will value the policy in the first case as NV - TC. It will value the policy in the second case as LV* - TC. Since WTP is not proportional to the risk reduction for large risk reductions, these need not be the same amount and may indeed differ dramatically. (Imagine that N is 1 million and L is 5.) Weighted CBA, let us imagine, employs weights that are sensitive to individual income and expected longevity, and therefore has different weights for taxpayers (designate the weight for taxpayers as w^T), members of the population who are exposed to a 1-in-N risk of dying from the toxin (w^N), and members of the population who are exposed to a 1-in-L risk of dying from the toxin (w^L), with $w^L >= w^N$. [FN72] So weighted CBA will value the first policy as $N \times w^N \times V - T \times w^T \times C$. Weighted CBA will value the second policy as $L \times w^L \times V^* - T \times w^T \times C$. Again, the two valuations can differ.

Because both unweighted and weighted CBA can give different valuations to the two policies, it is possible that both unweighted and weighted CBA will yield different choices in the two cases: favoring the policy in one case but the status quo in the other. But any social welfare function which is sensitive to distribution and is applied in an ex post manner will treat the two ***25** cases as identical. [FN73] The ex post account of social choice under uncertainty views equity as a matter of the distribution of realized, not expected, well-being. Each status quo involves the same distribution of realized well-being: taxpayers reach a certain level, members of the population reach a different level, and the unfortunate individual who dies from the toxin yet a different level. [FN74] Each policy also produces the same distribution of realized well-being: now everyone in the population reaches the same level of well-being, and the taxpayers reach a different level.

In short, CBA using the VSL approach--even CBA incorporating distributive weights--is a less than fully accurate proxy for any distributively sensitive SWF applied in an ex post manner under uncertainty.

II. A New Approach: Probabilistic Population Profile Analysis

This Part describes in detail how equity considerations could be brought to bear on risk policy choices via a technique I call “probabilistic population profile analysis” (“PPPA”).

PPPA represents one particular format for analyzing policy choices through the application of a social welfare function. Section A summarizes the philosophical basis for PPPA. Section B describes PPPA itself, and discusses its feasibility. Section C clarifies the connection between PPPA, equality measurement, and cost-benefit analysis.

A. Social Welfare Functions and the Philosophical Basis for PPPA

The SWF approach to distributive issues has been developed within theoretical welfare economics [FN75] and has been used

in the optimal tax literature to study tax policies. [FN76] SWFs have also been used, in a few academic works, to evaluate environmental regulation. [FN77]

***26** The approach is welfarist. It assumes that individual well-being is the sole morally relevant information about outcomes, and that principles of equality govern the distribution of well-being. This might be seen as a limitation of the approach. But "welfare" can be construed broadly, to encompass anything that improves the quality of an individual's life. More precisely, the welfare-enhancing or welfare-reducing features of a life might plausibly be understood as those features that individuals with full information and good deliberative conditions would converge in preferring or dispreferring. Individual well-being, on this ideal-preference account, arguably encompasses the quality of an individual's experiences, health states, intellectual life, practical accomplishments, relationships with friends and family, and standing and participation in the broader community. [FN78] To be sure, measuring all these items is a big challenge. But the crucial point to understand here is that the SWF framework is potentially inclusive with respect to the constituents of welfare.

The SWF approach employs a characteristic mathematical formalism to represent welfarist moral judgment. Each outcome [FN79] is mapped onto a vector of "utility numbers," representing each individual's well-being in that outcome. A given SWF is, in turn, a particular mathematical function that takes the utility vector for each outcome and assigns it a single number. That social welfare number represents how good or bad the outcome is, morally speaking, as compared to other outcomes.

THE SWF FRAMEWORK

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In what way is the SWF framework sensitive to distributive concerns? A crucial point is that the set of possible social welfare functions includes not merely the utilitarian SWF, which simply adds up individual utilities, but ***27** also a wide array of distributively sensitive or "equity regarding" SWFs. The formal expression of distributive sensitivity is the so-called "Pigou-Dalton" principle. This principle stipulates that shifting utility from someone at a higher utility level to someone at a lower level, without changing total utility, must increase the value of the SWF. [FN80]

THE PIGOU-DALTON PRINCIPLE

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Anyone proposing to employ the SWF framework for policy choice must confront a number of basic philosophical issues. First, which distributively-sensitive SWF should drive the analysis? While there is only one utilitarian SWF, an infinite number of SWFs satisfy the Pigou-Dalton principle. The optimal-tax literature has focused on a particular family of distributively-sensitive SWFs, the "Atkinsonian" family. As I will elaborate below, this family of distributively sensitive SWFs indeed has attractive properties, and PPPA should principally draw on SWFs within this family. The rank-weighted SWF, a different sort of distributively sensitive SWF, might also be used. [FN81]

A second basic question involves the time slice. Is equality a matter of equalizing individuals' lifetime well-being, or rather of equalizing well-being during some temporal fraction of their lives, such as annual or momentary well-being? Formally, do the individual utility numbers upon which SWFs operate represent lifetime utilities or "sublifetime" utilities? I have argued at length elsewhere for the lifetime view and will not repeat those arguments here. [FN82]

A third question involves the application of SWFs under conditions of uncertainty. Absent uncertainty, each policy choice available to a decisionmaker corresponds to a particular vector of lifetime utilities: the particular***28** outcome that the choice would produce. Given uncertainty, each policy choice corresponds to a set of vectors of lifetime utilities: the set of possible outcomes that the choice might produce, each assigned a probability. Formally, each individual's lifetime utility is a random variable U_i, and an outcome is a realization of random variables U_1 through U_N, with N individuals in the population. The question then arises whether the social welfare function should be applied to a given choice in an ex post or exante manner. As mentioned, Chris Sanchirico and I have elsewhere defended the ex post approach. ~~[FN83]~~ If W is the social welfare function, and E is the expectation operator, the ex post approach is to calculate $E(W(U_1, \ldots, U_N))$ for each choice, while the ex ante approach is to apply the social welfare function to the vector of expected utilities associated with each choice, i.e., to calculate $W(E(U_1), E(U_2), \ldots, E(U_N))$ for each choice.

Ex Ante Versus Ex Post Application of an SWF: An Example

W = the sum of the square root of individual utilities. There are 2 individuals in the population, Jim and June. A policymaker is choosing between the status quo (which has two equiprobable outcomes, A and B), and a policy (which also has two equiprobable outcomes, C and D). The numbers in the tables are the individuals' utilities in each possible outcome.

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B. PPPA, Step by Step

PPPA represents a concrete attempt to operationalize the SWF framework described in Section A: namely, one that employs an equity-regarding SWF which is applied to lifetime utilities, and which is applied in an ex post rather than ex ante manner.

PPPA begins by specifying a population of interest. This might be limited to U.S. citizens who are currently alive, or it might include other individuals, such as foreign citizens or future or past generations. For simplicity, I will focus on the case in which the population of interest comprises current ***29** U.S. citizens. In that case, there are N 300 million individuals in the population, and the same N exist in all possible outcomes. ~~[FN84]~~

Each individual i has different possible life histories. Each possible outcome O_k is a possible combination or "population profile" of life histories, one for each of the N individuals. If there are K such possible combinations, then there are K possible outcomes $\{O_1, \ldots, O_K\}$. Each outcome has the form $(L_1, L_2, \ldots, L_N)$, where L_1 is a possible life history for individual 1, L_2 a possible life history for individual 2, and so forth. Let us say that $L_{i,k}$ is the particular life history that individual i lives in outcome O_k.

Each possible life history $L_{i,k}$ is a description of certain welfare-relevant facts about individual i's life. What facts exactly? I propose that each $L_{i,k}$ include those facts about individual i that are readily measurable given current available metrics. In particular, at least for purposes of analyzing the equity implications of risk policy, $L_{i,k}$ should include all the various facts highlighted by the different literatures on risk equity described in Part I: health, longevity, income, and perhaps readily measurable markers of social position (paradigmatically, race and gender). The QALY and "individual risk" literatures underscore the

measurability of impacts on health and longevity, and the importance of health and longevity for individual well-being. The incidence-analysis literature underscores the measurability of income impacts, and the importance of income for individual well-being. Finally, as regards the literature on environmental justice, one can reject the social-gradient approach but preserve the insight that social position can impair individual flourishing.

In short, $L_{i,k}$ consists of the following sorts of facts.

-- The life-span of individual i in outcome O_k

-- The income of individual i during each period she is alive in outcome O_k

-- The health state of individual i during each period she is alive in outcome O_k

-- Measurable markers of individual i's social position (such as race and gender)

This template for $L_{i,k}$ is not meant to be rigid. To begin, there are important constituents of well-being, such as the individual's experiential states (happiness), relationships with friends and family, or accomplishments at work or in the community, that are not included on the list because they are more difficult to measure with current metrics. [FN85] Reciprocally, income is not ***30** a direct constituent of well-being but is on the list. Income is a "resource" or "primary good" that allows individuals to advance their well-being in various ways, and income measurement techniques are very well developed. Different variants of PPPA might replace income with consumption or omit both income and consumption and conceptualize each life history as a set of facts concerning the individual's longevity, health, experiential life, social position, friendships and family relationships, and the other attributes of human lives that are directly constitutive of well-being. However, the longevity-health-income-social position characterization seems more tractable for now.

The construct of a population profile is one of the key building blocks of PPPA. Another is a utility function, U, that maps each individual $L_{i,k}$ onto a lifetime utility number $U(L_{i,k})$. The final one is a social welfare function W that maps a vector of N lifetime utilities onto a single "social welfare" number.

Using these building blocks, PPPA proceeds as follows. (1) A policy choice situation, consisting of the status quo choice of inaction plus at least one alternative, is given exogenously. [FN86] (2) Each available policy choice corresponds to a probabilistic population profile, that is, to a probability distribution across population profiles. In other words, if $\{O_1, \ldots, O_K\}$ is the set of all possible outcomes, i.e., all possible population profiles, then each choice corresponds to a probability distribution across these outcomes. Risk assessment techniques and techniques for estimating the income impact of policy choices are used to determine which probabilistic population profile corresponds to a given choice. (3) The utility function U is used to transform each possible population profile O_k of individual longevity-health-income-social position histories, $O_k = (L,L,\ldots,L»»»)$, i»»»nto an N-entry vector of lifetime utilities, one for each individual in the population. Each choice therefore becomes a probability distribution across lifetime utility vectors. (4) The social welfare function W is applied to each choice--characterized as a probability distribution across lifetime utility vectors--in an ex post manner. The choice with the greatest expected W-value is that choice which is best, on balance, given both equity concerns and concerns about overall well-being.

Even if this approach is philosophically well-grounded, is it truly feasible? I will discuss the various steps of the approach in turn.

***31** 1. The Predictive Step: Mapping Choices onto Probabilistic Population Profiles

PPPA characterizes each choice as a probability distribution or lottery across population profiles, where each profile or outcome has the form $O_k = (L_{1,k}, L_{2,k}, ..., L_{N,k})$ and each $L_{i,k}$ includes information about individual i's lifespan, her health states in all the periods in which she is alive, her income in all the periods in which she is alive, and her measurable social position. For simplicity, I will assume that the relevant periods are years.

One aspect of this task is characterizing the effect of policy choices on each individual's possible income sequences over her lifetime. That task would presumably involve general equilibrium modeling. We have a model of the economy in the status quo, with some random elements, producing a probability distribution across population profiles. Each profile has information about each of the N individuals' wages, capital income, and perhaps other sources of earnings, in each period. A policy intervention perturbs this model in some way, leading to a different distribution of incomes.

General-equilibrium modeling is an established technique, [FN87] and a substantial number of studies have been undertaken that employ such models in the environmental context: to characterize the incidence of policies' burdens on different groups; to determine whether policies have net costs or benefits; and, in a few cases, to evaluate environmental policies with reference to an SWF. [FN88] Most relevant for my purposes, here, is the fact that general equilibrium models have been used to estimate the effect of policies on the distribution of lifetime incomes. A particularly thorough and impressive example is work by Fullerton and Rogers, who engage in modeling to characterize the progressivity of various taxes with respect to lifetime income. As they summarize their approach:

> [W]e build a general equilibrium simulation that encompasses all major U.S. taxes, many industries, both corporate and noncorporate sectors within each industry, and consumers identified by both age and lifetime income. It is not a model of annual decisionmaking, but a life-cycle model in which each individual receives a particular inheritance, a set of tax rules, a wage profile, and a transfer profile. Each then plans an entire lifetime of labor supply, savings, goods demands, and bequests. We also look at each industry's use of labor, capital, and intermediate inputs. We can then simulate the effects of a tax change on each economic decision through time. We calculate new labor supplies, savings, capital stocks, outputs, and prices. . . .
>
> ***32** . . . [W]e evaluate the effects of each U.S. tax by comparing its estimated burdens with those of a proportional tax . . . . In our lifetime framework, a progressive tax is one in which the lifetime tax burden as a fraction of lifetime income rises as lifetime income rises, and a regressive tax is one in which the lifetime tax burden as a fraction of lifetime income falls as lifetime income [rises]. [FN89]

Fullerton and Rogers are engaged in lifetime-income incidence analysis, while I am advocating a different approach to equity analysis, namely PPPA. What their work demonstrates, for my purposes, is that the kinds of models and techniques that would be required to estimate population profiles of individual income sequences, and changes in such profiles caused by policies, are already in use. [FN90]

What about the health and longevity characteristics of individual life histories? Describing the health and longevity

characteristics of a given population, such as the U.S. citizenry, is already the focus of a large amount of work by public health scholars and organizations. [FN91] Describing the change in status quo morbidity and premature mortality that would result from policies falls under the rubric of risk assessment--also a large area of existing work. [FN92]

Of course, neither population health characterization, nor risk assessment, currently focuses on the particular sort of information required by PPPA--namely, a probability distribution across population profiles. Ignoring lifetime-income information for the moment, PPPA would presumably work along something like the following lines. Existing population data would be used to calibrate a lifetime health-and-longevity model for the N individuals in the population. The model would assign an annual probability of both death and morbidity (perhaps summarized in a QALY value) to each individual. These probabilities could be a function not only of the individual's age but also of other characteristics. Running the N models once would produce a particular population health-and-longevity profile. Doing this repeatedly would produce a probability distribution across population health-and-longevity profiles for the status quo. A policy's effect consists in changing mortality and/or morbidity probabilities for some individuals in some years. Running the altered N models repeatedly would produce a probabilistic population health-and-longevity profile associated with the policy.

The approach to generating probabilistic population health-and-longevity profiles just described, although certainly not a standard format for public ***33** health work, is surely feasible with existing tools. [FN93] Microsimulation models that model lifetime histories of an entire population are already in use, particularly in evaluating the impacts of tobacco and cancer policy. [FN94] For example, Tammy Tengs and co-authors estimated the total change in QALYs that would result over 50 years from federal policy requiring safer cigarettes, by using the Tobacco Policy Model.

> The Tobacco Policy Model is a flexible system dynamics computer simulation model . . . [that is] designed to calculate the public health gains or losses from any change in the hazards or patterns of cigarette use.

To start the present simulation, we initialized the model with the number of people in the U.S. population in the year 2003. We divided the population into cohorts according to gender, initial age . . . and smoking status (current, former, or never smoker). . . . The model then simulates annual transitions such as birth, death, aging, net migration, and changes in smoking behavior in the U.S. population over 50 years with transition probabilities varying by age, gender, smoking status, and year.

. . . .

In our model, gains or losses in an individual's health are measured with quality-adjusted-life-years (QALYs). . . . Quality of life data for current, former, and never smokers of various ages and genders were obtained from [survey data]. We estimated mortality hazard functions using mortality data for each gender . . . and smoking status . . . . [FN95]

A bigger challenge for PPPA is integrating the income and health-and-longevity elements. Imagine that, using a general equilibrium model, we have generated a baseline probability distribution across population profiles each consisting of an income history for each of the N individuals in the population and a perturbation in that distribution occasioned by the policy. Similarly, using risk assessment techniques and information about population health, we have generated a baseline probability distribution across population profiles each consisting of a health-and-longevity history for each of the N individuals in the population and a perturbation in that distribution ***34** occasioned by the policy. How do we synthesize this information to produce the requisite characterization of the status quo and the policy as probability distributions over profiles that contain information both about each individual's health/longevity and about her income?

The simplest approach would be to assume that the income and the health/longevity components of population profiles occur

independently. In other words, the probability of a given combined profile, with information both about each individual's income and about each individual's health and longevity, is simply the product of the probabilities of the constituent income profile and health/longevity profile. This approach is very crude, of course, because morbidity (and mortality!) will change an individual's income. The practice of PPPA might commence using this approach; but certainly techniques should be developed to incorporate interactions between morbidity/mortality and income in predicting individual longevity-health-income histories and population profiles of these histories. Existing work on health equity in the "social gradient" tradition may be helpful here. Much of this work documents correlations between income and health/longevity [FN96] and could well be helpful in calibrating sophisticated composite life-cycle models that include both characteristics.

I have discussed techniques for characterizing population profiles with respect to individual health, longevity and income. Adding information about measurable social position, such as race and gender, should not pose a large challenge. Sophisticated models that estimate individual longevity-health-income histories might already include race and gender as one predictor of these attributes. [FN97] In any event, there is much existing information about the correlation of race and gender with income, health and longevity. [FN98]

2. The Well-Being Step: Identifying a Utility Function

PPPA requires a utility function U that maps each possible individual life history $L_{i,k}$ onto a lifetime utility number, thereby converting a population profile of life histories $O_k = (L_{1,k}, L_{2,k},...,L_{N,k})$ into a vector of lifetime utilities $(U(L_{1,k}),U(L_{2,k}),...,U(L_{N,k})) = (U_{1,k}, U_{,k},...,U_{,k}»»)$. Where does this utility function come from? Let us place to one side, for the moment, the difficult and controversial problem of incorporating measurable social position in ***35** the determination of utility. Consider the problem of specifying a utility function that assigns a lifetime utility number to each $L_{i,k}$ as a function of its income, health, and longevity attributes.

The best approach to specifying that function would involve surveys, where randomly selected members of the general public are placed in a favorable informational and deliberative state and are asked to rank different hypothetical longevity-health-income histories, and perhaps lotteries over these histories, with respect to well-being. Utility numbers, in turn, would be the numbers (unique up to some transformation) that represent respondents' well-informed preferences over the histories and lotteries. In previous work, I have discussed the use of utility surveys as a way to generate utility numbers that could improve the practice of CBA. [FN99] Here, I propose utility surveys as a way to generate the numbers that equity analysis would require.

Estimating utilities based on surveys inquiring about lifetime health-and-income histories is a less utopian enterprise than it may seem. Surveys are already widely employed to elicit information about individual well-being that is useful for policy analysis. [FN100] The three chief examples are "contingent valuation" surveys, which ask individuals about their WTP/WTA amounts for different policies; happiness surveys, which ask individuals to quantify their happiness or their satisfaction with their lives; and QALY surveys, which ask individuals to measure the quality of health states on a zero-to-one scale. The lifetime-health-and-income survey contemplated here is roughly analogous to a QALY survey, with two crucial differences. First, individuals should be asked to rank temporally extended histories rather than particular health states (which is what the QALY method focuses on). Second, individuals should be asked to rank histories that encompass both income and longevity/health.

Neither of these innovations represents a huge step beyond existing survey formats. As for the first, some survey work has already been done by public health researchers that departs from the standard QALY format and inquires about preferences over temporally extended health histories. [FN101] As ***36** for the second, contingent-valuation surveys that ask about WTP/WTA for

health effects or mortality risks are routinely conducted, [FN102] and these surveys do require respondents to make tradeoffs between income and health or longevity. Indeed, the theoretical literature on contingent-valuation surveys often assumes that respondents answer with reference to a utility function. In the case of a survey asking about WTP/WTA for health effects, this means a utility function that takes both health and income as its arguments. In the case of a survey asking about WTP/WTA for mortality risks, this means a utility function that is sensitive to the length of time for which a respondent is alive and can enjoy her income.

What particular survey format should be used to determine the utility value of longevity-health-income histories? This is a matter for experimentation. One possibility builds on the "standard gamble" format, widely employed in eliciting QALY valuations. The QALY standard gamble asks the respondent to identify the indifference probability q, such that she is indifferent between living some given period of time in a health state h, and a lottery with probability q of living for that period of time in perfect health and 1-q of dying instantly. Similarly, one might use a lifetime standard gamble to determine lifetime utilities. Specify a nearly perfect longevity-health-income history (one hundred years in full health and a high income) and a perfectly awful one (one hundred years in a health state no better than death and a subsistence income). For a given life-history $L_{i,k}$, ask the respondent for the probability u that makes her indifferent between getting the life-history for sure and a lottery with probability u of the nearly perfect life history and probability 1-u of the perfectly awful one. Set $U(L_{i,k}) = u$.

The lifetime standard gamble format is theoretically appealing because a strong case can be made that the utility numbers emerging from this format would be the correct numbers to use as inputs into the social welfare function. [FN103] However, the format might prove cognitively overwhelming, and other formats should be experimented with. Along with the standard gamble, so-called "time tradeoff" questions are routinely employed in QALY surveys. Ann Holmes has experimented with the use of time tradeoff questions to elicit respondent preferences with respect to both health and non-health characteristics. [FN104]

Another possibility is to constrain the form of the utility function. Health economists often assume that the utility of health and consumption or ***37** income is additive across periods and multiplicative within periods. [FN105] In other words,

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where individual i lives for T periods in outcome O_k; $h_{i,t}$ is her health state in period t; $y_{i,t}$ is her income or consumption in period t; and $q(h_{,t}»»)$ and $v(y_{i,t})$ are "subutility" functions measuring the value of health and income/consumption, respectively, in each period. [FN106] Bleichrodt and Quiggin have shown that this functional form follows from a set of preference axioms. [FN107] I have argued that $U(L_{i,k})$ might take a different form. If different axioms are satisfied, $U(L_{i,k}) = Q(H_{i,k}) \times V(Y_{i,k})$, where $H_{i,k}$ is individual i's lifetime health history in outcome O_k and $Y_{i,k}$ is her lifetime income history. [FN108] Surveys might be conducted to test whether the preferences of well-informed individuals regarding longevity-health-income histories tend to satisfy either set of axioms. [FN109] If one axiom set is more or less satisfied, surveys designed to establish the parameters of the particular functional form $U(L_{i,\ k})$ grounded on that set can then be undertaken. Surveys of this sort would presumably be less cognitively demanding than lifetime standard gambles. For example, if

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then surveys regarding preferences for hypothetical health-and-income combinations during a period (not whole lifetime histories) would be needed to estimate the $q(h_{i,t})$ and $v(y_{i,t})$ functions.

The utility function U should, ideally, represent the convergent preferences of well-informed respondents contemplating

hypothetical longevity-health-income histories. But what if survey respondents diverge in their answers?***38** After all, interrater convergence in the case of existing QALY surveys is often not very high. [FN110] This important question raises large issues about interpersonal comparisons, incommensurability, and the meaning of utility numbers, which I have grappled with elsewhere and cannot address at length here. [FN111] A first-cut response is to stress that well conducted surveys should attempt to debias respondents and provide them with information. If divergence persists, median or average values should be used, as a reasonable estimate of what respondents under yet more ideal conditions would converge in preferring.

I have suggested that surveys asking respondents about their preferences over hypothetical longevity-health-income histories would be very helpful in calibrating the utility function U. But survey data of this sort does not yet exist. How should PPPA be undertaken in the interim? An initial possibility is to ignore health in the analysis. The appropriate form of the utility function in the case where it is conceptualized as a function of income (or consumption) alone has been discussed at length in various subfields of economics. A standard assumption is that the utility function has the "constant relative risk aversion" form $U(y) = y^{1-e}/(1-e)$, or log (y) where e = 1. [FN112] The British government, which now recommends distributive weighting in CBA, adopted this assumption in deriving recommended weights. [FN113] The parameter e can be estimated based on individual behavior as well as surveys, and substantial work of this sort has been undertaken. [FN114] One review of this literature concludes that policymakers should use a range of 0.7 to 1.5 for the value of e; [FN115] another suggests a broader range, namely 0.5 to 4.0. [FN116] ***39** Using this constant-relative-risk-aversion function, utility would be assigned to a life-history as

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that is, by adding up the individual's income utility in all periods until she dies.

It should also be possible to employ existing data from health contingent-valuation surveys to estimate the shape of U, particularly if

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in accordance with the Bleichrodt and Quiggin axioms. The amount of money that an individual is willing to accept to move from one health state to a worse state (her WTA for that move), or the amount of money that she is willing to pay to move from one health state to a better state (her WTP amount), depends on the marginal utility of income in the two states. From WTP/WTA data, then, we can estimate the marginal utility of income in different health states, and thus the shape of the function $q(h_{i,t})$. By assuming further that the function $v(y_{i,t})$ is the constant relative risk aversion form with risk aversion parameter e, we have concrete specifications for both the q and v functions and can apply these to a given $L_{i,k}$ to calculate $U(L_{i,k})$. Viscusi and Evans have undertaken pioneering work that employs WTP/WTA data to estimate the marginal utility of income in different health states, [FN117] and more work of this kind would be very useful in estimating U for purposes of PPPA.

Finally, what about social position? Socioeconomic status automatically enters into PPPA, even without separate attention to social position, since an individual's life-history includes information about her income. Insofar as PPPA employs an SWF that is equity-regarding rather than utilitarian, or a utility function with diminishing marginal income utility, PPPA will automatically be sensitive to the distribution of income. It is not, however, automatically sensitive to the racial or gender characteristics of those who benefit or are harmed by policies. Should it be?

Incorporating social position as a determinant of individual lifetime utility--as a separate element of an individual's life-history--is a double-edged sword. On the one hand, this adjustment means that low-status individuals have stronger redistributive claims. Redistributing a unit of lifetime utility from a high- to a low-status individual with identical income, longevity, and health

characteristics increases the value of an equity-regarding ***40** SWF, but would not do so if social position were ignored. On the other hand, incorporating social position may mean that income, longevity, and health have greater marginal utility when possessed by high-status rather than low-status individuals. Imagine that lifetime utility is of the form

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where s_i is a positive number that measures status, increasing as status increases. Then a given increment in health or income in some period has a greater effect on lifetime utility for a high-status individual, as does a given extension of longevity. A utilitarian SWF would, therefore, end up shifting health, longevity, and income to higher-status individuals. An equity-regarding SWF could also do so, depending on how it balanced distributive considerations with overall well-being. Further, the degree to which race and gender currently correspond to lower-status social positions is a complicated and controversial question.

For these reasons, incorporating social position as a separate determinant of individual lifetime utility will be politically controversial, and agencies (and even academics) undertaking PPPA may hesitate to do so. Bracketing political constraints, social position should be incorporated in life histories as a separate determinant of individual lifetime utility. The double-edged impact of social position on welfarist analysis, described in the preceding paragraph, does not--to my mind--show the contrary. [FN118] But the best is the enemy of the good, and it is certainly possible to structure PPPA so that race and gender information is (1) wholly ignored, or (2) employed only at the predictive stage, to improve estimates of the probability of different population profiles, which are described as combinations of individual longevity-health-income histories rather than individual longevity-health-income-social position histories.

3. The Social Welfare Step: Identifying an SWF

The final step of PPPA is applying an equity-regarding SWF, or family of SWFs, to the probabilistic population profile in the status quo and resulting from each policy. This may seem like a hopeless task. There are countless functions from utility vectors to social welfare numbers that satisfy the Pigou-Dalton principle and therefore count as equity-regarding. How does the PPPA analyst know which one(s) to use?

This problem is more tractable than it may seem at first glance. The academic scholarship that has actually employed SWFs to study concrete ***41** policy questions often uses the so-called Atkinsonian family of SWFs. [FN119] This family has the form

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where y is the so-called inequality-aversion parameter and y>= 0, y 1.

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[FN120]

The set of SWFs comprised of SWFs within the Atkinsonian family and increasing transforms thereof [FN121] are the only SWFs that satisfy two plausible axioms in addition to the basic Pigou-Dalton axiom: separability and ratio-rescaling-invariance. [FN122] Separability means that the particular utility level of ***42** an individual who has the same utility in two outcomes being compared is irrelevant to the SWF's rankings of those outcomes. This axiom is a formal expression of the philosophical position known as “prioritarianism,” which many philosophers of equality now adopt. [FN123] Ratio-rescaling-invariance means that the ranking of utility vectors should not change if we multiply all utilities by a common positive constant. In other words, if W assigns a greater value to $(U_1,U_2, . . .,U_N)$ than to (U*, U» »*,»*,» .» . .,U_N*), then it must assign a greater value to $(kU_1, kU_2, . . ., kU_N)$ than to $(kU_1*, kU_2*, . . ., kU_N*)$. Ratio-rescaling-invariance is very plausible, since welfarist theory currently provides no basis for

thinking that there are genuine, measurable, and morally significant aspects of individual well-being which are captured by some vector of utility numbers representing a given outcome but lost if we multiply everyone's utility by a common positive constant. [FN124]

To be sure, the Atkinsonian SWFs are an entire family of SWFs, parameterized by the inequality-aversion parameter y. At one extreme, with y= 0, the Atkinsonian SWF becomes the utilitarian SWF. At the other extreme, with y = >>>, the Atkinsonian SWF becomes the "leximin" social ordering, which gives absolute priority to improving the well-being of worse-off individuals. [FN125] So which value of y should be used?

***43** A first cut at this problem is to use the entire range of values of y. [FN126] This might be illuminating. Larger values of ytranslate into a stronger social preference for equality. [FN127] If PPPA using the Atkinsonian family prefers one policy to another for all values of y, or for all values below a high value of y, or for all values above a low value of y, then the first policy is probably the best policy, all things considered. Conversely, if PPPA's ranking of the two policies is sensitive to the choice of y, then the case for one or the other policy is unclear.

A second cut at this problem is to isolate some range of values of yas particularly plausible through normative analysis, surveys, or reverse engineering. A given value of yhas policy implications. Normative analysis, in the standard reflective equilibrium mode, means making these policy implications explicit and deciding whether the analyst finds them intuitively acceptable or unacceptable. Atkinson long ago suggested a "leaky bucket" thought experiment for specifying a social welfare function, [FN128] and a number of other authors have since seconded his suggestion. [FN129] Leaky-bucket thought experiments have different variants, [FN130] the simplest being as follows. Imagine that one individual h is at well-being level U_h, and a second, less well-off individual l is at well-being level U_l. A policy reduces the first individual's well-being by a små amount, u, and improves the second's by du, with d less than or equal to 1. If d is equal to 1, then anyone but the utilitarian will count the policy as an improvement. Imagine decreasing the value of d from 1. At what value of d do you think that the policy and the status quo are equally good? Your answer fixes a value of y.

A different sort of thought experiment asks about sacrifices to overall well-being for the sake of equalizing well-being. [FN131] Specify an unequal population distribution of well-being, $(U_1, \ldots, U_N)$, and identify the level of ***44** well-being U^+ such that the initial distribution and the distribution $(U^+, U^+, \ldots, U^+)$ are equally good. The level U^+ fixes a value for y. [FN132]

Normative analysis to specify a value of yis no more "indeterminate" or "subjective" than normative philosophical scholarship generally, and should be undertaken by scholars, whether philosophers or welfare economists. A different tack is to conduct a "policy survey"--in effect, to invite the public to engage in normative analysis. "Policy surveys" invite respondents to evaluate policies, not from the stand-point of their own well-being, but from a more disinterested perspective. [FN133] Much survey work of this sort has been undertaken, including surveys about health and risk policy. [FN134] Some economists have in fact used policy surveys to estimate the degree of inequality-aversion of an Atkinsonian SWF: Amiel asks a leaky-bucket question, Lindholm an equalization question. [FN135]

Finally, "reverse engineering" the value of ymeans establishing that value implied by existing policies--for example, existing tax-and-transfer policies. [FN136]

Although the case for limiting PPPA analysis to Atkinsonian SWFs should be very persuasive to those who hold a

"prioritarian" understanding of equality-- who accept the separability axiom--it will be less persuasive to non-prioritarians. The debate between prioritarians and nonprioritarians continues apace in the philosophical literature, with no clear winner. [FN137] Ideally, then, SWF analysis should test policies using both Atkinsonian SWFs and a plausible nonprioritarian SWF. One appealing possibility is to use the rank-weighted SWF. Take a utility vector $(U_1, \ldots, U_N)$. Set W equal to a sum consisting of N times the smallest utility in this vector, plus (N-1) times the next-smallest utility, plus (N-2) times the third-smallest utility, and so forth, up to 1 times the largest utility. This rank-weighted SWF satisfies the Pigou-Dalton principle, is ratio-rescaling-invariant, and (as it happens) generates***45** the Gini coefficient as the corresponding measure of inequality, [FN138] but it does not satisfy the separability principle. A utility transfer from a high-utility to a low-utility individual increases social value (thus the Pigou-Dalton principle is satisfied); but the size of the increase depends on the ranks of the two individuals in the whole population distribution, not their utility levels taken alone.

C. PPPA, Cost-Benefit Analysis, and Equality Measurement

PPPA produces an integrated assessment of policies, sensitive to both overall well-being and equity. Equity-regarding SWFs such as the Atkinsonian SWFs or the rank-weighted SWF are sensitive to equity because they satisfy the Pigou-Dalton axiom. [FN139] At the same time, they are sensitive to overall well-being in that (1) Pareto superior outcomes are always preferred [FN140] and more generally (2) holding constant the degree of inequality, an equity-regarding SWF will prefer the outcome with greater total utility. [FN141]

These observations raise the question of how PPPA relates to cost-benefit analysis (CBA), on the one hand, and inequality measurement, on the other. Eric Posner and I have defended CBA as a proxy for overall well-being. [FN142] PPPA is more flexible than CBA. PPPA can yield a verdict about overall well-being, by inserting a utilitarian SWF into the format. Yet, as just explained, PPPA (unlike CBA) can yield a judgment about whether the policy is better than the status quo on balance, given both overall-well-being and equity concerns. This occurs automatically when PPPA employs an equity-regarding rather than utilitarian SWF.

***46** At some point PPPA might displace CBA. But that is not the proposal here. CBA is widely employed by agencies, and its techniques are now highly developed. PPPA is novel and untested. My proposal, therefore, is that agencies and policy analysts employ PPPA in conjunction with CBA. If both CBA and PPPA favor one policy over a second, then the case for the first policy is strong. If CBA favors the first policy but PPPA favors the second, then it would appear that overall well-being favors the first policy but that the overall balance of moral considerations-- overall well-being plus equity-- favors the second. The case for the first policy is weaker; the case for the second policy is stronger, although not yet necessarily clear, because PPPA itself is an experimental procedure. In this event, it may be appropriate for the agency to undertake a more intensive CBA or PPPA, or perhaps to elicit guidance from Congress or the President.

What about the connection between PPPA and inequality measurement? PPPA yields an integrated assessment of policies, but agencies may find it useful to ascertain how policies compare purely as a matter of equality. PPPA readily yields that sort of evaluation. Economists of inequality have developed the important insight that any equity-regarding SWF generates a corresponding inequality metric. For a given social welfare function W, there is a corresponding inequality metric M^W, which ranges from zero (no inequality) to 1 (maximal inequality), defined as follows. For any utility vector $(U_1, U_2, \ldots, U_N)$, identify U^+ such that $W(U_1, U_2, \ldots, U_N) = W(U^+, U^+, \ldots, U^+)$. In other words, a perfectly equal outcome in which every individual receives the same amount of utility, U^+, has the same W-value as the initial vector. Then

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The denominator of the

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fraction is the total well-being associated with the initial vector; the numerator is the amount of total well-being which, if equally distributed, would have the same W-value as the initial vector. The smaller this fraction is, the larger the fraction of the total well-being associated with the initial vector that could be lost in an equalizing redistribution while still holding social welfare constant, and thus the larger the degree of inequality. [FN143]

With this insight, PPPA can be straightforwardly adapted to provide a judgment about the change in expected inequality produced by a policy. The status quo is a probability distribution across lifetime utility vectors; the policy is a different distribution. For each possible status quo vector, we determine its inequality as measured by M^W. The expected status quo inequality ***47** is simply the sum of each vector's inequality, discounted by its probability. The same series of calculations yields the expected degree of inequality for the policy.

Conclusion

This Article presents a novel approach to considering the equity impacts of risk regulation policies. This approach, "probabilistic population profile analysis" (PPPA), is rooted in the SWF view of social choice--specifically, in a particular version of the SWF approach for which I have provided a full philosophical defense elsewhere, one that focuses on lifetime well-being and that adopts an ex post rather than ex ante view of choice under uncertainty. From this perspective, PPPA is a large improvement on existing approaches to risk equity, described in Part I. PPPA adopts a population-wide approach to equity, unlike the social gradient view adopted by environmental justice scholars. It attends to the impact of both income and health/longevity on individuals' (lifetime) well-being. (By contrast, "individual risk" tests focus solely on longevity; QALY analysis handles income impacts imperfectly; and incidence analysis handles health/longevity impacts imperfectly.) PPPA addresses uncertainty in an ex post manner, unlike "individual risk" tests or CBA using the VSL method. And PPPA is sensitive to both overall well-being and the distribution of well-being, unlike inequality metrics or incidence analysis (or, for that matter, "individual risk" tests or the disparate-impact tests employed in the environmental justice literature).

Nor is PPPA a utopian project. The SWF approach has already been employed to study tax policies and, in a few cases, environmental policies. Part II describes in detail how PPPA would be implemented. It discusses both the information that would be needed to bring the approach to full fruition (such as surveys to calibrate utility functions, and more survey work to calibrate the SWF), as well as the steps that policymakers can take in the interim.

Only utilitarians believe that policy choice should be solely a function of overall well-being. Only utilitarians, then, should be comfortable with the current state of policy analysis, as practiced by governmental agencies and supported by the existing scholarly literature. Cost-benefit analysis, which is a workable measure of overall well-being, [FN144] is now very highly developed and widely employed by agencies. Equity analysis garners much less scholarly attention and is rarely used in government. We need to develop implementable and philosophically well-grounded tools for evaluating the equity impacts of policies. PPPA is one such tool and, I believe, a particularly promising one.

[FNa1]. Leon Meltzer Professor of Law, University of Pennsylvania Law School. Thanks to Scott Farrow, Adam Finkel, John

Graham, James Hammitt, Olof Johansson-Stenman, Daniel Markovits, Andrew Oswald, Eric Posner, Chris Sanchirico, Cass Sunstein, and Jonathan Wiener, for very helpful comments.

[FN1]. For citations to the scholarly literature on risk assessment, and to descriptions of the use of risk assessment by governmental bodies, see Matthew D. Adler, Against "Individual Risk": A Sympathetic Critique of Risk Assessment, 153 U. Pa. L. Rev. 1121, 1128-29 nn.28-29 (2005) [hereinafter Adler, Against "Individual Risk"]. On cost-benefit scholarship, see, for example, A. Myrick Freeman III, The Measurement of Environmental and Resource Values (2d ed. 2003). On the use of cost-benefit analysis in the federal government, see generally Matthew D. Adler & Eric A. Posner, New Foundations of Cost-Benefit Analysis 1-4, 101-23 (2006), and sources cited therein.

[FN2]. Exec. Order No. 12,866 § 1(a), 58 Fed. Reg. 51,735, 51,735 (Oct. 4, 1993). The recent amendments to Executive Order 12,866, by Executive Order 13,422, do not change the substantive requirements imposed on agency rules by Executive Order 12,866 and, in particular, do not change its content regarding "distributive impacts" and "equity." Exec. Order. No. 13,422, 72 Fed. Reg. 2763 (Jan. 23, 2007).

[FN3]. See Circular A-4, Off. Mgmt. & Budget (Sept. 17, 2003), available at http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf.

[FN4]. Exec. Order No. 12,898 § 1-101, 59 Fed. Reg. 7629, 7629 (Feb. 11, 1994).

[FN5]. Id.

[FN6]. A number of these empirical studies are cited in William Bowen, An Analytical Review of Environmental Justice Research: What Do We Really Know?, 29 Envtl. Mgmt. 3, 13-15 (2002) and in Evan J. Ringquist, Assessing Evidence of Environmental Inequities: A Meta-Analysis, 24 J. Pol'y Anal. & Mgmt. 223, 245-47 (2005). Other scholarship about environmental justice is cited or excerpted in Clifford Rechtschaffen & Eileen Gauna, Environmental Justice: Law, Policy, and Regulation (2002); Sheila R. Foster, Meeting the Environmental Justice Challenge: Evolving Norms in Environmental Decisionmaking, 30 Envtl L. Rep. 10992 (2000); and Robert Kuehn, A Taxonomy of Environmental Justice, 30 Envtl. L. Rep. 10681 (2000).

[FN7]. On environmental justice tools, see, for example, EPA, Science Advisory Board: Review of Disproportionate Impact Methodologies (1998); Feng Liu, Environmental Justice Analysis: Theories, Methods, and Practice (2001); Transportation Research Board of the Nat'l Academies, Effective Methods for Environmental Justice Assessment (2004). As discussed below, there are close parallels between the environmental justice and health equity literatures, see infra text accompanying notes 15-19; and that latter literature has developed a variety of metrics for quantifying social skews in health. See, e.g., Johan P. Mackenbach & Anton E. Kunst, Measuring the Magnitude of Socio-economic Inequalities in Health: An Overview of Available Measures Illustrated with Two Examples from Europe, 44 Soc. Sci. Med. 757 (1997).

[FN8]. For a critical review of environmental justice policy at EPA, see EPA, Office of the Inspector General, EPA Needs to Consistently Implement the Intent of the Executive Order on Environmental Justice, Report No. 2004-P-00007 (2004). See also Richard J. Lazarus & Stephanie Tai, Integrating Environmental Justice into EPA Permitting Authority, 26 Ecology L.Q. 617 (1999); Bradford C. Mank, The Draft Title VI Recipient and Revised Investigation Guidances: Too Much Discretion for EPA and a More Difficult Standard for Complaints?, 30 Envtl. L. Rep. 11144 (2000) [hereinafter Mank, The Draft Title VI Recipient]; Bradford C. Mank, Executive Order 12,898, in The Law of Environmental Justice 107-14, 125-29 (Michael B. Gerrard ed., 1999) [hereinafter Mank, Executive Order 12,898]. On environmental justice policy at other federal agencies, see Denis Binder et al., A Survey of

Federal Agency Response to President Clinton's Executive Order No. 12898 on Environmental Justice, 31 Envtl. L. Rep. 11133 (2001); Mank, Executive Order 12,898, supra, at 114-23, 129-31.

[FN9]. On risk assessment at EPA, see, e.g., Adler, Against "Individual Risk," supra note 1, at 1149-64; id. at 1148 n.91 (citing sources). On cost-benefit analysis, see, for example, Economic Analyses at EPA (Richard D. Morgenstern ed., 1997).

[FN10]. See EPA, Office of the Inspector General, supra note 8, at 19-26 (discussing differing approaches to identifying disparate impacts on low-income and minority communities employed by EPA regional offices and EPA's failure to establish a single approach). EPA's guidance on incorporating distributional concerns into cost-benefit analysis is lengthier than OMB's in Circular A-4, see supra note 3; but it still fails to recommend specific policy metrics for quantifying the degree of distributional skew or balancing distributive concerns with efficiency/overall welfare. See EPA, Guidelines for Preparing Economic Analyses 139-74 (2000).

[FN11]. See infra Part I.C.

[FN12]. See infra Parts I.D, I.F.

[FN13]. See infra Part I.B.

[FN14]. For non-economists, what this formula means is that we assign the individual's health state and income state in each period a value. We next multiply these two numbers, arriving at a total value for each period. These period values are then summed to determine lifetime utility.

[FN15]. On this conception within the environmental justice literature, see, e.g., Kuehn, supra note 6, at 10683-84. The recent EPA Inspector General report claims that EPA itself is resistant to the social-gradient conception of risk equity. See EPA, Office of the Inspector General, supra note 8, at 10-11. EPA, however, has officially adopted this conception in various documents. See, e.g., EPA, EPA Guidance for Consideration of Environmental Justice in Clean Air Act Section 309 Reviews (1999); Mank, The Draft Title VI Recipient, supra note 8, at §1.3.

[FN16]. Scott Farrow has proposed a related approach to equity--namely that a policy not only pass the test of Kaldor-Hicks efficiency, but that actual compensation be provided to members of a "sensitive group," such as low-income or minority groups. Scott Farrow, Environmental Equity and Sustainability: Rejecting the Kaldor-Hicks Criteria, 27 Ecological Econ. 183, 185-86 (1998). This proposal, like the disparate-impact tests considered in the text, is vulnerable to the objection that it ignores inequalities among individuals who do not belong to the "sensitive group."

[FN17]. See Washington v. Davis, 426 U.S. 229 (1976).

[FN18]. See, e.g., 42 U.S.C. 2000e-2(k) (2006). I say "arguably" because it is plausible (although certainly not uncontroversial) to take the view that federal prohibitions on practices with a disparate impact are grounded in Congress's power to enforce the Equal Protection Clause, under Section 5 of the Fourteenth Amendment. See, e.g., Richard A. Primus, Equal Protection and Disparate Impact: Round Three, 117 Harv. L. Rev. 493, 494-95 & n.4 (2003).

[FN19]. See, e.g., Sudhir Anand, The Concern for Equity in Health, in Public Health, Ethics, and Equity 15, 19-20 (Sudhir Anand et al. eds., 2004); Paula Braveman, Health Disparities and Health Equity: Concepts and Measurement, 27 Ann. Rev. Pub. Health 167, 169-70 (2006); C.J.L. Murray et al., Health Inequalities and Social Group Differences: What Should We Measure?, 77 Bull. World Health Org. 537, 537-38 (1999); Adam Wagstaff & Eddy van Doorslaer, Overall Versus Socioeconomic Health Inequality: A Measurement Framework and Two Empirical Illustrations, 13 Health Econ. 297, 297 (2004); WHO Task Force on Research Priorities for Equity in Health & The WHO Equity Team, Priorities for Research to Take Forward the Health Equity Policy Agenda, 83 Bull. World Health Org. 948, 948 (2005).

[FN20]. See Liu, supra note 7, at 95-96; Transportation Research Board, supra note 7, at 19.

[FN21]. See supra sources cited in note 7.

[FN22]. Paula Braveman & Sofia Gruskin, Defining Equity in Health, 57 J. Epidemiology & Cmty. Health 254, 254 (2003) (emphasis removed). For a similar analysis, see Braveman, supra note 19, at 180-82.

[FN23]. See Braveman & Gruskin, supra note 22, at 256; Braveman, supra note 19, at 180-88.

[FN24]. Iris Marion Young, Equality of Whom? Social Groups and Judgments of Injustice, 9 J. Pol. Phil. 1, 7 (2001).

[FN25]. Id. at 8.

[FN26]. Id. at 16.

[FN27]. Id. at 15 (emphasis omitted).

[FN28]. Id. at 16.

[FN29]. Much of the recent philosophical literature on equality has tried to articulate a conception of equality that is sensitive to individual responsibility--a concern triggered by Ronald Dworkin's famous work on equality of resources, which distinguishes between “brute luck” and “option luck.” See, e.g., Richard J. Arneson, Welfare Should be the Currency of Justice, 30 Can. J. Phil. 497 (2000) (citing Ronald Dworkin, What is Equality? Part 1: Equality of Welfare, 10 Phil. & Pub. Aff. 189 (1981); Ronald Dworkin, What is Equality? Part 2: Equality of Resources, 10 Phil. & Pub. Aff. 283 (1981); Ronald Dworkin, What is Equality? Part 3: The Place of Liberty, 73 Iowa L. Rev. 1 (1987)).

[FN30]. See, e.g., Derek Parfit, Equality or Priority?, in The Ideal of Equality 81, 95-97 (Matthew Clayton & Andrew Williams eds., 2000) (discussing egalitarian views that do not object to natural inequality).

[FN31]. See Adler, Against “Individual Risk,” supra note 1, at 1149-79.

[FN32]. See id. at 1155-58.

[FN33]. More precisely, FDA takes this approach for carcinogens exempt from the Delaney Clause. See id. at 1164-69.

[FN34]. See id. at 1150-52.

[FN35]. See id. at 1169-71.

[FN36]. See id. at 1173-78.

[FN37]. See, e.g., Adam M. Finkel, Comparing Risks Thoughtfully, 7 Risk: Health, Safety & Env't 325, 342-44 (1996); John D. Graham, Making Sense of Risk: An Agenda for Congress, in Risks, Costs, and Lives Saved 183, 190-91 (Robert W. Hahn ed., 1996). See also Matthew D. Adler, Risk, Death and Harm: The Normative Foundations of Risk Regulation, 87 Minn. L. Rev. 1293, 1423-31 (2003) (discussing environmental-justice account that attends to skews with respect to "individual risk" levels).

[FN38]. For overviews of the literature on measuring the inequality of income, see Hilde Bojer, Distributional Justice: Theory and Measurement 63-134 (2003); Peter Lambert, The Distribution and Redistribution of Income 13-132 (3d ed. 2001); Amartya Sen, On Economic Inequality 24-46 (expanded ed. 1997); F.A. Cowell, Measurement of Inequality, in 1 Handbook of Income Distribution 87 (A.B. Atkinson & F. Bourguignon eds., 2000). As I explain in Part II of the Article, my position is that risk regulation policies should be evaluated with reference to an Atkinsonian social welfare function, which can in turn be decomposed into an Atkinsonian measure of inequality and overall welfare. See infra Part II.C.

[FN39]. Shortly before publication of this Article, I became aware of empirical work by Jonathan Levy and collaborators that does precisely this. See Jonathan I. Levy et al., Quantifying the Efficiency and Equity Implications of Power Plant Air Pollution Control Strategies in the United States, 115 Envtl. Health Persp. 743 (2007). The approach (which the authors see as applicable to health as well as mortality risks) is also described in Jonathan I. Levy et al., Incorporating Concepts of Inequality and Inequity into Health Benefits Analysis, 5 Int'l J. Equity in Health 2 (2006). Although I argue for a different approach here, Levy and his collaborators are to be commended for analyzing the equity implications of air pollution policies in a rigorous and novel way, focusing on population-wide inequality rather than social gradients, and applying inequality metrics developed in the income-inequality literature to risk regulation.

[FN40]. See W. Kip Viscusi, Risk Equity, in Cost-Benefit Analysis: Legal, Economic, and Philosophical Perspectives 7, 25-31 (Matthew D. Adler & Eric A. Posner eds., 2001) (criticizing conception of risk equity that focuses on incremental risk).

[FN41]. There are different ways to define the incremental fatality risk to person P from toxins of type X during period T: (1) the risk that X-type toxins cause P's death during T; (2) the difference in the risk that P dies during T, conditional on his exposure to X-type toxins, and the risk that P dies during T, conditional on non-exposure; and (3) the difference in the risk that P dies in the manner characteristic of deaths caused by X-type toxins (e.g., dies from cancer), conditional on his exposure to X-type toxins, and the risk that P dies in that manner conditional on non-exposure. If T is less than a full lifetime, all three definitions are possibilities. If T is a full lifetime, the first and third are. My critique of an approach to risk equity that focuses on incremental fatality risks does not depend on which precise definition of incremental risk is adopted.

[FN42]. See Matthew D. Adler, Well-Being, Inequality, and Time: The Time-Slice Problem and its Policy Implications (Univ. of Pa. Inst. for Law & Econ., Research Paper No. 07-17, 2007), available at http://ssrn.com/abstract=1006871; see also infra text accompanying note 82.

[FN43]. See Matthew D. Adler & Chris William Sanchirico, Inequality and Uncertainty: Theory and Legal Applications, 155 U. Pa. L. Rev. 279 (2006).

[FN44]. This particular variant of the "individual risk" approach is chosen simply for the sake of illustration. Other holistic variants of the "individual risk" approach also involve an ex ante conception of equality under uncertainty--for example, measuring the distribution of the risk of death during some time period other than a year, or measuring the distribution of the lifetime risk of death in a particular manner (e.g., cancer), or measuring the distribution of life expectancy.

[FN45]. See Adler & Sanchrico, supra note 43, at 304-34.

[FN46]. See id. at 334-50.

[FN47]. I use $l(h_{i,t})$ here, rather than $q(h_{i,t})$, as in the additive-across-periods/multiplicative-within-periods representation of lifetime utility as a function of health and income, see infra text accompanying notes 105-107, because it is an open question what the connection is between the l function, i.e., the zero-to-one scaling of health states elicited through QALY surveys, and the q function.

[FN48]. See generally Matthew D. Adler, QALYs and Policy Evaluation: A New Perspective, 6 Yale J. Health Pol'y L. & Ethics 1, 1-16 (2006) (describing QALY metric, discussing current governmental use, and reviewing and citing scholarship).

[FN49]. See generally Franco Sassi et al., Equity and the Economic Evaluation of Healthcare, 5 Health Tech. Assessment 1, 16-28 (2001) (summarizing this literature).

[FN50]. See Emmanuela Gakidou et al., Defining and Measuring Health Inequality: An Approach Based on the Distribution of Health Expectancy, 78 Bull. World Health Org. 42 (2000).

[FN51]. See, e.g., Paul Dolan, The Measurement of Individual Utility and Social Welfare, 17 J. Health Econ. 39 (1998); Lars Lindholm & Måns Rosén, On the Measurement of the Nation's Equity Adjusted Health, 7 Health Econ. 621 (1998); Lars Peter Osterdal, Axioms for Health Care Resource Allocation, 24 J. Health Econ. 679 (2005); Adam Wagstaff, QALYs and the Equity-Efficiency Trade-Off, 10 J. Health Econ. 21, 35-38 (1991); Alan Williams, Intergenerational Equity: An Exploration of the 'Fair Innings' Argument, 6 Health Econ. 117 (1997).

[FN52]. See Sassi, supra note 49, at 19-21.

[FN53]. See, e.g., Gakidou et al., supra note 50, at 43-44; Magnus Johannesson, Should We Aggregate Relative or Absolute

Changes in QALYs?, 10 Health Econ. 573, 574-75 (2001); Williams, supra note 51, at 120-21.

[FN54]. Namely, a policy might reduce the expected value of a given social welfare function taking individual lifetime QALYs as its arguments, but increase the expected value of that same social welfare function now taking individual utility as a function of individual longevity, health, and income as its arguments. This latter approach is just PPPA.

[FN55]. More precisely, the decision rule compares the incremental cost-effectiveness of policies with cutoff ratios. See Adler, supra note 48, at 8-9, 85-88.

[FN56]. See Don Fullerton & Diane Lim Rogers, Who Bears the Lifetime Tax Burden? 1-17 (1993).

[FN57]. See generally Ian W.H. Parry et al., The Incidence of Pollution Control Policies 10-19 (Resources for the Future, Discussion Paper 05-24, June 2005) (reviewing literature), available at http:// www.rff.org/rff/Documents/RFF-DP-05-24.pdf.

[FN58]. See id. at 5-6, 14.

[FN59]. See id. at 25.

[FN60]. See infra Part I.E.

[FN61]. See supra text accompanying note 50.

[FN62]. See infra Part II.B.2.

[FN63]. See Louis Kaplow, Why Measure Inequality? 5-6 (Harvard Law Sch. Olin Discussion Paper No. 386, 2002).

[FN64]. See infra Part II.C.

[FN65]. See Adler & Posner, supra note 1, at 1-5.

[FN66]. See Olof Johansson-Stenman, Distributional Weights in Cost-Benefit Analysis--Should We Forget About Them?, 81 Land Econ. 337 (2005).

[FN67]. See H.M. Treasury, The Green Book: Appraisal and Evaluation in Central Government 24-25, 91-96 (2003), available at http://www.hm-treasury.gov.uk/media/3/F/green_book_260907.pdf; Jean Drèze, Distribution Matters in Cost-Benefit Analysis: Comment on K.A. Brekke, 70 J. Pub. Econ. 485, 486 (1998).

[FN68]. These are the changes in annual income amounts in the policy outcome that make the individual indifferent between the

status quo and the policy. Strictly speaking, these changes are not WTP/WTA amounts--since an individual's WTP/WTA is usually understood as a present, one-time payment sufficient to make her indifferent between the policy and the status quo. To calculate WTP/WTA amounts in this standard sense, we would need to know how long the individuals live and what the discount rate is. For simplicity, then, my example uses WTP/WTA defined as compensating changes to annual income. The point of the example--namely, that large changes in individual incomes pose difficulties for the specification of weights-- is unaffected by the choice of annual versus one-time compensation measures.

[FN69]. See Johansson-Stenman, supra note 66, at 337-38, 340-42; Parry, supra note 57, at 26-29. See also Liqun Liu, Combining Distributional Weights and the Marginal Cost of Funds: The Concept of Person-Specific Marginal Cost of Funds, 34 Pub. Fin. Rev. 60, 63-64 (2006) (discussing use of SWF to set the marginal cost of funds).

[FN70]. See Adler, Against "Individual Risk," supra note 1, at 1197-98, 1198 n.300.

[FN71]. See also James K. Hammitt & Nicolas Treich, Statistical Versus Identified Lives in Benefit-Cost Analysis, 35 J. Risk & Uncertainty 45 (2005) (showing that CBA, using the VSL method, may deviate from a utilitarian SWF that maximizes the sum of expected utilities because that method is sensitive to information about the distribution of individual fatality risks that the utilitarian SWF would ignore).

[FN72]. I say that $w^L >= w^N$ to accommodate both the possibility that the weights for the exposed individuals are determined by their attributes in the status quo (in which case $w^L > w^N$) and the possibility that those weights are determined by their attributes with the policy (in which case $w^L = w^N$). However these weights are set, weighted CBA can deviate from an SWF applied in an ex post manner.

[FN73]. For that matter, a utilitarian SWF which is applied in an ex post or ex ante manner will treat the two cases as identical. From the ex post perspective, the two cases are identical; and a utilitarian SWF always reaches the same verdicts whether applied ex post or ex ante. See Adler and Sanchirico, supra note 43, at 307. Only a distributively-sensitive SWF applied in an ex ante manner might treat the two cases as different.

[FN74]. To be sure, this is only true if the amount and distribution of fear in the two cases are the same. See generally Matthew D. Adler, ~~Fear Assessment: Cost-Benefit Analysis and the Pricing of Fear and Anxiety, 79 Chi-Kent L. Rev. 977 (2004)~~. The hypothetical should therefore be structured so that no individual experiences a different fear state in the status quo in the first case than in the second case, and so that no individual experiences a different fear state with the policy in the first case than in the second case. In particular, it might be assumed that the exposed populations in the two cases are unaware of their exposures.

[FN75]. See Robin Boadway & Neil Bruce, Welfare Economics 137-69 (1984).

[FN76]. See Matti Tuomala, Optimal Income Tax and Redistribution 1-14 (1990); Nicholas Stern, The Theory of Optimal Commodity and Income Taxation: An Introduction, in The Theory of Taxation for Developing Countries 22 (David Newberry & Nicholas Stern eds., 1987).

[FN77]. See Parry et al., supra note 57, at 26-28. A recent article by Marc Fleurbaey addresses issues of health equity using the

SWF framework. See Marc Fleurbaey, Health Equity and Social Welfare, 83/84 Annales d'Economie et de Statistique 21 (2006). Unfortunately, I became aware of Fleurbaey's article as this Article was going to press and was not able to revise the Article to discuss how it bears on my analysis.

[FN78]. See Adler & Posner, supra note 1, at 25-39; Matthew D. Adler, Welfare Polls: A Synthesis, 81 N.Y.U. L. Rev. 1875, 1904-05, 1959-68 (2006).

[FN79]. By "outcome," I mean a set of possible worlds that is homogenous with respect to each individual's well-being. A possible world is a completely specified possible history of the universe. A different definition of outcome is also conceivable: one might just define an outcome as a single possible world and conceptualize SWFs as operating on utility vectors corresponding to each possible world. But this definition unnecessarily inflates the number of outcomes, since every possible world within each set of possible worlds homogeneous with respect to each individual's well-being would have the same utility vector.

[FN80]. See Adler & Sanchirico, supra note 43, at 296-304.

[FN81]. See infra Part II.B.3.

[FN82]. See Adler, supra note 42.

[FN83]. See Adler & Sanchirico, supra note 43.

[FN84]. Variable-population issues pose a difficult set of problems for social choice theory which I will not attempt to engage here. See generally Charles Blackorby et al., Population Issues in Social Choice Theory, Welfare Economics, and Ethics (2005). Extending PPPA to the variable-population case is a topic for further research.

[FN85]. To be sure, there is a burgeoning literature on the measurement of happiness, but I take it that data on the current population distribution of happiness, and on how policies perturb that, is still thinner than data on health and income. In any event, as mentioned immediately below, PPPA certainly could be modified to incorporate happiness data and have lifetime utilities be partly determined by happiness. Crucially, however, happiness is not the sole component of well-being. For citations to the happiness literature and a discussion of the connection between happiness and well-being, see Matthew D. Adler & Eric A. Posner, Happiness Research and Cost-Benefit Analysis (Univ. of Pa. Inst. for Law & Econ., Research Paper No. 07-15, 2007), available at http://ssrn.com/abstract=999928.

[FN86]. Our best-developed policy-analytic tools, such as CBA, provide rigorous guidance in choosing among a given set of options, not in identifying the initial choice set. See Matthew D. Adler, Rational Choice, Rational Agenda-Setting, and Constitutional Law: Does the Constitution Require Basic or Strengthened Public Rationality?, in Linking Politics and Law 109, 113-14 (Christoph Engel & Adrienne Héritier eds., 2003). PPPA is similar to CBA in this regard.

[FN87]. See EPA, Guidelines for Preparing Economic Analyses 126-30 (2000).

[FN88]. See id.; Parry, supra note 57; Klaus Conrad, Computable General Equilibrium Models in Environmental and Resource Economics, in The International Yearbook of Environmental and Resource Economics 2002/2003 66, 66 (Tom Tietenberg & Henk Folmer eds., 2002).

[FN89]. Fullerton & Rogers, supra note 56, at 4-5.

[FN90]. Another example of the use of simulation models to estimate policy effects on lifetime incomes is Jan H.M. Nelissen, Annual Versus Lifetime Income Redistribution by Social Security, 68 J. Pub. Econ. 223 (1998). Further examples are discussed id. at 224-25.

[FN91]. See generally Summary Measures of Population Health (Christopher J.L. Murray et al. eds., 2002).

[FN92]. See generally sources cited supra note 1.

[FN93]. See Michael Wolfson & Geoff Rowe, On Measuring Inequalities in Health, 79 Bull. World Health Org. 553, 557-58 (2001) (describing use of microsimulation modeling to estimate population health inequality and stating that existing modeling methods are "more than adequate").

[FN94]. On tobacco policy, see, for example, Sajjad Ahmad & John Billimek, Estimating the Health Impacts of Tobacco Harm Reduction Policies: A Simulation Modeling Approach, 25 Risk Anal. 801 (2005); Tammy O. Tengs et al., Federal Policy Mandating Safer Cigarettes: A Hypothetical Simulation of the Anticipated Population Health Gains or Losses, 23 J. Pol'y Anal. & Mgmt. 857 (2004) and sources cited therein. On cancer policy, see David Fone et al., Systematic Review of the Use and Value of Computer Simulation Modelling in Population Health and Health Care Delivery, 25 J. Pub. Health Med. 325, 332 (2003).

[FN95]. Tengs et al., supra note 94, at 860.

[FN96]. See, e.g., Tony Blakely & Nick Wilson, Shifting Dollars, Saving Lives: What Might Happen to Mortality Rates, and Socio-Economic Inequalities in Mortality Rates, if Income Was Redistibuted?, 62 Soc. Sci. Med. 2024, 2024-25 (2006); Braveman, supra note 19, at 169-70, 172; Ulf-G. Gerdtham & Magnus Johannesson, Income-Related Inequality in Life-Years and Quality-Adjusted Life-Years, 19 J. Health Econ. 1007, 1007-08 (2000). See also Angus Deaton, Health, Inequality, and Economic Development, 41 J. Econ. Lit. 113, 113-14 (2003) (discussing literature concerning connection between income inequality and health).

[FN97]. For example, the Tobacco Policy Model described above uses gender as one predictor of annual transitions. See Tengs et al., supra note 94, at 860.

[FN98]. See, e.g., Braveman, supra note 19, at 170-72; Peter Franks et al., The Burden of Disease Associated with Being African-American in the United States and the Contribution of Socio-Economic Status, 62 Soc. Sci. & Med. 2469, 2469-70 (2006).

[FN99]. See Adler, supra note 78, at 1965-68; Adler, supra note 48, at 53-57, 55 n.184.

[FN100]. See generally Adler, supra note 78.

[FN101]. See Adler, supra note 48, at 19-20, 47; Aki Tsuchiya & Paul Dolan, The QALY Model and Individual Preferences for Health States and Health Profiles over Time: A Systematic Review of the Literature, 25 Med. Decision Making 460 (2005). To be sure, surveys to elicit respondents' preferences regarding longevity-health-income histories must be designed to be feasible, given respondents' cognitive limitations. Respondents cannot be asked to evaluate every possible history. On this score, it should be noted that the proposal of some health scholars to use a survey format which would value health histories--the "healthy year equivalent" or "HYE" format--has been criticized as infeasible. See id. at 465-67. However, it is not clear why using surveys to assign values to temporally extended histories is qualitatively less feasible than using surveys to value momentary states, which is what the QALY format does. Just as it is impossible for a cognitively limited respondent to consider all possible histories, so it is impossible for her to consider all possible momentary states. QALY survey designers circumvent this difficulty in various ways. For example, they may use standardized "health state classification systems" to describe health states as a combination of locations on a discrete number of dimensions, and ask each respondent to value a sample of the total set of possible states, so as to estimate a function that maps each combination of locations along the dimensions to a QALY value. See, e.g., Adler, supra note 48, at 48-50. It is not clear why similar devices could not be used to elicit valuations of temporally extended histories.

[FN102]. See, e.g., Adler, supra note 48, at 40-41 n.133 (citing surveys of health-related contingent valuation studies).

[FN103]. In particular, Harsanyi's account of interpersonal comparisons, which reduces judgments of overall well-being to preferences over lotteries of possible life histories, provides a theoretical basis for the lifetime standard gamble. See Adler, supra note 48, at 17-24 (presenting Harsanyi's account).

[FN104]. See Ann M. Holmes, A Method to Elicit Utilities for Interpersonal Comparisons, 17 Med. Decision Making 10 (1997).

[FN105]. See James K. Hammitt, How Much is a QALY Worth? Admissible Utility Functions for Health and Wealth 2 (May 2002) (unpublished manuscript, on file with the Harvard Environmental Law Review).

[FN106]. Strictly, $h_{i,t}$ should be $h_{i,t,k}$ and $y_{i,t}$ should be $y_{i,t,k}$, but to avoid unwieldy symbols I have omitted the "k" subscript.

[FN107]. See Han Bleichrodt & John Quiggin, Life-Cycle Preferences over Consumption and Health: When Is Cost-Effectiveness Analysis Equivalent to Cost-Benefit Analysis?, 18 J. Health Econ. 681, 683-90 (1999).

[FN108]. See Adler, supra note 48, at 25-30. More precisely, $U(L_{i,k}) = Q(H_{i,k}) \times V(B_{i,k})$, where $B_{i,k}$ is the "background" or non-health characteristics of individual i in outcome O_k (such as income, social position, family relationships, or professional accomplishment). If PPPA ignores background characteristics other than income, then $Q(H_{i,k}) \times V(B»$ ») be»comes $Q(H^{i,k}) \times V(Y^{i,k})$.

[FN109]. Cf. William N. Evans & W. Kip Viscusi, Estimation of State-Dependent Utility Functions using Survey Data, 73 Rev. Econ. & Stat. 94 (1991) (using contingent-valuation surveys to estimate the structure of utility as a function of health and income); W. Kip Viscusi & William N. Evans, Utility Functions that Depend on Health Status: Estimates and Economic Implications, 80 Am. Econ. Rev. 353 (1990) (same); Beatrice Rey & Jean-Charles Rochet, Health and Wealth: How Do They Affect Individual

Preferences?, 29 Geneva Papers on Risk & Ins. Theory 43 (2004) (discussing possible test to discriminate between different health-and-wealth utility functions).

[FN110]. See, e.g., Paul Dolan et al., The Time Trade-Off Method: Results from a General Population Survey, 5 Health Econ. 141, 150 (1996).

[FN111]. See, e.g., Adler, supra note 48, at 21-22; Adler & Posner, supra note 1, at 49-50, 161-62, 161 n.28; Matthew D. Adler, Incommensurability and Cost-Benefit Analysis, 146 U. Pa. L. Rev. 1371, 1401-08 (1998).

[FN112]. See, e.g., Tuomala, supra note 76, at 47; Olof Johansson-Stenman, On the Value of Life in Rich and Poor Countries and Distributional Weights Beyond Utilitarianism, 17 Envtl. & Resource Econ. 299, 302-03 (2000); Christian Gollier, The Economics of Risk and Time 27 (2001).

[FN113]. See David J. Evans, The Elasticity of Marginal Utility of Consumption: Estimates for 20 OECD Countries, 26 Fiscal Studies 197, 200 (2005).

[FN114]. See Frank A. Cowell & Karen Gardiner, Welfare Weights 25-29 (STICERD, London School of Economics, 1999); Evans, supra note 113; David Pearce & David Ulph, A Social Discount Rate for the United Kingdom 9-15 (CSERGE Working Paper GEC 95-01, 1995). See also Louis Kaplow, The Value of a Statistical Life and the Coefficient of Relative Risk Aversion, 31 J. Risk & Uncertainty 23 (2005) (discussing high values of e estimated in literature on "equity premium," and the inconsistency between those values and existing estimates of the income elasticity of the value of statistical life); Louis R. Eeckhoudt & James K. Hammitt, Background Risks and the Value of a Statistical Life, 23 J. Risk and Uncertainty 261, 276-77 (2001) (discussing relation between income elasticity of VSL and coefficient of relative risk aversion). For an interesting recent study that uses a Harsanyi-style veil of ignorance format to estimate e, see Olof Johansson-Stenman et al., Measuring Future Grandparents' Preferences for Equality and Relative Standing, 112 Econ. J. 362 (2002).

[FN115]. Pearce & Ulph, supra note 114, at 14-16. These authors focus on the range of e appropriate for policymaking in the United Kingdom.

[FN116]. Cowell & Gardiner, supra note 114, at 33. See also Johansson-Stenman et al., supra note 114, at 363 (noting that "values in the interval 0.5-2 [for relative risk aversion] are often referred to").

[FN117]. See Viscusi & Evans, supra note 109, at 363-67. See also Frank A. Sloan et al., Alternative Approaches to Valuing Intangible Health Losses: The Evidence for Multiple Sclerosis, 17 J. Health Econ. 475, 478, 489-90 (1998).

[FN118]. As already mentioned, Ann Holmes has conducted surveys where respondents are asked to value hypothetical lives described both in terms of health and in terms of other characteristics. The additional characteristics include gender. See Holmes, supra note 104.

[FN119]. See Tuomala, supra note 76, at 28-29; Johansson-Stenman, supra note 112, at 302-03; Samuel Fankhauser et al., The Aggregation of Climate Change Damages: A Welfare Theoretic Approach, 10 Evntl. & Resource Econ. 249, 257 (1997). In some of

this literature, the social welfare function is an Atkinsonian function that takes individual incomes rather than utilities as its arguments. See Parry et al., supra note 57, at 26-28; Louis Kaplow, Concavity of Utility, Concavity of Welfare, and Redistribution of Income 2 (Harvard L. Sch. Discussion Paper No. 437, 2003). Atkinsonian SWFs are also used in the health economics literature that discusses applying SWFs to QALYs. See sources cited supra note 51.

[FN120]. See, e.g., Bojer, supra note 38, at 110. The formula for the Atkinsonian SWF is sometimes multiplied by 1/N, where N is the population size. Where N is the same in all outcomes--as assumed throughout this Article, see supra text accompanying note 84--that formula is equivalent to the one given in the text, both in its ranking of utility vectors and in its ranking of policies. In the case where y= 1, the formula for the Atkinsonian SWF is sometimes given as the product of individuals' utilities rather than the sum of the logarithms of utilities. These formulations are increasing transformations of each other (see, e.g., Fankhauser, supra note 119, at 257-58) and therefore order utility vectors (but not necessarily policies) the same way. See infra note 121.

[FN121]. Take an Atkinsonian SWF

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with yspecified. Consider W*, which is an increasing transformation of W. (In other words, $W^*(U_1,U_2,...,U_N) = g(W(U_1,U_2,...,U_N))$, where g is what's known as an “increasing” or “monotonically increasing” function, which means that the graph of g always slopes up). Because W* is an increasing transformation of W, W* and W order utility vectors the same way. However, W* and W applied in an ex post fashion to policies (probability distributions over utility vectors) may not order these policies the same way. This raises the difficult question, which I cannot address here, about how one identifies the appropriate transformation to use in PPPA, once one has specified y. That identification involves determining the degree to which policymakers should be risk averse in social welfare. As an initial matter, I suggest, PPPA should assume risk-neutrality in social welfare, i.e., simply use the Atkinsonian SWF itself rather than some nonlinear transformation. But the issue certainly deserves more exploration.

[FN122]. See Lambert, supra note 38, at 94-102; Anthony Atkinson, On the Measurement of Inequality, 2 J. Econ. Theory 244, 244-45, 249-52 (1970). It is important to note that the Atkinsonian family of SWFs is not attractive if individuals' lifetime utilities can be negative. With negative utilities, the function $U_i^{1-y}/(1-y)$ is either undefined or, if defined, is either decreasing or strictly convex. Therefore, the SWF will not satisfy both the Pareto principle and the Pigou-Dalton principle. Identifying an appropriate SWF that can allow for negative utilities is a difficult task that I will not attempt to resolve here. See Campbell Brown, Matters of Priority 192-197 (Mar. 2005) (unpublished Ph.D. thesis, The Australian National University) (on file with the Harvard Environmental Law Review) (proving that no SWF has the prioritarian form of summing an increasing, strictly concave function of individual utilities and has an unrestricted domain and is invariant to a ratio transformation); Amartya Sen, Social Choice Theory, in 3 Handbook of Mathematical Economics 1073, 1127 & n.74 (Kenneth J. Arrow & Michael D. Intriligator eds., 1986). As for utility vectors that include zeros, the Atkinsonian SWF will be defined only for y< 1.

[FN123]. See Adler & Sanchirico, supra note 43, at 300-02.

[FN124]. Harsanyi-style utility numbers, the expectations of which represent well-informed individuals' convergent preferences over lotteries of life histories, will be unique up to an affine transformation. It is a well-known feature of such “von-Neumann/ Morgenstern” utilities, meant to represent decisions under risk or uncertainty, that they are unique up to an affine transformation. In other words, given a utility function U which maps life histories onto utilities, such that the expected utility numbers calculated using these utilities accurately represent a well-informed individual's preferences over lotteries of those histories, we can multiply

U by a positive constant c and add a constant d. Expectations with respect to these new utilities will produce the very same ordering of lotteries as expectations with respect to the original utilities.

By taking a morally significant zero point--for example, a life no better than nonexistence--and giving it a utility of zero, we can narrow down the set of admissible utility functions. Consider a function U* that represents the well-informed individual's ordering of lotteries and assigns a value of zero to the zero point. Any admissible function will have to be produced by taking U* and multiplying it by a positive constant. However, that transformation remains admissible. Any new function produced by multiplying U* by a positive constant will still assign zero to the zero point, and expectations formed with respect to this new function will still order lotteries of life histories correctly.

To preclude multiplying utilities assigned to life histories by a positive constant, we would need to have morally significant information beyond (1) well-informed individuals' (convergent) ordering of life histories and lotteries of life histories, and (2) their (convergent) identification of the zero point. It is hard to see what that information would be.

[FN125]. See, e.g., Lambert, supra note 38, at 99-102; Kristof Bosmans, Extreme Inequality Aversion Without Separability, 32 Econ. Theory 589, 592 (2007).

[FN126]. See Fankhauser et al., supra note 119, at 257-59. Many studies use a smaller range of values of y, often in the context of an SWF that takes incomes rather than utilities as its arguments. See Lambert, supra note 38, at 129; Parry, supra note 57, at 28.

[FN127]. For any unequal distribution of utilities, there is an amount U^+ of utility which, if equally distributed, has the same social welfare value as the unequal distribution. That amount, U^+, is lower the greater the value of y. Also, for a given pair of individuals at utility levels High and Low, the ratio between the marginal social value of Low's utility and High's utility increases with y.

[FN128]. See Yoram Amiel et al., Measuring Attitudes Towards Inequality, 101 Scandinavian J. Econ. 83, 86-88 (1999) (discussing Atkinson's proposal).

[FN129]. See, e.g., Cowell & Gardiner, supra note 114, at 15-16; Pearce & Ulph, supra note 114, at 14-15; Stern, supra note 76, at 47-48. A closely related kind of question asks about the choice between benefiting some individual by a certain amount and a better-off individual by a greater amount. See Dolan, supra note 51, at 51-52.

[FN130]. Other variants could specify the two individuals' health, income and longevity positions and ask about leaky transfers of health, income or longevity. Given a utility function from longevity-health-income histories to utility, answers to these sorts of question will also fix or help fix a y.

[FN131]. See, e.g., Lindholm & Rosén, supra note 51; Williams, supra note 51.

[FN132]. It should be stressed that leaky-bucket and equalization thought experiments are only two particularly straightforward forms of normative reflection about the value of y. Any analysis of the implications of a given yfor some principle that the analyst endorses, or some scenario about which the analyst has intuitions, could be helpful in specifying y. See, e.g., Fankhauser et al., supra note 119, at 259-62 (identifying values of yconsistent with use of uniform per-unit global warming damages).

[FN133]. On the distinction between policy surveys and welfare polls, see Adler, supra note 78.

[FN134]. See, e.g., Paul Dolan et al., QALY Maximisation and People's Preferences: A Methodological Review of the Literature, 14 Health Econ. 197 (2005).

[FN135]. See Amiel et al., supra note 128, at 86; Lindholm & Rosén, supra note 51. For related survey work, see Ignacio Abasolo & Aki Tsuchiya, Exploring Social Welfare Functions and Violation of Monotonicity: An Example from Inequalities in Health, 23 J. Health Econ. 313 (2004); Louis Gevers et al., Professed Inequality Aversion and its Error Component, 81 Scandinavian J. Econ. 238 (1979); Herbert Glejser et al., An Econometric Study of the Variables Determining Inequality Aversion Among Students, 10 Eur. Econ. Rev. 173 (1977); Magnus Johannesson & Ulf-G. Gerdtham, A Note on the Estimation of the Equity-Efficiency Trade-off for QALYs, 15 J. Health Econ. 359 (1996); Magnus Johannesson & Ulf-G. Gerdtham, A Pilot Test of Using the Veil of Ignorance Approach to Estimate a Social Welfare Function for Income, 2 Applied Econ. Lett. 400 (1995).

[FN136]. See Lambert, supra note 38, at 129; Cowell & Gardiner, supra note 114, at 24-25.

[FN137]. See Adler & Sanchirco, supra note 43, at 296-302.

[FN138]. See Adler & Sanchirico, supra note 43, at 302. Actually, there are many different variations on the simple rank-weighted SWF described in the text. Consider any SWF which ranks utilities from lowest to highest, multiplies each by a positive weight which is a decreasing function of rank, and sums the weighted utilities. Any such SWF will be ratio-rescaling-invariant, satisfy the Pareto principle, and satisfy the Pigou-Dalton principle. So an equity analyst who is conducting a particularly full PPPA analysis might want to consider evaluating policies using different rank-weighted SWFs within this general family. See generally Blackorby et al., supra note 84, at 75-82, 99-100 (discussing rank-weighted family of SWFs).

[FN139]. See supra text accompanying notes 80-81.

[FN140]. Although it is possible to have “non-Paretian” SWFs--SWFs that sometimes fail to prefer a Pareto-superior outcome--the case for the Pareto principle is powerful, and it is certainly possible for SWFs to both satisfy the Pigou-Dalton principle and be Paretian. In particular, Atkinsonian SWFs and the rank-weighted SWF have both characteristics See Adler & Sanchirico, supra note 43, at 291-304; Blackorby et al., supra note 84, at 69-82.

[FN141]. The ordering of outcomes produced by a given equity-regarding SWF W is the same as that produced by assigning each utility vector a number equaling

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is total utility and M^W is an inequality measure generated by the SWF. See Marc Fleurbaey, Equality versus Priority: How Relevant is the Distinction?, in Fairness and Goodness in Health (Daniel Wikler et al. eds., World Health Organization) (forthcoming). Holding constant the degree of inequality, i.e., the value of M^W, outcomes with greater total utility are preferred.

[FN142]. See Adler & Posner, supra note 1.

[FN143]. See, e.g., Lambert, supra note 38, at 94-102; Sen, supra note 38, at 38-39; Bojer, supra note 38, at 108-11; Cowell, supra note 38, at 113-15.

[FN144]. See Adler & Posner, supra note 1.

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The White House

Office of the Press Secretary

For Immediate Release December 10, 2012

Remarks by the President at the Daimler Detroit Diesel Plant, Redford, MI

Daimler Detroit Diesel Plant
Redford, Michigan

2:29 P.M. EST

THE PRESIDENT: Hello, Redford! (Applause.) It is good to be back in Michigan. (Applause.) How is everybody doing today? (Applause.)

Now, let me just start off by saying we have something in common -- both our teams lost yesterday. (Laughter.) I mean, I would like to come here and talk a little smack about the Bears, but we didn't quite get it done. But it is wonderful to be back. It is good to see everybody in the great state of Michigan. (Applause.)

A few people I want to acknowledge -- first of all, the Mayor of Detroit here -- Dave Bing is in the house. (Applause.) We've got the Redford Supervisor -- Tracey Schultz Kobylarz. (Applause.) We've got some outstanding members of Congress who are here -- please give them a big round of applause. (Applause.)

I want to thank Martin for hosting us. I want to thank Jeff and Gibby for giving me a great tour of the factory. (Applause.) I've got to say I love coming to factories.

AUDIENCE MEMBER: I love you!

THE PRESIDENT: I love you. (Applause.)

So in addition to seeing the best workers in the world -- (applause) -- you've also got all this cool equipment. (Laughter.) I wanted to try out some of the equipment, but Secret Service wouldn't let me. (Laughter.) They said, you're going to drop something on your head, hurt yourself. (Laughter.) They were worried I'd mess something up. And Jeff and Gibby may not admit it, but I think they were pretty happy the Secret Service wouldn't let me touch the equipment. (Laughter.)

Now, it's been a little over a month since the election came to an end. (Applause.) So it's now safe for you to turn your televisions back on. (Laughter.) All those scary political ads are off the air. You can answer your phone again -- nobody is calling you in the middle of dinner asking for your support. But, look, I have to admit there's one part of the campaign that I miss, and that is it is a great excuse for me to get out of Washington and come to towns like this and talk to the people who work so hard every day and are looking out for their families and are in their communities, and just having a conversation about what kind of country do we want to be; what kind of country do we want to leave behind for our kids. Because ultimately, that's what this is about.

And I believe -- and I've been saying this not just for the last six months or the last year, but ever since I got into public office -- I believe America only succeeds and thrives when we've got a strong and growing middle class. (Applause.) That's what I believe. I believe we're at our best when everybody who works hard has a chance to get ahead; that they can get a job that pays the bills; that they've got health care that they can count on; that they can retire with dignity and respect, maybe take a vacation once in a while -- nothing fancy, just being able to pack up the kids and go someplace and enjoy time with people that you love; make sure that your kids can go to a good school; make sure they can aspire to whatever they want to be.

That idea is what built America. That's the idea that built Michigan. That's the idea that's at the heart of the economic plan I've been talking about all year long on the campaign trail. I want to give more Americans the chance to earn the skills that businesses are looking for right now, and give our kids the kind of education they need to succeed in the 21st century. I want to make sure America leads the world in research and technology and clean energy. I want to put people back to work rebuilding our roads and our bridges and our schools. (Applause.) That's how we grow an economy.

WATCH THE VIDEO

December 10, 2012 9:12 PM

President Obama Speaks on the Economy and Middle-Class Tax Cuts

BLOG POSTS ON THIS ISSUE

January 23, 2013 12:45 PM EST

Fireside Hangouts: Vice President Biden Joins a Conversation on Reducing Gun Violence

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January 23, 2013 10:40 AM EST

Surprise! President and Mrs. Obama Greet White House Tour (Bo Was There, Too)

The President and First Lady welcomed the guests with handshakes, hugs and even fistbumps, and Bo was treated to a near-constant stream of affectionate pats and petting.

January 21, 2013 3:26 PM EST

Be a Part of the Next Four Years

The President's second term will offer many ways

I want us to bring down our deficits, but I want to do it in a balanced, responsible way. And I want to reward -- I want a tax code that rewards businesses and manufacturers like Detroit Diesel right here, creating jobs right here in Redford, right here in Michigan, right here in the United States of America. (Applause.) That's where we need to go. That's the country we need to build. And when it comes to bringing manufacturing back to America -- that's why I'm here today.

Since 1938, Detroit Diesel has been turning out some of the best engines in the world. (Applause.) Over all those years, generations of Redford workers have walked through these doors. Not just to punch a clock. Not just to pick up a paycheck. Not just to build an engine. But to build a middle-class life for their families; to earn a shot at the American Dream.

For seven and a half decades, through good times and bad, through revolutions in technology that sent a lot of good jobs -- manufacturing jobs -- overseas, men and women like you, your parents, maybe even your grandparents, have done your part to build up America's manufacturing strength. That's something you can all be proud of. And now you're writing a new proud chapter to that history. Eight years ago, you started building axles here alongside the engines. That meant more work. That meant more jobs. (Applause.) So you started seeing products -- more products stamped with those three proud words: Made in America.
Today, Daimler is announcing a new $120 million investment into this plant, creating 115 good, new union jobs building transmissions and turbochargers right here in Redford -- (applause) -- 115 good new jobs right here in this plant, making things happen. That is great for the plant. It's great for this community. But it's also good for American manufacturing. Soon, you guys will be building all the key parts that go into powering a heavy-duty truck, all at the same facility. Nobody else in America is doing that. Nobody else in North America is doing that.

And by putting everything together in one place, under one roof, Daimler engineers can design each part so it works better with the others. That means greater fuel efficiency for your trucks. It means greater savings for your customers. That's a big deal. And it's just the latest example of Daimler's leadership on this issue.

Last year, I was proud to have your support when we announced the first-ever national fuel-efficiency standards for commercial trucks, which is going to help save consumers money and reduce our dependence on foreign oil. That's good news. (Applause.)

But here's the other reason why what you guys are doing, what Daimler is doing, is so important. For a long time, companies, they weren't always making those kinds of investments here in the United States. They weren't always investing in American workers. They certainly weren't willing to make them in the U.S. auto industry.

Remember, it was just a few years ago that our auto industry was on the verge of collapse. GM, Chrysler were all on the brink of failure. And if they failed, the suppliers and distributors that get their business from those companies, they would have died off, too. Even Ford could have gone down -- production halted. Factories shuttered. Once proud companies chopped up and sold off for scraps. And all of you -- the men and women who built these companies with your own hands -- would have been hung out to dry. And everybody in this community that depends on you -- restaurant owners, storekeepers, bartenders -- (laughter and applause) -- their livelihoods would have been at stake, too.

So I wasn't about to let that happen. I placed my bet on American workers. We bet on American ingenuity. I'd make that same bet any day of the week. (Applause.) Three and a half years later, that bet is paying off. This industry has added over a quarter of a million new jobs. Assembly lines are humming again. The American auto industry is back.

And companies like Daimler know you're still a smart bet. They could have made their investment somewhere else, but they didn't. And if you ask them whether it was a tough call, they'll tell you it wasn't even close. So the word is going out all around the world: If you want to find the best workers in the world, if you want to find the best factories in the world, if you want to build the best cars or trucks or any other product in the world, you should invest in the United States of America. This is the place to be. (Applause.)

See, you're starting to see the competitive balance is tipping a little bit. Over the past few years, it's become more expensive to do business in countries like China. Our workers have become even more productive. Our energy costs are starting to go down here in the United States. And we still have the largest market. So when you factor in everything, it makes sense to invest here, in America.

And that's one of the reasons why American manufacturing is growing at the fastest pace since the 1990s. And thanks in part to that boost in manufacturing, four years after the worst economic crisis of our lifetimes, our economy is growing again. Our businesses have created more than 5.5 million new jobs over the past 33 months. So we're making progress. (Applause.) We're moving in the right direction. We're going forward.

So what we need to do is simple. We need to keep going. We need to keep going forward. We should do everything we can to keep creating good middle-class jobs that help folks rebuild security for their families. (Applause.) And we should do everything we can to encourage companies like Daimler to keep investing in American workers.

And by the way, what we shouldn't do -- I just got to say this -- what we shouldn't be doing is trying to take away

for citizens to participate in conversations with the President and his team about the issues that are most important to them.

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your rights to bargain for better wages and working conditions. (Applause.) We shouldn't be doing that. (Applause.) These so-called "right to work" laws, they don't have to do with economics; they have everything to do with politics. (Applause.) What they're really talking about is giving you the right to work for less money. (Applause.)

You only have to look to Michigan -- where workers were instrumental in reviving the auto industry -- to see how unions have helped build not just a stronger middle class but a stronger America. (Applause.) So folks from our state's capital, all the way to the nation's capital, they should be focused on the same thing. They should be working to make sure companies like this manufacturer is able to make more great products. That's what they should be focused on. (Applause.) We don't want a race to the bottom. We want a race to the top. (Applause.)

America is not going to compete based on low-skill, low-wage, no workers' rights. That's not our competitive advantage. There's always going to be some other country that can treat its workers even worse. Right?

AUDIENCE: Right!

THE PRESIDENT: What's going to make us succeed is we got the best workers -- well trained, reliable, productive, low turnover, healthy. That's what makes us strong. And it also is what allows our workers then to buy the products that we make because they got enough money in their pockets. (Applause.)

So we've got to get past this whole situation where we manufacture crises because of politics. That actually leads to less certainty, more conflict, and we can't all focus on coming together to grow.

AUDIENCE MEMBER: That's right!

THE PRESIDENT: And the same thing -- we're seeing the same thing in Washington. I'm sure you've all heard the talk recently about some big deadlines we're facing in a few weeks when it comes to decisions on jobs and investment and taxes. And that debate is going to have a big impact on all of you. Some of you may know this: If Congress doesn't act soon, meaning in the next few weeks, starting on January 1st, everybody is going to see their income taxes go up.

AUDIENCE: No!

THE PRESIDENT: It's true. You all don't like that.

AUDIENCE: No!

THE PRESIDENT: Typical, middle-class family of four will see an income tax hike of around $2,200. How many of you can afford to pay another $2,200 in taxes? Not you?

AUDIENCE: No!

THE PRESIDENT: I didn't think so. You can't afford to lose that money. That's a hit you can't afford to take. And, by the way, that's not a good hit for businesses, either -- because if Congress lets middle-class taxes go up, economists will tell you that means people will spend nearly $200 billion less than they otherwise would spend. Consumer spending is going to go down. That means you've got less customers. Businesses get fewer profits. They hire fewer workers. You go in a downward spiral. Wrong idea.

Here is the good news: We can solve this problem. All Congress needs to do is pass a law that would prevent a tax hike on the first $250,000 of everybody's income -- everybody. (Applause.) That means 98 percent of Americans -- and probably 100 percent of you -- (laughter) -- 97 percent of small businesses wouldn't see their income taxes go up a single dime. Even the wealthiest Americans would still get a tax cut on the first $250,000 of their income. But when they start making a million, or $10 million, or $20 million you can afford to pay a little bit more. (Applause.) You're not too strapped.

So Congress can do that right now. Everybody says they agree with it. Let's get it done. (Applause.)

So that's the bare minimum. That's the bare minimum we should be doing in order to the grow the economy. But we can do more. We can do more than just extend middle-class tax cuts. I've said I will work with Republicans on a plan for economic growth, job creation, and reducing our deficits. And that has some compromise between Democrats and Republicans. I understand people have a lot of different views. I'm willing to compromise a little bit.

But if we're serious about reducing our deficit, we've also got to be serious about investing in the things that help us grow and make the middle class strong, like education, and research and development, and making sure kids can go to college, and rebuilding our roads and our infrastructure. (Applause.) We've got to do that.

So when you put it all together, what you need is a package that keeps taxes where they are for middle-class families; we make some tough spending cuts on things that we don't need; and then we ask the wealthiest

Americans to pay a slightly higher tax rate. And that's a principle I won't compromise on, because I'm not going to have a situation where the wealthiest among us, including folks like me, get to keep all our tax breaks, and then we're asking students to pay higher student loans. Or suddenly, a school doesn't have schoolbooks because the school district couldn't afford it. Or some family that has a disabled kid isn't getting the help that they need through Medicaid.

We're not going to do that. We're not going to make that tradeoff. That's not going to help us to grow. Our economic success has never come from the top down; it comes from the middle out. It comes from the bottom up. (Applause.) It comes from folks like you working hard, and if you're working hard and you're successful, then you become customers and everybody does well.

Our success as a country in this new century will be defined by how well we educate our kids, how well we train our workers, how well we invent, how well we innovate, how well we build things like cars and engines -- all the things that helped create the greatest middle class the world has ever known. That's how you bring new jobs back to Detroit. That's how you bring good jobs back to America. That's what I'm focused on. That's what I will stay relentlessly focused on going forward. (Applause.)

Because when we focus on these things –- when we stay true to ourselves and our history, there's nothing we can't do. (Applause.) And if you don't believe me, you need to come down to this plant and see all these outstanding workers.

In fact, as I was coming over here, I was hearing about a guy named Willie. (Applause.) Where's Willie? There's Willie right here. There's Willie. (Applause.) Now, in case you haven't heard of him, they actually call him "Pretty Willie." (Laughter.) Now, I got to say you got to be pretty tough to have a nickname like "Pretty Willie." (Laughter.) He's tough.

On Wednesday, Willie will celebrate 60 years working at Detroit Diesel -- 60 years. (Applause.) Willie started back on December 12, 1952. I was not born yet. (Laughter.) Wasn't even close to being born. He made $1.40 an hour. The only time he spent away from this plant was when he was serving our country in the Korean War. (Applause.) So three generations of Willie's family have passed through Detroit Diesel. One of his daughters works here with him right now -- is that right? There she is. (Applause.)

In all his years, Willie has been late to work only once. It was back in 1977. (Laughter.) It's been so long he can't remember why he was late -- (laughter and applause) -- but we're willing to give him a pass.

So Willie believes in hard work. You don't keep a job for 60 years if you don't work hard. Sooner or later, someone is going to fire you if you don't work hard. He takes pride in being part of something bigger than himself. He's committed to family; he's committed to community; he's committed to country. That's how Willie lives his life. That's how all of you live your lives.

And that makes me hopeful about the future, because you're out there fighting every day for a better future for your family and your country. And when you do that, that means you're creating value all across this economy. You're inspiring people. You're being a good example for your kids. That's what makes America great. That's what we have to stay focused on.

And as long as I've got the privilege of serving as your President, I'm going to keep fighting for you. I'm going to keep fighting for your kids. I'm going to keep fighting for an America where anybody, no matter who you are, no matter what you look like, no matter where you come from, you can make it if you try here in America. (Applause.)

Thank you very much, everybody. God bless you. (Applause.)

END
2:51 P.M. EST

Remarks of President Barack Obama – As Prepared for Delivery
Address to Joint Session of Congress
Tuesday, February 24th, 2009

(en español)

Madame Speaker, Mr. Vice President, Members of Congress, and the First Lady of the United States:

I've come here tonight not only to address the distinguished men and women in this great chamber, but to speak frankly and directly to the men and women who sent us here.

I know that for many Americans watching right now, the state of our economy is a concern that rises above all others. And rightly so. If you haven't been personally affected by this recession, you probably know someone who has – a friend; a neighbor; a member of your family. You don't need to hear another list of statistics to know that our economy is in crisis, because you live it every day. It's the worry you wake up with and the source of sleepless nights. It's the job you thought you'd retire from but now have lost; the business you built your dreams upon that's now hanging by a thread; the college acceptance letter your child had to put back in the envelope. The impact of this recession is real, and it is everywhere.

But while our economy may be weakened and our confidence shaken; though we are living through difficult and uncertain times, tonight I want every American to know this:

We will rebuild, we will recover, and the United States of America will emerge stronger than before.

The weight of this crisis will not determine the destiny of this nation. The answers to our problems don't lie beyond our reach. They exist in our laboratories and universities; in our fields and our factories; in the imaginations of our entrepreneurs and the pride of the hardest-working people on Earth. Those qualities that have made America the greatest force of progress and prosperity in human history we still possess in ample measure. What is required now is for this country to pull together, confront boldly the challenges we face, and take responsibility for our future once more.

Now, if we're honest with ourselves, we'll admit that for too long, we have not always met these responsibilities – as a government or as a people. I say this not to lay blame or look backwards, but because it is only by understanding how we arrived at this moment that we'll be able to lift ourselves out of this predicament.

The fact is, our economy did not fall into decline overnight. Nor did all of our problems begin when the housing market collapsed or the stock market sank. We have known for decades that our survival depends on finding new sources of energy. Yet we import more oil today than ever before. The cost of health care eats up more and more of our savings each year, yet we keep delaying reform. Our children will compete for jobs in a global economy that too many of our schools do not prepare them for. And though all these challenges went unsolved, we still managed to spend more money and pile up more debt, both as individuals and through our government, than ever before.

In other words, we have lived through an era where too often, short-term gains were prized over long-term prosperity; where we failed to look beyond the next payment, the next quarter, or the next election. A surplus became an excuse to transfer wealth to the wealthy instead of an opportunity to invest in our future. Regulations were gutted for the sake of a quick profit at the expense of a healthy market. People bought homes they knew they couldn't afford from banks and lenders who pushed those bad loans anyway. And all the while, critical debates and difficult decisions were put off for some other time on some other day.

Well that day of reckoning has arrived, and the time to take charge of our future is here.

Now is the time to act boldly and wisely – to not only revive this economy, but to build a new foundation for lasting prosperity. Now is the time to jumpstart job creation, re-start lending, and invest in areas like energy, health care, and education that will grow our economy, even as we make hard choices to bring our deficit down. That is what my economic agenda is designed to do, and that's what I'd like to talk to you about tonight.

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February 24, 2009 4:30 PM

The President Addresses Joint Session of Congress: February 24, 2009

BLOG POSTS ON THIS ISSUE

January 23, 2013 12:45 PM EST

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January 21, 2013 3:26 PM EST

Be a Part of the Next Four Years

The President's second term will offer many ways

It's an agenda that begins with jobs.

As soon as I took office, I asked this Congress to send me a recovery plan by President's Day that would put people back to work and put money in their pockets. Not because I believe in bigger government – I don't. Not because I'm not mindful of the massive debt we've inherited – I am. I called for action because the failure to do so would have cost more jobs and caused more hardships. In fact, a failure to act would have worsened our long-term deficit by assuring weak economic growth for years. That's why I pushed for quick action. And tonight, I am grateful that this Congress delivered, and pleased to say that the American Recovery and Reinvestment Act is now law.

Over the next two years, this plan will save or create 3.5 million jobs. More than 90% of these jobs will be in the private sector – jobs rebuilding our roads and bridges; constructing wind turbines and solar panels; laying broadband and expanding mass transit.

Because of this plan, there are teachers who can now keep their jobs and educate our kids. Health care professionals can continue caring for our sick. There are 57 police officers who are still on the streets of Minneapolis tonight because this plan prevented the layoffs their department was about to make.

Because of this plan, 95% of the working households in America will receive a tax cut – a tax cut that you will see in your paychecks beginning on April 1st.

Because of this plan, families who are struggling to pay tuition costs will receive a $2,500 tax credit for all four years of college. And Americans who have lost their jobs in this recession will be able to receive extended unemployment benefits and continued health care coverage to help them weather this storm.

I know there are some in this chamber and watching at home who are skeptical of whether this plan will work. I understand that skepticism. Here in Washington, we've all seen how quickly good intentions can turn into broken promises and wasteful spending. And with a plan of this scale comes enormous responsibility to get it right.

That is why I have asked Vice President Biden to lead a tough, unprecedented oversight effort – because nobody messes with Joe. I have told each member of my Cabinet as well as mayors and governors across the country that they will be held accountable by me and the American people for every dollar they spend. I have appointed a proven and aggressive Inspector General to ferret out any and all cases of waste and fraud. And we have created a new website called recovery.gov so that every American can find out how and where their money is being spent.

So the recovery plan we passed is the first step in getting our economy back on track. But it is just the first step. Because even if we manage this plan flawlessly, there will be no real recovery unless we clean up the credit crisis that has severely weakened our financial system.

I want to speak plainly and candidly about this issue tonight, because every American should know that it directly affects you and your family's well-being. You should also know that the money you've deposited in banks across the country is safe; your insurance is secure; and you can rely on the continued operation of our financial system. That is not the source of concern.

The concern is that if we do not re-start lending in this country, our recovery will be choked off before it even begins.

You see, the flow of credit is the lifeblood of our economy. The ability to get a loan is how you finance the purchase of everything from a home to a car to a college education; how stores stock their shelves, farms buy equipment, and businesses make payroll.

But credit has stopped flowing the way it should. Too many bad loans from the housing crisis have made their way onto the books of too many banks. With so much debt and so little confidence, these banks are now fearful of lending out any more money to households, to businesses, or to each other. When there is no lending, families can't afford to buy homes or cars. So businesses are forced to make layoffs. Our economy suffers even more, and credit dries up even further.

That is why this administration is moving swiftly and aggressively to break this destructive cycle, restore confidence, and re-start lending.

We will do so in several ways. First, we are creating a new lending fund that represents the largest effort ever to help provide auto loans, college loans, and small business loans to the consumers and entrepreneurs who keep this economy running.

Second, we have launched a housing plan that will help responsible families facing the threat of foreclosure lower their monthly payments and re-finance their mortgages. It's a plan that won't help speculators or that neighbor down the street who bought a house he could never hope to afford, but it will help millions of Americans who are struggling with declining home values – Americans who will now be able to take advantage of the lower

for citizens to participate in conversations with the President and his team about the issues that are most important to them.

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interest rates that this plan has already helped bring about. In fact, the average family who re-finances today can save nearly $2000 per year on their mortgage.

Third, we will act with the full force of the federal government to ensure that the major banks that Americans depend on have enough confidence and enough money to lend even in more difficult times. And when we learn that a major bank has serious problems, we will hold accountable those responsible, force the necessary adjustments, provide the support to clean up their balance sheets, and assure the continuity of a strong, viable institution that can serve our people and our economy.

I understand that on any given day, Wall Street may be more comforted by an approach that gives banks bailouts with no strings attached, and that holds nobody accountable for their reckless decisions. But such an approach won't solve the problem. And our goal is to quicken the day when we re-start lending to the American people and American business and end this crisis once and for all.

I intend to hold these banks fully accountable for the assistance they receive, and this time, they will have to clearly demonstrate how taxpayer dollars result in more lending for the American taxpayer. This time, CEOs won't be able to use taxpayer money to pad their paychecks or buy fancy drapes or disappear on a private jet. Those days are over.

Still, this plan will require significant resources from the federal government – and yes, probably more than we've already set aside. But while the cost of action will be great, I can assure you that the cost of inaction will be far greater, for it could result in an economy that sputters along for not months or years, but perhaps a decade. That would be worse for our deficit, worse for business, worse for you, and worse for the next generation. And I refuse to let that happen.

I understand that when the last administration asked this Congress to provide assistance for struggling banks, Democrats and Republicans alike were infuriated by the mismanagement and results that followed. So were the American taxpayers. So was I.

So I know how unpopular it is to be seen as helping banks right now, especially when everyone is suffering in part from their bad decisions. I promise you – I get it.

But I also know that in a time of crisis, we cannot afford to govern out of anger, or yield to the politics of the moment. My job – our job – is to solve the problem. Our job is to govern with a sense of responsibility. I will not spend a single penny for the purpose of rewarding a single Wall Street executive, but I will do whatever it takes to help the small business that can't pay its workers or the family that has saved and still can't get a mortgage.

That's what this is about. It's not about helping banks – it's about helping people. Because when credit is available again, that young family can finally buy a new home. And then some company will hire workers to build it. And then those workers will have money to spend, and if they can get a loan too, maybe they'll finally buy that car, or open their own business. Investors will return to the market, and American families will see their retirement secured once more. Slowly, but surely, confidence will return, and our economy will recover.

So I ask this Congress to join me in doing whatever proves necessary. Because we cannot consign our nation to an open-ended recession. And to ensure that a crisis of this magnitude never happens again, I ask Congress to move quickly on legislation that will finally reform our outdated regulatory system. It is time to put in place tough, new common-sense rules of the road so that our financial market rewards drive and innovation, and punishes short-cuts and abuse.

The recovery plan and the financial stability plan are the immediate steps we're taking to revive our economy in the short-term. But the only way to fully restore America's economic strength is to make the long-term investments that will lead to new jobs, new industries, and a renewed ability to compete with the rest of the world. The only way this century will be another American century is if we confront at last the price of our dependence on oil and the high cost of health care; the schools that aren't preparing our children and the mountain of debt they stand to inherit. That is our responsibility.

In the next few days, I will submit a budget to Congress. So often, we have come to view these documents as simply numbers on a page or laundry lists of programs. I see this document differently. I see it as a vision for America – as a blueprint for our future.

My budget does not attempt to solve every problem or address every issue. It reflects the stark reality of what we've inherited – a trillion dollar deficit, a financial crisis, and a costly recession.

Given these realities, everyone in this chamber – Democrats and Republicans – will have to sacrifice some worthy priorities for which there are no dollars. And that includes me.

But that does not mean we can afford to ignore our long-term challenges. I reject the view that says our problems will simply take care of themselves; that says government has no role in laying the foundation for our common prosperity.

For history tells a different story. History reminds us that at every moment of economic upheaval and transformation, this nation has responded with bold action and big ideas. In the midst of civil war, we laid railroad tracks from one coast to another that spurred commerce and industry. From the turmoil of the Industrial Revolution came a system of public high schools that prepared our citizens for a new age. In the wake of war and depression, the GI Bill sent a generation to college and created the largest middle-class in history. And a twilight struggle for freedom led to a nation of highways, an American on the moon, and an explosion of technology that still shapes our world.

In each case, government didn't supplant private enterprise; it catalyzed private enterprise. It created the conditions for thousands of entrepreneurs and new businesses to adapt and to thrive.

We are a nation that has seen promise amid peril, and claimed opportunity from ordeal. Now we must be that nation again. That is why, even as it cuts back on the programs we don't need, the budget I submit will invest in the three areas that are absolutely critical to our economic future: energy, health care, and education.

It begins with energy.

We know the country that harnesses the power of clean, renewable energy will lead the 21st century. And yet, it is China that has launched the largest effort in history to make their economy energy efficient. We invented solar technology, but we've fallen behind countries like Germany and Japan in producing it. New plug-in hybrids roll off our assembly lines, but they will run on batteries made in Korea.

Well I do not accept a future where the jobs and industries of tomorrow take root beyond our borders – and I know you don't either. It is time for America to lead again.

Thanks to our recovery plan, we will double this nation's supply of renewable energy in the next three years. We have also made the largest investment in basic research funding in American history – an investment that will spur not only new discoveries in energy, but breakthroughs in medicine, science, and technology.

We will soon lay down thousands of miles of power lines that can carry new energy to cities and towns across this country. And we will put Americans to work making our homes and buildings more efficient so that we can save billions of dollars on our energy bills.

But to truly transform our economy, protect our security, and save our planet from the ravages of climate change, we need to ultimately make clean, renewable energy the profitable kind of energy. So I ask this Congress to send me legislation that places a market-based cap on carbon pollution and drives the production of more renewable energy in America. And to support that innovation, we will invest fifteen billion dollars a year to develop technologies like wind power and solar power; advanced biofuels, clean coal, and more fuel-efficient cars and trucks built right here in America.

As for our auto industry, everyone recognizes that years of bad decision-making and a global recession have pushed our automakers to the brink. We should not, and will not, protect them from their own bad practices. But we are committed to the goal of a re-tooled, re-imagined auto industry that can compete and win. Millions of jobs depend on it. Scores of communities depend on it. And I believe the nation that invented the automobile cannot walk away from it.

None of this will come without cost, nor will it be easy. But this is America. We don't do what's easy. We do what is necessary to move this country forward.

For that same reason, we must also address the crushing cost of health care.

This is a cost that now causes a bankruptcy in America every thirty seconds. By the end of the year, it could cause 1.5 million Americans to lose their homes. In the last eight years, premiums have grown four times faster than wages. And in each of these years, one million more Americans have lost their health insurance. It is one of the major reasons why small businesses close their doors and corporations ship jobs overseas. And it's one of the largest and fastest-growing parts of our budget.

Given these facts, we can no longer afford to put health care reform on hold.

Already, we have done more to advance the cause of health care reform in the last thirty days than we have in the last decade. When it was days old, this Congress passed a law to provide and protect health insurance for eleven million American children whose parents work full-time. Our recovery plan will invest in electronic health records and new technology that will reduce errors, bring down costs, ensure privacy, and save lives. It will launch a new effort to conquer a disease that has touched the life of nearly every American by seeking a cure for cancer in our time. And it makes the largest investment ever in preventive care, because that is one of the best ways to keep our people healthy and our costs under control.

This budget builds on these reforms. It includes an historic commitment to comprehensive health care reform – a down-payment on the principle that we must have quality, affordable health care for every American. It's a commitment that's paid for in part by efficiencies in our system that are long overdue. And it's a step we must

take if we hope to bring down our deficit in the years to come.

Now, there will be many different opinions and ideas about how to achieve reform, and that is why I'm bringing together businesses and workers, doctors and health care providers, Democrats and Republicans to begin work on this issue next week.

I suffer no illusions that this will be an easy process. It will be hard. But I also know that nearly a century after Teddy Roosevelt first called for reform, the cost of our health care has weighed down our economy and the conscience of our nation long enough. So let there be no doubt: health care reform cannot wait, it must not wait, and it will not wait another year.

The third challenge we must address is the urgent need to expand the promise of education in America.

In a global economy where the most valuable skill you can sell is your knowledge, a good education is no longer just a pathway to opportunity – it is a pre-requisite.

Right now, three-quarters of the fastest-growing occupations require more than a high school diploma. And yet, just over half of our citizens have that level of education. We have one of the highest high school dropout rates of any industrialized nation. And half of the students who begin college never finish.

This is a prescription for economic decline, because we know the countries that out-teach us today will out-compete us tomorrow. That is why it will be the goal of this administration to ensure that every child has access to a complete and competitive education – from the day they are born to the day they begin a career.

Already, we have made an historic investment in education through the economic recovery plan. We have dramatically expanded early childhood education and will continue to improve its quality, because we know that the most formative learning comes in those first years of life. We have made college affordable for nearly seven million more students. And we have provided the resources necessary to prevent painful cuts and teacher layoffs that would set back our children's progress.

But we know that our schools don't just need more resources. They need more reform. That is why this budget creates new incentives for teacher performance; pathways for advancement, and rewards for success. We'll invest in innovative programs that are already helping schools meet high standards and close achievement gaps. And we will expand our commitment to charter schools.

It is our responsibility as lawmakers and educators to make this system work. But it is the responsibility of every citizen to participate in it. And so tonight, I ask every American to commit to at least one year or more of higher education or career training. This can be community college or a four-year school; vocational training or an apprenticeship. But whatever the training may be, every American will need to get more than a high school diploma. And dropping out of high school is no longer an option. It's not just quitting on yourself, it's quitting on your country – and this country needs and values the talents of every American. That is why we will provide the support necessary for you to complete college and meet a new goal: by 2020, America will once again have the highest proportion of college graduates in the world.

I know that the price of tuition is higher than ever, which is why if you are willing to volunteer in your neighborhood or give back to your community or serve your country, we will make sure that you can afford a higher education. And to encourage a renewed spirit of national service for this and future generations, I ask this Congress to send me the bipartisan legislation that bears the name of Senator Orrin Hatch as well as an American who has never stopped asking what he can do for his country – Senator Edward Kennedy.

These education policies will open the doors of opportunity for our children. But it is up to us to ensure they walk through them. In the end, there is no program or policy that can substitute for a mother or father who will attend those parent/teacher conferences, or help with homework after dinner, or turn off the TV, put away the video games, and read to their child. I speak to you not just as a President, but as a father when I say that responsibility for our children's education must begin at home.

There is, of course, another responsibility we have to our children. And that is the responsibility to ensure that we do not pass on to them a debt they cannot pay. With the deficit we inherited, the cost of the crisis we face, and the long-term challenges we must meet, it has never been more important to ensure that as our economy recovers, we do what it takes to bring this deficit down.

I'm proud that we passed the recovery plan free of earmarks, and I want to pass a budget next year that ensures that each dollar we spend reflects only our most important national priorities.

Yesterday, I held a fiscal summit where I pledged to cut the deficit in half by the end of my first term in office. My administration has also begun to go line by line through the federal budget in order to eliminate wasteful and ineffective programs. As you can imagine, this is a process that will take some time. But we're starting with the biggest lines. We have already identified two trillion dollars in savings over the next decade.

In this budget, we will end education programs that don't work and end direct payments to large agribusinesses

that don't need them. We'll eliminate the no-bid contracts that have wasted billions in Iraq, and reform our defense budget so that we're not paying for Cold War-era weapons systems we don't use. We will root out the waste, fraud, and abuse in our Medicare program that doesn't make our seniors any healthier, and we will restore a sense of fairness and balance to our tax code by finally ending the tax breaks for corporations that ship our jobs overseas.

In order to save our children from a future of debt, we will also end the tax breaks for the wealthiest 2% of Americans. But let me perfectly clear, because I know you'll hear the same old claims that rolling back these tax breaks means a massive tax increase on the American people: if your family earns less than $250,000 a year, you will not see your taxes increased a single dime. I repeat: not one single dime. In fact, the recovery plan provides a tax cut – that's right, a tax cut – for 95% of working families. And these checks are on the way.

To preserve our long-term fiscal health, we must also address the growing costs in Medicare and Social Security. Comprehensive health care reform is the best way to strengthen Medicare for years to come. And we must also begin a conversation on how to do the same for Social Security, while creating tax-free universal savings accounts for all Americans.

Finally, because we're also suffering from a deficit of trust, I am committed to restoring a sense of honesty and accountability to our budget. That is why this budget looks ahead ten years and accounts for spending that was left out under the old rules – and for the first time, that includes the full cost of fighting in Iraq and Afghanistan. For seven years, we have been a nation at war. No longer will we hide its price.

We are now carefully reviewing our policies in both wars, and I will soon announce a way forward in Iraq that leaves Iraq to its people and responsibly ends this war.

And with our friends and allies, we will forge a new and comprehensive strategy for Afghanistan and Pakistan to defeat al Qaeda and combat extremism. Because I will not allow terrorists to plot against the American people from safe havens half a world away.

As we meet here tonight, our men and women in uniform stand watch abroad and more are readying to deploy. To each and every one of them, and to the families who bear the quiet burden of their absence, Americans are united in sending one message: we honor your service, we are inspired by your sacrifice, and you have our unyielding support. To relieve the strain on our forces, my budget increases the number of our soldiers and Marines. And to keep our sacred trust with those who serve, we will raise their pay, and give our veterans the expanded health care and benefits that they have earned.

To overcome extremism, we must also be vigilant in upholding the values our troops defend – because there is no force in the world more powerful than the example of America. That is why I have ordered the closing of the detention center at Guantanamo Bay, and will seek swift and certain justice for captured terrorists – because living our values doesn't make us weaker, it makes us safer and it makes us stronger. And that is why I can stand here tonight and say without exception or equivocation that the United States of America does not torture.

In words and deeds, we are showing the world that a new era of engagement has begun. For we know that America cannot meet the threats of this century alone, but the world cannot meet them without America. We cannot shun the negotiating table, nor ignore the foes or forces that could do us harm. We are instead called to move forward with the sense of confidence and candor that serious times demand.

To seek progress toward a secure and lasting peace between Israel and her neighbors, we have appointed an envoy to sustain our effort. To meet the challenges of the 21st century – from terrorism to nuclear proliferation; from pandemic disease to cyber threats to crushing poverty – we will strengthen old alliances, forge new ones, and use all elements of our national power.

And to respond to an economic crisis that is global in scope, we are working with the nations of the G-20 to restore confidence in our financial system, avoid the possibility of escalating protectionism, and spur demand for American goods in markets across the globe. For the world depends on us to have a strong economy, just as our economy depends on the strength of the world's.

As we stand at this crossroads of history, the eyes of all people in all nations are once again upon us – watching to see what we do with this moment; waiting for us to lead.

Those of us gathered here tonight have been called to govern in extraordinary times. It is a tremendous burden, but also a great privilege – one that has been entrusted to few generations of Americans. For in our hands lies the ability to shape our world for good or for ill.

I know that it is easy to lose sight of this truth – to become cynical and doubtful; consumed with the petty and the trivial.

But in my life, I have also learned that hope is found in unlikely places; that inspiration often comes not from those with the most power or celebrity, but from the dreams and aspirations of Americans who are anything but ordinary.

I think about Leonard Abess, the bank president from Miami who reportedly cashed out of his company, took a $60 million bonus, and gave it out to all 399 people who worked for him, plus another 72 who used to work for him. He didn't tell anyone, but when the local newspaper found out, he simply said, "I knew some of these people since I was 7 years old. I didn't feel right getting the money myself."

I think about Greensburg, Kansas, a town that was completely destroyed by a tornado, but is being rebuilt by its residents as a global example of how clean energy can power an entire community – how it can bring jobs and businesses to a place where piles of bricks and rubble once lay. "The tragedy was terrible," said one of the men who helped them rebuild. "But the folks here know that it also provided an incredible opportunity."

And I think about Ty'Sheoma Bethea, the young girl from that school I visited in Dillon, South Carolina – a place where the ceilings leak, the paint peels off the walls, and they have to stop teaching six times a day because the train barrels by their classroom. She has been told that her school is hopeless, but the other day after class she went to the public library and typed up a letter to the people sitting in this room. She even asked her principal for the money to buy a stamp. The letter asks us for help, and says, "We are just students trying to become lawyers, doctors, congressmen like yourself and one day president, so we can make a change to not just the state of South Carolina but also the world. We are not quitters."

We are not quitters.

These words and these stories tell us something about the spirit of the people who sent us here. They tell us that even in the most trying times, amid the most difficult circumstances, there is a generosity, a resilience, a decency, and a determination that perseveres; a willingness to take responsibility for our future and for posterity.

Their resolve must be our inspiration. Their concerns must be our cause. And we must show them and all our people that we are equal to the task before us.

I know that we haven't agreed on every issue thus far, and there are surely times in the future when we will part ways. But I also know that every American who is sitting here tonight loves this country and wants it to succeed. That must be the starting point for every debate we have in the coming months, and where we return after those debates are done. That is the foundation on which the American people expect us to build common ground.

And if we do – if we come together and lift this nation from the depths of this crisis; if we put our people back to work and restart the engine of our prosperity; if we confront without fear the challenges of our time and summon that enduring spirit of an America that does not quit, then someday years from now our children can tell their children that this was the time when we performed, in the words that are carved into this very chamber, "something worthy to be remembered." Thank you, God Bless you, and may God Bless the United States of America.

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DEMOCRATIC STAFF DIRECTOR

December 14, 2012

The Honorable Steven Chu
Secretary
Department of Energy
1000 Independence Avenue, S.W.
Washington, DC 20585

Dear Secretary Chu,

I write to convey my disappointment in the deeply flawed methodology utilized in a Department of Energy (DOE)-commissioned study that was intended to analyze the economic impacts associated with the export of liquefied natural gas (LNG) from the United States and to request that this analysis be appropriately updated. The economic analysis performed by NERA Economic Consulting (NERA) and released last week found that LNG exporting will lead to higher domestic energy prices and will have significant negative impacts on American manufacturing and workers, similar to the conclusions reached by previous studies.[1] But I was disappointed to find fundamental flaws with the study that I fear may have led to conclusions that severely underestimate the negative impacts of large-scale natural gas exporting. Given the important role this study may play in determining U.S. natural gas export policy, I strongly urge that the study's methodology be reevaluated in some key areas, that the most recent projection data available be utilized in the model, and that the model be re-run and re-analyzed.

There are several fundamental flaws associated with the NERA study:

1) **NERA's model used energy projection data from the Energy Information Administration's (EIA's) 2011 World Energy Outlook, which was published in 2010. This data badly underestimates the growth that has already occurred in domestic natural gas demand as well as demand that is expected in the future.**

[1] EIA, "Effect of Increased Natural Gas Exports on Domestic Energy Markets," January 2012. Available at: http://www.eia.gov/analysis/requests/fe/pdf/fe_lng.pdf. Deloitte, "Made in America: The Economic Impact of LNG Exports from the United States," 2011. Available at: http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/Energy_us_er/us_er_MadeinAmerica_LNGPaper_122011.pdf

I am concerned that because of its utilization of 2010 data that have already been shown to be grossly inaccurate, the NERA study fails to fully grasp the pace and scope with which the boom in shale gas production is transforming major sectors of the American economy. The electricity sector is rapidly switching from coal to cleaner burning natural gas. Heavy industrial users—already consumers of 40 percent of total U.S. natural gas supplies—are making tens of billions of dollars of additional capital investments in energy-intensive manufacturing that will create huge amounts of new domestic natural gas demand. And natural gas vehicles are now expected to be significant drivers of new domestic natural gas demand. Yet the NERA study failed to capture this new economic reality because it used natural gas demand projections for these rapidly changing sectors that are significantly out of date.

The older data used in the NERA study projects a much different future for natural gas than the most recent projections from the Energy Information Administration (EIA):

- The data used by NERA projected that natural gas use in the U.S. power sector would actually *decline* between 2010 and 2020. In reality, natural gas use in the power sector has already grown by 27 percent since 2010, and the latest EIA projections are that it will grow 11 percent between 2010 and 2020.[2]

- The data used by NERA projected that natural gas use in the industrial sector would grow by 1.46 quadrillion BTU between 2010 and 2035. The latest EIA projections, however, are that industrial demand will grow by 47 percent more than that, or by 2.15 quadrillion BTU, over this period.[3]

- The data used by NERA projected annual natural gas use in the transportation sector would grow to 160 billion cubic feet in 2035. But the latest EIA projections are that it will grow to more than *seven times* that level by 2035.[4]

I understand that data from EIA's 2013 Annual Energy Outlook (AEO) was not available at the time the NERA study was conducted. But 2012 AEO data certainly was available, and that data did assume marginally higher levels of U.S. natural gas demand relative to the 2011 AEO. So I am puzzled why NERA chose to use the older 2011 WEO data..

Further, even EIA's most recent 2013 AEO projections for domestic natural gas demand fail to capture many of the more than 100 newly announced natural gas-intensive manufacturing projects that have been announced over the past 18 months. Those projects represent over $90 billion in investment and billions of cubic feet of additional future daily natural gas use. Studies

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[2] EIA, Annual Energy Outlook 2013.

[3] Id.

[4] Id.

from other analysts, such as IHS CERA, foresee natural gas demand in America growing far more than what EIA assumes even in their most recent 2013 AEO. A thorough and comprehensive exporting analysis should have examined these types of higher future domestic demand scenarios, especially at a time when projections are changing so quickly year-to-year. Yet while the NERA study acknowledged that "the potential exists for significant increases in natural gas demand across the U.S. economy," it failed to consider that potential in any of its modeling. The only context in which NERA considered higher domestic natural gas demand was in the context of higher general economic growth and a scenario in which ultimately recoverable shale resources were relatively high. While it makes sense to assume greater shale gas supplies will lead to lower prices and ultimately higher incremental domestic demand, this should not be the only method for considering higher future domestic demand.

I therefore request that new economic modeling be done that utilizes the 2013 AEO data or a similar data set developed in the past six months. In addition, I request that you provide me with a copy of any document (such as the contract or scoping documents for the study) in the Department's possession that describes the task and data NERA was expected to utilize.

2) The NERA study fundamentally misinterpreted a key report on the impact of energy cost increases on America's energy-intensive trade-exposed manufacturers and failed to delineate the impact of natural gas exporting on specific manufacturing sectors.

In order to better understand how energy-intensive trade-exposed (EITE) manufacturers (such chemical, fertilizer, glass, and steel manufacturers) can be impacted by higher energy costs, NERA cited extensively from a 2009 study that looked at potential impacts of the Waxman-Markey energy and climate legislation, H.R. 2454, on U.S. manufacturers. This report, "The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries," (Interagency Report) was an interagency government effort responding to a request from several U.S. senators about my bill.[5] Based on this report, apparently, and NERA's own modeling of natural gas exports, NERA concluded that "The cap-and-trade program in the Waxman-Markey bill would have caused increases in energy costs and impacts on EITE even broader than would the allowing of LNG exports because the Waxman-Markey bill applied to all fuels and increased the costs of fuels used for about 70% of electricity generation." The NERA analysis was correct in looking to the Interagency Report because the impacts of natural gas exporting on EITE manufacturers are potentially similar to those resulting from greenhouse gas regulation. Unfortunately, NERA's conclusion based on its review of this report is unequivocally wrong.

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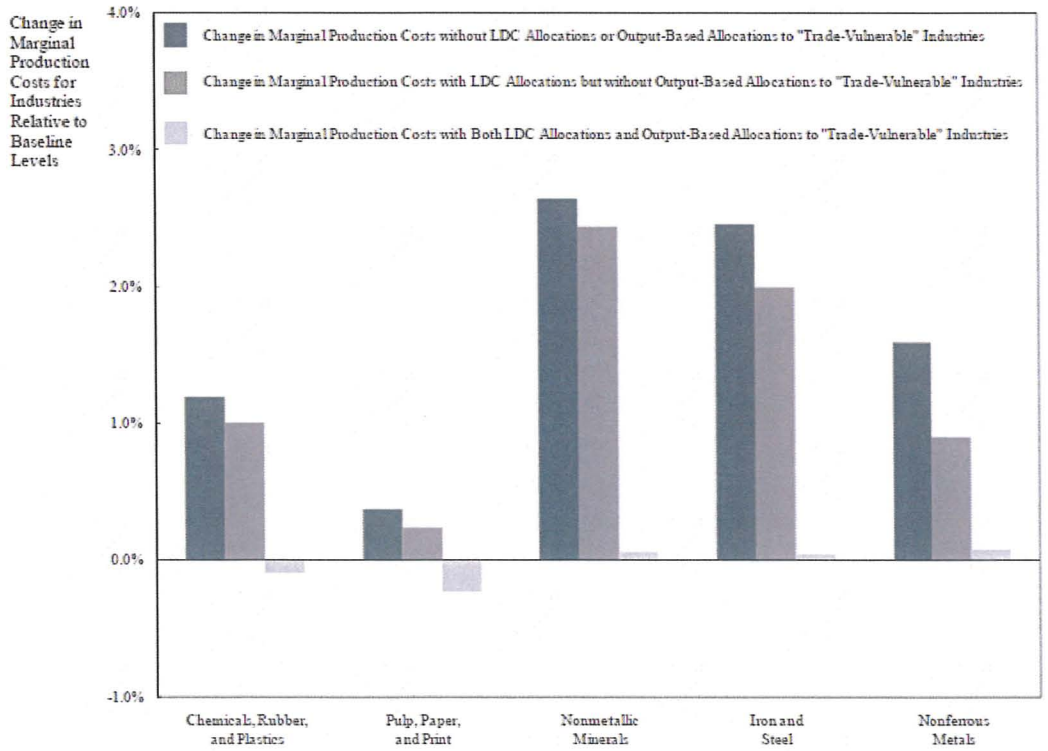
[5] U.S. Government Agencies, "The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries," December 2, 2009. Available at: http://www.epa.gov/climatechange/Downloads/EPAactivities/InteragencyReport_Competitiveness-EmissionLeakage.pdf

In crafting H.R.2454, Energy and Commerce Committee Chairman Henry Waxman and I were well aware of and very concerned about the impacts of greenhouse gas regulation on America's manufacturing competitiveness. That's why in the cap-and-trade portion of the bill, we included a detailed allowance allocation plan to ensure that EITE manufacturers were not put at a disadvantage relative to foreign competitors, while still incentivizing reductions in greenhouse gas emissions. Industries verified to be energy-intensive and trade-exposed were allotted allowances under the cap-and-trade program to neutralize any cost increases associated with emissions from their direct energy consumption. They were also allocated allowances to neutralize any cost increases resulting from the indirect emissions associated with their electricity use.

The conclusion of the Interagency Report was that the cap-and-trade program would have very little impact, no impact, or potentially *positive* impact on EITE manufacturers. Figure 14 from the Interagency Report and its explanation below detail these findings:

> "Yet, as Figure 14 indicates, together, the LDC allocations and output-based rebates can, in fact, fully — and potentially more than fully — mitigate the increase in production costs borne by energy-intensive trade-exposed industries, and the associated competitiveness impacts, even after accounting for the program's indirect effects."

Figure 14. Effect of Domestic Cap-and-Trade Program on Marginal Production Costs of Energy-Intensive Trade-Exposed Industries without and with Allocations to Local Distribution Companies and Output-Based Allocations to "Trade-Vulnerable" Industries



Largely as a result of the fair way in which American manufacturing was treated in the bill, energy-intensive manufacturers like DuPont, GE, Dow, Alcoa, and many others supported Waxman-Markey.[6] With natural gas exports, however, there are no analogous policies to those contained in the Waxman-Markey legislation to help maintain affordable energy for consumers and help American manufacturers maintain global competitiveness. This is the key point the NERA analysis seemed to miss. The Interagency Report was clear that without the mitigating measures included in Waxman-Markey, some EITE industries would have been exposed to production cost increases of 2.5 percent or more. The potentially crippling cost increases that could have hit up to 12 percent of U.S. manufacturing output and affected 780,000 workers were neutralized by the allocation system contained in Waxman-Markey. However, similar impacts on EITE industries resulting from large-scale natural gas exports would not be neutralized and therefore should be more fully accounted for in an analysis of natural gas exports.

It is very important for us to know exactly which of the EITE industries would be deeply affected by natural gas exporting. Unfortunately, the NERA study also fell short in that regard. The NERA study concludes the discussion on EITE industries by saying that "competitive impacts of higher natural gas prices attributable to LNG exports will be very narrow, but it was not possible to model impacts on each of the potentially affected sectors." I find this unacceptable. The Interagency Report modeled sector-by-sector impacts of cap-and-trade, and it is imperative that a similar modeling of sector-by-sector impacts resulting from natural gas exports be conducted as well. Further, since the manufacturing sector has endured both a crushing economic recession and a dynamic resurgence (driven at least in part by low natural gas prices) in the last five years, sector-by-sector impacts should be modeled using more recent data than that used for the Interagency Report, which used data from 2007.

I therefore request modeling be done that looks at the impact of natural gas exporting on U.S. manufacturing on a sector-by-sector basis using the most recent data available.

3) **The NERA report failed to assess the relative economic impacts associated with domestic industrial utilization of natural gas compared to exporting, and it made inaccurate assumptions regarding who would benefit through exporting.**

According to Dow Chemical, the value of every unit of energy used by the manufacturing sector is multiplied by a factor of 20 within the economy because of the production it stimulates throughout the value chain.[7] In addition, for every manufacturing job created on the factory

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[6] "Building the American Clean Energy Economy," page 27, July, 30, 2012. Available at: http://globalwarming.markey.house.gov/files/WEB/ACESPacket/ACESCleanEnergyPlan.pdf

[7] Dow Chemical Company, press release, December 6, 2012. Available at: https://media.gractions.com/EE3B35BC4057E0B833E10AB0A1E1F8B9EC78B9DF/72575bdb-20f2-49b0-aa77-1869d9081e56.pdf

floor, five to eight more jobs are created in the larger economy. On the other hand, exporting our energy provides a narrow benefit to natural gas producers and exporters and has little to no domestic value multiplier for the American economy. The NERA analysis goes into detail in explaining why it believes that the fertilizer, chemical, iron and steel, and other EITE industries are both low value-added industries and susceptible to international competition. But it does not explain how the loss of these industries would impact U.S. employment or the supply chains in which these industries are intricately tied.

I am particularly concerned about the assumption in the NERA study that financing of natural gas investments would originate from U.S. sources and that the investment benefits would accrue to Americans widely. This is an important assumption in determining both net U.S. economy-wide costs and benefits as well as distributional impacts, and I believe this assumption is inaccurate and misleading.

Many foreign corporations, either directly or through partnerships, produce oil and gas in the United States utilizing foreign financing arrangements. Many of these foreign companies are actually *owned by foreign governments*. In fact, because of an oil company court challenge, many foreign state-owned companies are already producing billions of dollars worth of oil and gas in U.S. waters in the Gulf of Mexico without paying a dime in royalties to U.S. taxpayers. Beneficiaries include Italy's state-owned company ENI, Brazil's Petrobras, Norway's Statoil, and Columbia's Ecopetrol.[8]

Even in the case where natural gas exporting leads to increased gas production by American companies, the vast majority of Americans will see no investment income from natural gas exporting. The NERA report says "Different socioeconomic groups depend on different sources of income, though through retirement savings an increasingly large number of workers share in the benefits of higher income to natural resource companies whose shares they own." Polls suggest that roughly half of Americans own stock.[9] The Americans that own stock in natural gas companies, in particular, is likely much lower than that. And the vast majority of those Americans are likely exposed to the natural gas sector only through diversified mutual funds, meaning their ownership stake is very small.

The dividends and capital gains received from natural gas investments will go mostly to the people that benefit from dividends and capital gains already: the wealthy. According to The Washington Post, more than 50 percent of all capital gains over the past two decades have

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[8] House Natural Resources Committee Democrats, press release, September 18, 2012. Available at: http://democrats.naturalresources.house.gov/press-release/markey-chinese-oil-deal-would-expand-foreign-oil-company-access-free-drilling-gulf-rob

[9] Dennis Jacobe, Gallup, "In U.S., 54% Have Stock Market Investments, Lowest Since 1999," April 20, 2011. Available at: http://www.gallup.com/poll/147206/stock-market-investments-lowest-1999.aspx

accrued to the wealthiest 0.1 percent of taxpayers.[10] The richest five percent of Americans receive 80 percent of all capital gains. Similarly, over a third of dividends go to the top one percent of earners of the population. And 72 percent of dividends go to households that earn more than $100,000 a year. More simply, the minority of Americans with significant ownership stakes in natural gas production—the wealthy—will likely see benefits from exporting, while for the majority of Americans, higher energy bills and diminished job prospects mean natural gas exporting reduces economic wellbeing. Further, the vast majority of shale gas reserves are on private lands, which means royalties on increased gas production will tend to go to private landowners rather than to the U.S. Treasury where the benefits would be more widely shared.

I therefore request that modeling and analysis be done to look at the impact of natural gas exporting on U.S. employment. Please also examine how, on average, the costs and benefits of natural gas exporting are distributed to Americans, based on geography and income level.

The flaws in the NERA study indicate that we still have a long way to go before we can be confident that large-scale LNG exporting is truly in America's interest and can be done in a way that protects American consumers and manufacturers. It is critical that policy makers and the American people have a true understanding of the full impacts of exporting domestically produced natural gas before the Department moves forward in granting additional LNG export permits. Please respond to my request for the Department to ensure that economic models are re-run based on the most recent data, that new and important areas are added to the model, that inaccurate assumptions are corrected, and that analysis and findings are updated to reflect these important changes.

I thank you for your attention to this issue. Please direct questions on this matter to Jonathan Phillips on my staff at jonathan.phillips@mail.house.gov or (202) 225-6065.

Sincerely,

Edward J. Markey
Ranking Member
Committee on Natural Resources

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[10] Steven Mufson and Jia Lynn Yang, Washington Post, "Capital Gains Tax Rates Benefiting Wealthy Feed Growing Gap Between Rich and Poor," September 11, 2011. Available at: http://www.washingtonpost.com/business/economy/capital-gains-tax-rates-benefiting-wealthy-are-protected-by-both-parties/2011/09/06/gIQAdJmSLK_story.html

United States Senate

WASHINGTON, DC 20510

January 10, 2013

The Honorable Steven Chu
Secretary
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Dear Secretary Chu:

After reviewing the recently released NERA Economic Consulting study[1] commissioned by the Department, I remain deeply concerned about the Department of Energy's approval process for liquefied natural gas ("LNG") export applications. The Natural Gas Act ("NGA") requires the Department to determine whether approving an application to export LNG is in the "public interest," and the Department has indicated that this report will be central to the approval process for these applications. Export applications, which are typically for 20 years or more, and the associated LNG export terminals will reshape the North American natural gas market for years to come. The shortcomings of the NERA study are numerous and render this study insufficient for the Department to use in any export determination. The NERA study would need to be updated with new EIA projections, more realistic market assumptions, regional impacts of the proposed actual export terminals, and evaluations of the actual impacts on consumers and businesses of exporting LNG.

The NERA study's most glaring shortfall is its reliance on two-year-old domestic energy market projections that diverge widely from the government's current understanding of future supply and demand. The study used the Energy Information Administration's (EIA) Annual Energy Outlook 2011 ("AEO2011") reference case, which was released in 2010, as the foundation for its own LNG study. However, on the same day the NERA study was released, the EIA issued its Annual Energy Outlook Reference Case for 2013 ("AEO2013"). There are significant differences between the two EIA AEO reference cases, including projections for gas consumption, energy prices and electric sector energy consumption that render the NERA study inaccurate in reflecting the current sector conditions necessary to inform today's decision-making. Among the most notable data differences are:

- More homes and businesses will rely on natural gas-fired electricity: U.S. net electricity generation by coal power plants in 2035 is projected to be 22.7% lower in AEO2013 than in AEO2011; a majority of this power will be replaced by natural gas-fired generation, which is 15.2% more in AEO2013 than AEO2011;
- Overall natural gas consumption will be higher: The AEO2013 predicts U.S. natural gas consumption will be 8% higher in 2035 than the AEO2011 figure used by NERA.

[1] W. David Montgomery, et al., "Macroeconomic Impacts of LNG Export from the United States," NERA Economic Consulting, December, 2012, http://www.fossil.energy.gov/programs/gasregulation/reports/nera_lng_report.pdf. Referred to hereafter as "NERA study."

- EIA assumed LNG would be *imported*: Perhaps the most illustrative deviation between the two sets of data is that EIA still expected the U.S. to import LNG in its AEO2011 projections adding to U.S. supplies. The AEO2013 projects there will be net exports of LNG, reducing U.S. supplies.

Even if NERA were to use the new EIA projections, the model it employed for this study has additional deficiencies that would need to be addressed before it could be relied upon to serve as a basis for the statutory findings required by the Natural Gas Act. For example:

1) The NERA study evaluates dozens of scenarios representing different market conditions, but it does not consider the significant domestic demand growth that outside experts and private industry expect to occur over the next decade. By excluding these sources of demand, NERA, like the EIA's Annual Energy Outlooks, is significantly understating demand from emerging segments of the natural gas market. Two overlooked examples are as follows:

- Natural gas is expected to become major transportation fuel: Outside experts suggest EIA has greatly underestimated the use of natural gas by the transportation sector. Citi projected that heavy trucks alone could use 3.3 Bcf/D of natural gas by 2020, displacing up to 600,000 barrels of diesel fuel every day.[2] The Citi estimate is more than 20 times what EIA projected in its AEO2011, which, in turn, is one-fourth of the agency's AEO2013 projection. The railroad industry is also reported to be studying a switch to natural gas-fueled locomotives, which would further drive up demand.[3]
- Projected industrial growth is not fully accounted for by EIA or NERA: The growth in natural gas production and low prices have attracted 100 proposed industrial projects, representing $90 billion in investment and tens of thousands of new jobs, according to Dow Chemical. The proposed projects identified in the Dow analysis represent an estimated increase in demand of 8 Bcf/d. Dow expects near term industrial demand growth to reach 11 Bcf/d. The AEO2011 does not account for these projects, nor does the AEO2013. EIA actually projects non-electric related industrial natural gas demand to decline.[4]

2) The NERA study purports to treat the U.S. and Canada as a single North American market, but its assumptions ignore the potential effect of Canadian LNG exports. The study ignores this important market development, even though Canada's National Energy Board has already approved two LNG export projects in British Columbia. The board also is considering a third LNG export project submitted over the summer by Royal Dutch Shell. Published reports suggest these projects could result in 9 billion cubic feet per day ("Bcf/D") of exports, beginning as early as 2014.[5]

3) LNG terminals use a substantial amount of energy in the liquefaction process. This energy is largely derived from natural gas, representing an amount equivalent to as much as 10% of the amount of natural gas ultimately processed into LNG during the conversion. Both the EIA and NERA appear to have

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[2] Ed Morse, et al., "Energy 2020: North America, the New Middle East?," *Citi*, March 20, 2012.
[3] Zain Shauk, "Natural gas could be cheaper way to run a railroad," *Houston Chronicle*, October, 9, 2012, http://www.chron.com/business/energy/article/Natural-gas-could-be-cheaper-cleaner-way-to-run-3933795.php.
[4] Dow Chemical, "DOE Report on LNG Exports Short Changes Manufacturing and U.S. Competitiveness," December 6, 2012, http://www.dow.com/news/press-releases/article/?id=6138.
[5] Martin O'Rourke, "Canada expects to start LNG exports from late 2014: energy minister," *Platts*, September 18, 2012, http://www.platts.com/RSSFeedDetailedNews/RSSFeed/NaturalGas/8731348.

misrepresented the use of natural gas by LNG terminals for this purpose, which in turn understates the overall gas demand attributable to LNG exports:

- EIA understated natural gas consumption by LNG terminals: In its analysis of LNG exports released in January 2012,[6] the EIA reduced the amount of LNG that would actually be exported under its projections by 10% to account for this additional consumption of natural gas during conversion. (NERA uses the same low and high export cases of 6 Bcf and 12 Bcf.) Under the EIA's 6 Bcf/D export case, only 5.4 Bcf/D would actually be exported; in its 12 Bcf/D case, only 10.8 Bcf/D would actually be exported. DOE export permits are for actual export quotas. Thus, actual exports at those nominal 6 Bcf/D and 12 Bcf/D levels would require adding 10% to overall natural gas demand above and beyond the export volumes. The EIA analysis subtracts the gas used for processing.
- The NERA study also underestimates LNG terminal demand: The NERA study states that 9% of the LNG produced at the terminals will be "burned off" for liquefaction,[7] which is likely a mischaracterization of the actual gas usage for liquefaction. High value LNG would not be used to power the conversion plant. While there will be some boil off loses after LNG is produced, the larger issue is the additional natural gas demand resulting from gas consumption during the liquification conversion process and how the NERA study factors this additional demand into the full exporting lifecycle process. Gas that is used for liquefaction, regardless of its source, needs to be added to the overall demand for natural gas attributable to export volumes approved in the export permits and placed on board LNG tankers. It does not appear that the NERA study does so. The NERA study further errs by pricing the cost of the additional conversion gas at the wellhead price of natural gas despite the fact that gas used for liquefaction will need to be processed and physically transported by pipeline to the LNG terminal location at higher cost and likely impacting transportation and hub and regional prices along the way.

Although the NERA study acknowledges that some sectors of the economy will be hurt by exports, the NERA study fails to fully assess the impacts of rising natural gas prices on homeowners and businesses. The report recognizes negative consequences of LNG exports, but spends only a few paragraphs of its 230-page report actually examining them in detail. Still, they are notable:

- There is a massive wealth transfer between manufacturing and residential consumers that benefits the natural gas industry but "raises energy costs and, in the process, depresses both real wages and the return on capital in all other industries."[8]
- Labor, investment and tax income would fall $10 billion in 2015 as a result of LNG exports; they are reduced by more than $30 billion in 2020 and more than $40 billion in 2025, 2030 and 2035.[9]

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[6] Energy Information Administration, "Effect of Increased Natural Gas Exports on Domestic Energy Markets," January, 2012, http://www.eia.gov/analysis/requests/fe/pdf/fe_lng.pdf.
[7] NERA Study at 86
[8] NERA study at 7
[9] *Ibid.*, at 8

- "Households will be negatively affected by having to pay higher prices for the natural gas they use for heating and cooking. Domestic industries for which natural gas is a significant component of their cost structure will experience increases in their cost of production, which will adversely impact their competitive position in a global market and harm U.S. consumers who purchase their goods."[10]
- "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."[11]
- With minimal analysis, the study concludes that a "narrow" group of energy-intensive, trade-exposed industries would be experience "serious competitive impacts."[12] The study tries to downplay the economic importance of these manufacturing industries by saying they represent ½% of total U.S. employment;however, that equaled 1.2 million jobs at the end of November. Given the number of current employees and future expected growth, these impacts deserve further study.
- Regional gas prices are expected to increase with higher demand and an increase in wellhead natural gas prices, leading to a decline in U.S. consumption of natural gas.[13]

Despite these serious impacts that are acknowledged within the study, NERA has not conducted further in-depth inquiry into how these impacts will actually be felt in the economy. Appendix F of the study identifies a number of critical factors that the study simply did not consider, without which the report represents a wholly insufficient basis for approving individual export applications which will have significant national, regional and local impacts. These significant gaps in analysis are best explained by the text included in Appendix F[14] itself:

- "Where Production or Export Terminals Will be Located – There are proposals for export facilities in the Mid-Atlantic, Pacific Northwest, and Canada, all of which could change basis differentials and potentially the location of additional natural gas production, with corresponding regional impacts. To analyze alternative locations of export facilities it would be necessary to repeat both the EIA and the NERA analyses with additional scenarios incorporating demand for natural gas exports in different regions."
- "Regional Economic Impacts – Since EIA assumed that all demand for domestic production-associated LNG exports was located in the Gulf region, it was not possible in this study to examine regional impacts on either natural gas prices or economic activity. The Gulf Coast is not necessarily a representative choice given the range of locations now in different applications, so that any attempt to estimate regional impacts would be misleading without more regional specificity in the location of exports."
- "Effects on Different Socioeconomic Groups – Changes in energy prices are often divided into 'effects on producers' and 'effects on consumers.' … The ultimate incidence of all price changes is on individuals and households, for private businesses are owned ultimately by people. Price

[10] *Ibid.*, at 13
[11] *Ibid.*, at 13
[12] *Ibid.*, at 12
[13] *Ibid.*, at 35-36
[14] *Ibid.*, at 210-211

changes affect not only the cost of goods and services purchased by households, but also their income from work and investments, transfers from government and the taxes they pay. More relevant indicators of the distribution of gains and losses include real disposable income by income category, real consumption expenditures by income category, and possibly other measures of distribution by socioeconomic group or geography. This study only addresses the net economic effects of natural gas price changes and improved export revenues, not their distribution."

As the Department has acknowledged when it elected to insert the NERA study into the docket of each pending LNG export application, the Department is statutorily required to assess the impact of the individual applications as well as the total impact of proposed export volumes. The NERA study provides no insight into the regional market impacts of these applications, and very little information on the effects of proposed exports on different socioeconomic groups. As such, it is not an adequate basis upon which to approve those individual applications.

As I stated in my previous letter, I remain deeply concerned that the Department has not articulated a set of criteria or procedures that will allow it to meet its obligations under the Natural Gas Act to make the required public interest determinations. Proper, transparent mechanisms must be in place to effectively evaluate all LNG export applications – prior to their approval – to gauge whether each application is in the public interest. The inadequacies of the NERA study only underscore the need for the Department to establish those criteria and procedures in a transparent and accurate manner informed by data that most accurately reflects the world today.

Sincerely,

Ron Wyden

Ron Wyden
United States Senator