The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries

An Interagency Report Responding to a Request
from Senators Bayh, Specter, Stabenow, McCaskill, and Brown

December 2, 2009*

* A set of minor corrections were made to this report on February 23, 2010. See Appendix D for a description of these revisions.

TABLE OF CONTENTS

I. Executive Summary

Proposed greenhouse gas cap-and-trade legislation will play an important role in advancing both the United States' transition to a clean-energy economy and the long-run competitiveness of U.S. manufacturing. Some energy-intensive trade-exposed industries have raised questions, however, about the potential near-term international competitiveness impacts of domestic energy and climate legislation. If the adoption of a domestic cap-and-trade program leads some manufacturing activity and its associated emissions to shift to countries that do not yet have comparable greenhouse gas regulations, along with the economic concerns that this poses, this presents environmental concerns because the resulting "emission leakage" can undermine the environmental effectiveness of a domestic emissions cap. The most effective approach to address these concerns is to ensure significant action by all major emitters through ongoing international negotiations. It is important to understand, however, both the scope of potential competitiveness and leakage impacts that could exist prior to securing such action, and also the ability of certain provisions in proposed legislation — particularly the American Clean Energy and Security Act of 2009 (H.R. 2454) — to mitigate those impacts.

This report is a response to a request from Senators Bayh (D-Indiana), Specter (D-Pennsylvania), Stabenow (D-Michigan), McCaskill (D-Missouri), and Brown (D-Ohio). In a September 11, 2009 letter to the White House (see Appendix C), the Senators request "assistance in assessing the … provisions [addressing energy-intensive trade-exposed industries] in Section 782(e) of … H.R. 2454." In particular, they seek an analysis that determines which industrial sectors are likely to be eligible for allowance rebates to "trade-vulnerable" industries under H.R. 2454, and that assesses "potential competitiveness impacts to energy intensive and trade exposed manufacturers if the United States adopts a climate change policy…." The Senators further request that the analysis consider the range of measures in H.R. 2454 that may benefit energy-intensive trade-exposed industries, and "identify additional data that, if provided, could improve the assessment of competitiveness impacts."

This report examines patterns of energy use, emissions, and trade across manufacturing sectors to identify vulnerable industries, assesses the potential impacts of proposed legislation on these industries, and estimates how key allowance allocation provisions moderate these impacts on costs, trade flows, and ultimately emission leakage. Given that, on average, energy expenditures account for less than 2 percent of the value of U.S. manufacturing output, the vast majority of U.S. industry will be largely unaffected by proposed legislation. H.R. 2454 establishes thresholds for "presumptive eligibility" for mitigation measures based on an industry's energy intensity, greenhouse gas intensity, and trade intensity. These thresholds offer useful criteria for identifying vulnerable industries. Based on a preliminary assessment using these criteria, 44 of about 500 manufacturing industries would be "presumptively eligible." Almost all of these industries fall within the chemicals, paper, nonmetallic minerals (*e.g.*, cement and glass), or primary metals (*e.g.*, aluminum and steel) sectors. In addition to these industries, the processing subsectors of a few mineral industries are also likely to be deemed eligible. Together, these energy-intensive trade-exposed industries account for 12 percent of total manufacturing output and 6 percent of manufacturing employment (half a percent of total U.S. non-farm employment), but almost half of manufacturing greenhouse gas emissions. In 2006, their emissions were about 730 million metric tons of carbon dioxide equivalent (MMTCO$_2$e).

To understand H.R. 2454's impacts on industry, we draw on prior literature, new analysis of these industries' emission intensities, existing modeling by the Environmental Protection Agency (EPA) and Energy Information Administration (EIA), and new modeling conducted for this report. In assessing impacts on these industries, we focus on the effects of an allowance price of $20 per ton of CO$_2$e. This price was chosen because it is representative of the near- to medium-term allowance prices under H.R. 2454 projected by various studies. For example, Congressional Budget Office and EIA analyses of H.R. 2454 both projected that allowance prices would reach $20 by the middle of the coming decade, while EPA analysis projected that prices would reach $20 somewhat later, after 2020. In modeling impacts on industry, we consider scenarios with and without two key provisions in H.R. 2454 that can reduce competitiveness impacts and leakage, the allocation of allowances to local distribution companies (LDCs) for electricity and the allocations (or rebates) to "trade-vulnerable" industries.

The economic modeling that we conduct examines average impacts on each of five broad energy-intensive trade-exposed industrial sectors: chemicals, plastics and rubber; pulp and paper; nonmetallic minerals; iron and steel; and nonferrous metals (*e.g.*, aluminum). That modeling finds that, at an allowance price of $20 per ton and absent H.R. 2454's allocation provisions, the average increase in production costs experienced by energy-intensive trade-exposed industries within each of these five broad sectors would range from less than 0.5 percent to slightly more than 2.5 percent. In turn, across the five sectors, these increased production costs would lead to average impacts on net imports that, when defined as a percentage of domestic production, generally fall within the same range. However, the modeling also finds that the allocations to LDCs and "trade-vulnerable" industries can eliminate almost all — and, in some cases, potentially more than all — of those cost impacts, as well as the resulting changes in net imports and associated emission leakage. The conclusions regarding the effectiveness of the mitigating allocations appear robust. Analyses of Europe's greenhouse gas cap-and-trade program (the European Union Emission Trading Scheme) that examined key sectors in detail and used a range of allowance prices reached similar conclusions about the ability of output-based allocations to limit a cap-and-trade program's impacts on net imports and associated leakage.

The modeling indicates that, even absent the mitigating allocation measures, total annual emission leakage to unregulated countries associated with a cap-and-trade program's impacts on the international competitiveness of domestic "trade-vulnerable" industries is likely to be only on the order of 10 $MMTCO_2e$. The modeling projects that the vast majority of emission reductions achieved by these industries under a cap-and-trade program will be from reductions in the emission-intensity of their production (*e.g.*, increased energy efficiency, or shifts to lower-emission production methods), rather than from declines in production associated with increased imports from unregulated countries. Importantly, while output-based allocations can essentially eliminate the leakage that is associated with the reduced international competitiveness of domestic industry, if carefully designed, these allocations can do so while preserving incentives for industry to reduce the emission-intensity of its production. With such allocations, leakage associated with impacts on the international competitiveness of domestic industries falls to about one $MMTCO_2e$, or about one percent of the estimated emission reductions from those industries.

There are important caveats to this analysis. Most importantly, absent the mitigating policy measures like those in H.R. 2454, some industries would likely be more significantly affected by climate policy than the average effects reported above. However, even for these industries, well-designed output-based allocations should be equally effective in mitigating the impacts that they would otherwise experience. Also, while the model used for this report has several features that make it preferable to other models in addressing competitiveness and leakage issues, it examines a climate policy's impacts relative to the economy as it was in 2004. In some respects, this feature causes the model to overstate impacts on industry, such as by excluding effects of recent legislation (*e.g.*, the Energy Independence and Security Act of 2007 and the American Recovery and Reinvestment Act of 2009) in increasing the efficiency of manufacturing and growing a clean energy economy. In other respects, this feature causes the model to understate impacts. Further, while the modeling assumes a $20 allowance price and provides a snapshot of impacts under this price, allowance prices are expected to change over time, leading to effects that would also vary over time.

As more information continues to be gathered going forward, this will improve our ability to characterize competitiveness and leakage impacts, as well as the effects of the allocation provisions in H.R. 2454 that can mitigate these impacts. For example, improvements in our understanding of intra-industry variation in the emission-intensity and trade-exposure of firms can help us better understand both the distribution of impacts within an industry, as well as the industry-wide impacts themselves. Some firms in energy-intensive trade-exposed industries that are less emission-intensive than their sector average may experience a net benefit from the imposition of climate policy — when considering both the requirement to submit allowances and also the mitigating allocations — while others that are more emission-intensive than average may still face higher costs after the mitigating allocation measures.

Finally, while the modeling performed in this report assumes straightforward implementation of output-based allocations, in reality, there are challenging implementation issues. For example, for purposes of granting allocations, it will be difficult to define appropriate output metrics across the varied products in some industries (*e.g.*, chemicals). Also, some of the data needed to develop and implement meaningful benchmarks are not currently collected.

In developing this report, the Administration met with a range of stakeholders (see Appendix B), including representatives from affected industries, labor, and non-governmental organizations. We consider this report to be a first step in the Administration's engagement on this issue, and look forward to working with stakeholders to improve both our understanding of these issues and their implications for policy design.

II. Introduction

In commenting on the House of Representatives' passage of the American Clean Energy and Security Act of 2009 (H.R. 2454), the President declared that such legislation is "…a bold and necessary step that holds the promise of creating new industries and millions of new jobs; decreasing our dangerous dependence on foreign oil; and strictly limiting the release of pollutants that threaten the health of families and communities and the planet itself." As creators, producers, and consumers of clean energy technologies, the U.S. manufacturing sector will play a critical role in achieving our national clean energy and climate change goals. At the same time, while U.S. manufacturers have much to gain in the transition to a clean energy economy, it is important that policies to achieve that transition be carefully designed to avoid unintended adverse impacts on our manufacturing sector.

A greenhouse gas cap-and-trade program can play an important role in advancing the long-run competitiveness of domestic manufacturing sectors as the world transitions to a clean energy economy by providing manufacturers with important incentives for innovation and flexibility as we undergo this transition. In the near term, however, there is a legitimate concern that, absent any mitigating measures, the adoption of a domestic cap-and-trade program could place a limited set of energy-intensive industries at a disadvantage relative to international competitors that do not face similar, contemporaneous regulations. If this leads some manufacturing activity and its associated emissions to shift to countries that do not yet have comparable greenhouse gas regulations, along with the economic concerns that this poses, this also presents environmental concerns because the resulting "emission leakage" can undermine the environmental effectiveness of a domestic emissions cap.[1]

The Administration believes that the most effective approach to address concerns with emission leakage and international competitiveness impacts is to negotiate a new international climate change agreement that ensures that all the major emitters take significant actions to

[1] This report focuses on one significant source of emission leakage whereby the adoption of domestic greenhouse gas regulations leads to shifts in emission-intensive manufacturing activity and associated emissions to countries without comparable regulations. The report focuses on this type of leakage because of the nature of the Senators' request and because it can be prevented through careful domestic policy design. There are, however, other ways in which the adoption of domestic regulations can lead to increased emissions abroad that cannot be controlled through domestic policy design. For example, by reducing U.S. demand for oil, and thereby world oil prices, U.S. greenhouse gas regulations can lead to increased consumption of oil (and increased emissions) abroad, which would partly offset the reductions achieved at home.

reduce their emissions. Some of our major trading partners already have taken significant action. For example, since 2005, the European Union has had a greenhouse gas cap-and-trade program in place that covers the power sector and major manufacturing emission sources. As the United States moves forward with our energy and climate policies, some trading partners may lag in adopting comparable greenhouse gas regulations. Consequently, some period of time may elapse between when the United States implements a cap-and-trade program and when all of our major trading partners adopt comparable measures. In light of this possibility, the Administration has responded to the request to assess impacts on international competitiveness and leakage during this interim period. Likewise, it is important to evaluate how effectively these impacts can be mitigated by certain provisions of a domestic cap-and-trade program, like those set forth in the American Clean Energy and Security Act of 2009 (H.R. 2454).[2]

This report evaluates a cap-and-trade program's impacts on emission leakage and the international competitiveness of U.S. manufacturing. It begins in Section III by identifying energy-intensive trade-exposed manufacturing industries, and presenting estimates of their emissions. Section IV examines the factors that affect potential leakage in these industries, and Section V reviews the experience of these industries within the European cap-and-trade program. Section VI surveys the provisions in H.R. 2454 and also in the American Recovery and Reinvestment Act of 2009 that assist energy-intensive manufacturing in the transition to a clean energy economy. Section VII uses economic modeling to assess potential impacts of a cap-and-trade program on emission leakage and the competitiveness of U.S. manufacturing, and to evaluate the efficacy of particular provisions in H.R. 2454 that have been developed to address concerns about international competitiveness and emission leakage. Finally, Section VIII discusses caveats and next steps.

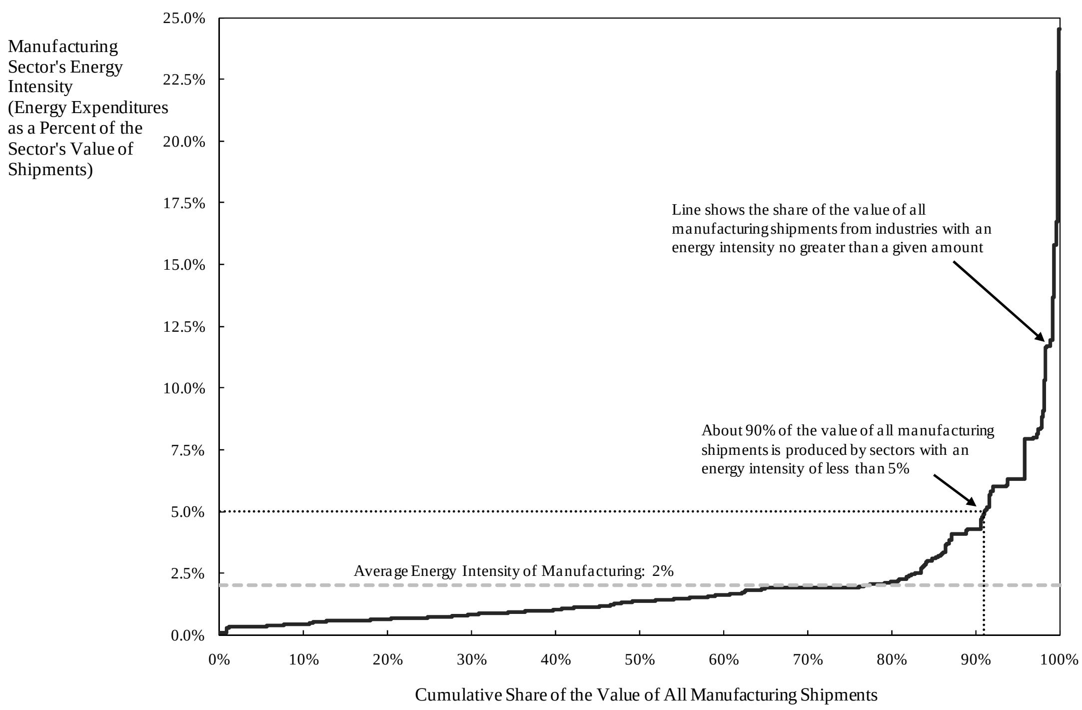
III. Energy-Intensive Trade-Exposed Industries

Through its requirement that firms acquire and submit allowances to cover their greenhouse gas emissions, a cap-and-trade program like that incorporated in H.R. 2454 will tend to have more significant effects on an industry the more emission-intensive that industry is. While some industries have significant greenhouse gas emissions associated with manufacturing

[2] While this report focuses on H.R. 2454, reflecting the request from the Senators, the provisions in H.R. 2454 are very similar to those in the Clean Energy Job and American Power Act of 2009 (S. 1733).

processes that do not involve fuel combustion, most manufacturing emissions are associated with energy use. As a result, the more energy-intensive an industry is, the more emission-intensive it is, and hence the more it will likely be affected by a cap-and-trade program. On the whole, energy expenditures equal only 2 percent of the value of U.S. manufacturing's output (see Figure 1) and three-quarters of all manufacturing output is from industries with energy expenditures below 2 percent of the value of their output. Thus, the vast majority of U.S. industry will be relatively unaffected by a greenhouse gas cap-and-trade program. Industries whose energy expenditures exceed five percent of the value of their output — a threshold given significance in H.R. 2454, as described below — account for only one-tenth of the value of U.S. manufacturing output, and less than two percent of U.S. gross domestic product in 2007. Thus, while concerns have been expressed about a cap-and-trade program's impacts on U.S. manufacturing, it is important to recognize that these concerns apply only to a small subset of manufacturers, and thereby call for narrowly and carefully targeted policies.

Figure 1. Energy Intensity of U.S. Manufacturing Sectors in 2007



Note: This chart does not account for 14 (of 471) manufacturing sectors for which data on energy expenditures were withheld in the Economic Census to maintain confidentiality of individual companies' data. However, these sectors account for only 2 percent of the value of all manufacturing shipments.
Source: 2007 Economic Census.

H.R. 2454 establishes specific criteria that industries must meet to be eligible for the provisions that are intended to address emission leakage associated with impacts on international competitiveness. Using the best and most recent publicly available data, the remainder of this section identifies the specific energy-intensive trade-exposed industries that would likely be deemed eligible for these provisions, and quantifies their recent emissions.[3]

A. Identifying Energy-Intensive Trade-Exposed Industries

In the course of establishing provisions to address emission leakage associated with the international competitiveness impacts of a domestic cap-and-trade program, H.R. 2454 establishes criteria for identifying energy-intensive trade-exposed industries.[4] Specifically, H.R. 2454 considers an industry to be "presumptively eligible" for emission allowance allocations (or "rebates") to "trade-vulnerable" industries if the industry's energy intensity or its greenhouse gas intensity is at least 5 percent, and its trade intensity is at least 15 percent.[5] In addition, H.R. 2454 considers an industry to be "presumptively eligible" if its energy or greenhouse gas intensity is at least 20 percent, regardless of its trade intensity. H.R. 2454 stipulates the specific data sources that should be relied on in assessing industry eligibility; these include the Census Bureau's Annual Survey of Manufactures and Economic Census, the Energy Information Administration's (EIA) Manufacturing Energy Consumption Survey, and data from the United States International Trade Commission. The bill also requires that, to the extent feasible, eligibility assessments should be conducted at the most disaggregated level for which the necessary public data are available — the six-digit industry classification under the North American Industry Classification System (NAICS).[6]

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[3] In addition to drawing on publicly available data, the Administration has met with various stakeholder groups, including representatives of energy-intensive industries, and has requested their assistance going forward in obtaining additional data that is not yet available in the public domain, but that would improve assessments of affected industries and competitiveness impacts. While some stakeholders have provided the Administration with data and analyses that can help better inform various aspects of the discussion about competitiveness impacts, what has been provided to date does not affect the specific analyses and estimates presented in this report.

[4] The criteria established in S. 1733 are generally consistent with those in H.R. 2454.

[5] An industry's energy intensity is defined as its energy expenditures as a share of the value of its domestic production. An industry's greenhouse gas intensity is defined as its total greenhouse gas emissions (including indirect emissions from electricity consumption) times $20 per ton of emissions, divided by the value of the industry's domestic production. An industry's trade intensity is defined as the combined value of its exports and imports as a share of the value of its domestic production and imports. This paragraph describes the general criteria established for identifying "presumptively eligible" industries and does not address additional, more detailed eligibility considerations set forth in H.R. 2454. However, the preliminary eligibility assessment presented in Table 1 reflects the application of all the criteria and considerations set forth in H.R. 2454.

[6] NAICS is the standard classification system used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business

The U.S. Environmental Protection Agency (EPA) has previously developed a preliminary assessment of the sectors that would likely be deemed “presumptively eligible” for allowance allocations to “trade-vulnerable” industries under H.R. 2454. However, the recent release of updates to key data sources has allowed EPA to revise that preliminary assessment.[7]

Table 1 presents the set of six-digit industries that would likely be deemed “presumptively eligible” for allocations under H.R. 2454 based on EPA’s updated preliminary assessment. For each industry, Table 1 also presents estimates of the industry's emissions as well as relevant economic characteristics, such as employment, output, energy intensity, greenhouse gas intensity, and trade intensity. The final determination of “presumptively eligible” industries would be made in a formal EPA rulemaking upon enactment of legislation. Moreover, emission estimates in Table 1 are intended to give a sense for the overall scale of the industries’ recent emissions and would not be used for eligibility determinations or allocations.

According to the preliminary assessment of the nearly 500 six-digit manufacturing industries, 44 would be deemed “presumptively eligible” for allowance rebates under H.R. 2454. Of these, 12 are in the chemicals sector, 4 are in the paper sector, 13 are in the nonmetallic minerals sector (*e.g.*, cement and glass manufacturers), and 8 are in the primary metals sector (*e.g.*, aluminum and steel manufacturers). Many of these sectors are at or near the beginning of the value chain, and provide the basic materials needed for manufacturing advanced technologies. In addition to these 44 industries, the processing subsectors of a few mineral industries are also likely to be deemed “presumptively eligible.” In total, in 2007, the “presumptively eligible” industries accounted for 12 percent of total manufacturing output and employed about 780,000 workers, or about 6 percent of manufacturing employment and half a percent of total U.S. non-farm employment. As Figure 2 indicates, most industrial sectors have energy intensities of less than 5 percent, and will therefore have minimal direct exposure to a climate policy’s economic impacts.

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economy. The most detailed public data on the production and operation of manufacturing facilities is provided at a six-digit industry classification level. Within manufacturing, there are nearly 500 six-digit sectors. Classifications with fewer digits (*e.g.*, at the four-digit level) aggregate these six-digit sectors into more broadly defined sectors.

[7] For example, relevant data from the 2007 Economic Census and the Energy Information Administration’s 2006 Manufacturing Energy Consumption Survey were released over the summer.

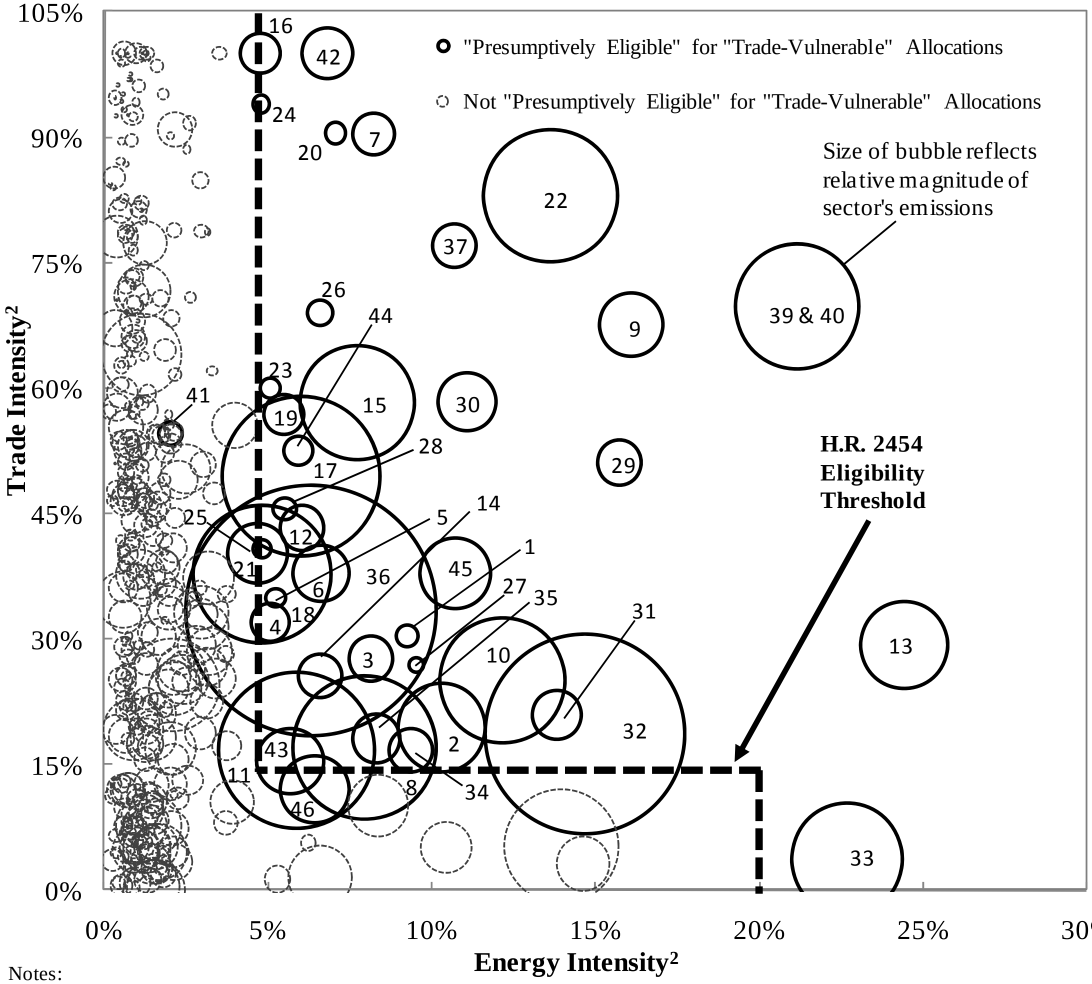
Table 1. Preliminary Assessment of Industries Likely to Be Deemed "Presumptively Eligible" for Allowance Rebates under Section 401 of H.R. 2454[1]

NAICS Code and Title	2007 Economic Statistics[2]			Eligibility Determination		2006 Emissions ($MMTCO_2e$)[5]				GHG Intensity at $20 per Ton of CO_2e[6]
	Value of Shipments ($1,000)	Employees	Establishments	Energy Intensity[3]	Trade Intensity[4]	Direct Combustion Emissions	Process Emissions	Indirect Electricity Emissions	Total Emissions	
311213: Malt manufacturing	786,571	1,022	25	9%	30%	0.8	0.0	0.3	1.0	2.6%
311221: Wet Corn Milling	12,117,145	8,448	64	10%	19%	12.1	0.0	4.3	16.4	3.3%
311613: Rendering and Meat Byproduct Processing	3,563,862	9,355	228	8%	28%	3.5	0.0	0.7	4.2	2.3%
313111: Yarn Spinning Mills	5,011,244	24,750	249	5%	32%	0.4	0.0	2.9	3.3	1.3%
314992: Tire Cord and Tire Fabric Mills	1,069,765	3,577	22	5%	35%	0.2	0.0	0.6	0.8	1.4%
321219: Reconstituted Wood Product Manufacturing	6,896,468	20,426	262	7%	38%	2.7	0.0	4.1	6.8	1.7%
322110: Pulp Mills	5,027,395	7,268	39	8%	90%	2.7	0.0	1.1	3.8	1.8%
322121: Paper (except Newsprint) Mills[7]	46,291,440	75,921	241	8%	17%	29.3	0.0	14.6	44.0	1.9%
322122: Newsprint Mills	3,440,645	4,917	21	16%	68%	2.7	0.0	6.0	8.7	5.1%
322130: Paperboard Mills[7]	25,354,745	36,641	187	12%	25%	19.3	0.0	14.0	33.3	2.9%
325110: Petrochemical Manufacturing	77,661,772	9,257	56	6%	17%	48.5	0.7	3.0	52.2	1.6%
325131: Inorganic Dye and Pigment Manufacturing	5,689,517	7,606	96	6%	43%	2.5	0.0	1.8	4.4	1.5%
325181: Alkalies and Chlorine Manufacturing (incl soda ash beneficiation)	6,370,780	6,364	49	24%	29%	7.8	4.2	3.9	16.0	5.0%
325182: Carbon Black Manufacturing	1,487,557	1,591	32	7%	26%	0.7	3.0	0.4	4.1	5.4%
325188: All Other Basic Inorganic Chemical Manufacturing	22,828,592	35,801	631	8%	58%	7.3	5.1	15.4	27.8	2.9%
325192: Cyclic Crude and Intermediate Manufacturing	5,947,517	3,006	31	5%	102%	1.8	0.0	1.7	3.5	1.2%
325199: All Other Basic Organic Chemical Manufacturing	81,997,462	70,602	818	6%	49%	34.4	5.9	13.7	54.0	1.3%
325211: Plastics Material and Resin Manufacturing	85,231,585	71,216	1,059	5%	38%	28.1	0.0	12.2	40.3	1.0%
325212: Synthetic Rubber Manufacturing	8,253,660	9,794	152	5%	57%	2.4	0.0	1.1	3.6	1.0%
325221: Cellulosic Organic Fiber Manufacturing	925,820	1,353	15	7%	90%	0.7	0.0	0.2	0.9	1.9%
325222: Noncellulosic Organic Fiber Manufacturing	6,963,293	14,684	109	5%	40%	4.4	0.0	3.2	7.6	2.2%
325311: Nitrogenous Fertilizer Manufacturing	5,524,151	3,920	156	14%	83%	6.4	30.5	1.5	38.4	18.5%
327111: Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories	867,553	4,825	30	5%	60%	0.7	0.0	0.1	0.9	1.8%
327112: Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing	783,594	8,774	664	5%	94%	0.5	0.0	0.1	0.7	1.4%
327113: Porcelain Electrical Supply Manufacturing	737,282	4,465	113	5%	41%	0.4	0.0	0.3	0.7	1.3%
327122: Ceramic Wall and Floor Tile Manufacturing	1,126,093	6,272	183	7%	69%	1.1	0.0	0.3	1.4	2.4%
327123: Other Structural Clay Product Manufacturing	243,009	1,650	54	10%	27%	0.4	0.0	0.0	0.4	3.5%
327125: Nonclay Refractory Manufacturing	1,372,439	5,338	101	6%	46%	0.9	0.0	0.3	1.1	1.7%
327211: Flat Glass Manufacturing	3,420,860	10,991	93	16%	51%	2.9	0.1	1.1	4.2	2.5%
327212: Other Pressed and Blown Glass and Glassware Manufacturing	4,316,979	21,189	524	11%	58%	4.1	0.1	3.2	7.4	3.7%
327213: Glass Container Manufacturing	4,899,025	14,928	74	14%	21%	2.7	0.1	2.4	5.3	2.4%
327310: Cement Manufacturing	10,619,945	17,749	302	15%	19%	31.0	46.6	7.7	85.3	15.9%
327410: Lime Manufacturing	1,875,567	4,369	83	23%	4%	10.4	15.1	0.9	26.4	33.0%
327992: Ground or Treated Mineral and Earth Manufacturing	2,826,839	6,497	258	9%	17%	3.1	0.0	1.0	4.1	3.0%
327993: Mineral Wool Manufacturing	6,147,076	18,891	307	8%	18%	2.2	0.0	2.6	4.8	1.5%
331111: Iron and Steel Mills[8]	102,186,442	114,315	743	6%	33%	101.3	0.0	32.8	134.1	2.6%
331112: Electrometallurgical Ferroalloy Product Manufacturing	1,319,541	2,144	20	11%	77%	0.5	1.5	2.1	4.0	6.1%
331210: Iron and Steel Pipe and Tube Manufacturing from Purchased Steel[8]	8,637,314	17,408	153	2%	N/A	1.4	0.0	1.2	2.6	0.6%
331311: Alumina Refining	1,337,014	1,611	16	21%	70%	2.3	6.7	24.3	33.4	9.0%
331312: Primary Aluminum Production	6,657,285	9,355	54	22%	64%	Emissions and GHG Intensity Reflected in Alumina Refining				
331411: Primary Smelting and Refining of Copper[9]	8,247,767	1,771	13	2%	55%	1.0	0.0	0.3	1.3	0.3%
331419: Primary Smelting and Refining of Nonferrous Metal (except Copper and Aluminum)	5,987,185	8,067	183	7%	135%	1.1	0.8	3.8	5.7	1.9%
331511: Iron Foundries	11,795,934	51,503	470	6%	15%	4.0	0.0	5.4	9.4	1.6%
335991: Carbon and Graphite Product Manufacturing	2,795,262	8,666	143	6%	52%	0.7	0.0	1.0	1.7	1.4%
212210: Iron Ore Mining	2,955,254	4,989	22	11%	38%	6.3	0.0	4.4	10.7	7.3%
212234: Copper Ore and Nickel Ore Mining[9]	8,985,692	10,384	31	6%	12%	6.7	0.0	3.2	9.9	2.2%
TOTALS	**618,581,937**	**783,670**	**9,176**			**405**	**120**	**205**	**730**	

Notes:

1. This table updates previous EPA analysis (released June 10, 2009) with recently released data, including the 2007 Economic Census and 2006 Manufacturing Energy Consumption Survey. This does not represent a final EPA determination and the emissions estimates presented here will not be used to make any allocation determinations. The methodology is detailed in a separate EPA memorandum available upon request.
2. While these statistics reflect 2007 data, the energy, greenhouse gas, and trade intensities presented to the right are typically based on data from earlier years, as required in H.R. 2454 and described in the above-referenced memorandum.
3. Energy intensity is equal to a sector's energy expenditures divided by its value of shipments. The specific calculations and sources of relevant data are detailed in the above-referenced memorandum.
4. Trade intensity is equal to the sum of the value of a sector's imports and exports, divided by the sum of its value of shipments and imports. The specific calculations and sources of relevant data are detailed in the above-referenced memorandum.
5. The Energy Information Administration's 2006 Manufacturing Energy Consumption Survey was used to estimate direct combustion emissions and indirect electricity emissions from 25 industries that account for 90% of the total estimated direct combustion and indirect electricity emissions of the presumptively eligible industries. The remaining emissions estimates are based on EPA analysis that relies on several data sources. All process emissions estimates are derived from EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007*. Given data limitations, emissions estimates for 10 sectors (with total estimated emissions of 43 $MMTCO_2e$) reflect estimates of 2007, rather than 2006, emissions. The above-referenced memorandum provides additional details regarding emissions estimation methods.
6. As called for in H.R. 2454, greenhouse gas intensity is calculated by monetizing an industry's emissions at a price of $20 per ton of carbon dioxide equivalent, and dividing this value by the industry's value of shipments.
7. The U.S. Census Bureau recently adjusted the classifications that it employs in assigning imports and exports to the paper and paperboard industries, and will report revised data beginning with 2009. The trade intensities reported here reflect EPA's preliminary analysis of how this adjustment would affect reported trade data in prior years. The above-referenced memorandum provides additional details regarding the methodology employed to determine the trade intensity of these sectors.
8. Iron and steel mill process emissions are included in the "Direct Combustion" estimate due to the nature of the data collection and reporting by the Manufacturing Energy Consumption Survey. The above-referenced EPA memorandum provides additional details explaining this categorization.
9. On their own, these sectors do not meet either the energy or trade intensity thresholds specified in the bill, but are expected to be eligible based on other language in the bill. The above-referenced memorandum provides additional details regarding eligibility determination for these sectors.

Figure 2. Energy Intensity, Trade Intensity, and Emissions of U.S. Manufacturing Sectors at the Six-Digit NAICS Code Level[1]



1. Malt Manufacturing (311213)
2. Wet Corn Milling (311221)
3. Rendering and Meat Byproduct Processing (311613)
4. Yarn Spinning Mills (313111)
5. Tire Cord and Tire Fabric Mills (314992)
6. Reconstituted Wood Product Manufacturing (321219)
7. Pulp Mills (322110)
8. Paper (except Newsprint) Mills (322121)
9. Newsprint Mills (322122)
10. Paperboard Mills (322130)
11. Petrochemical Manufacturing (325110)
12. Inorganic Dye and Pigment Manufacturing (325131)
13. Alkalies and Chlorine Manufacturing (325181)
14. Carbon Black Manufacturing (325182)
15. All Other Basic Inorganic Chemical Mfg. (325188)
16. Cyclic Crude and Intermediate Manufacturing (325192)
17. All Other Basic Organic Chemical Mfg. (325199)
18. Plastics Material and Resin Manufacturing (325211)
19. Synthetic Rubber Manufacturing (325212)
20. Cellulosic Organic Fiber Manufacturing (325221)
21. Noncellulosic Organic Fiber Manufacturing (325222)
22. Nitrogenous Fertilizer Manufacturing (325311)
23. Vitr. China Plumbing Fixture and Other Mfg. (327111)
24. Vitreous China and Other Pottery Mfg. (327112)
25. Porcelain Electrical Supply Manufacturing (327113)
26. Ceramic Wall and Floor Tile Manufacturing (327122)
27. Other Structural Clay Product Manufacturing (327123)
28. Nonclay Refractory Manufacturing (327125)
29. Flat Glass Manufacturing (327211)
30. Other Pressed/Blown Glass and Glsswr. Mfg. (327212)
31. Glass Container Manufacturing (327213)
32. Cement Manufacturing (327310)
33. Lime Manufacturing (327410)
34. Ground or Treated Mineral and Earth Mfg. (327992)
35. Mineral Wool Manufacturing (327993)
36. Iron and Steel Mills (331111)
37. Electrometallurgical Ferroalloy Product Mfg. (331112)
38. Iron/Steel Pipe/Tube Mfg. from Purchsd. Steel (331210)
39. Alumina Refining (331311)
40. Primary Aluminum Production (331312)
41. Primary Smelting and Refining of Copper (331411)
42. Smltg./Rfg. of Nonfrs. Mtl. (ex. Cpr. and Almn.) (331419)
43. Iron Foundries (331511)
44. Carbon and Graphite Product Manufacturing (335991)
45. Iron Ore Mining (212210)
46. Copper Ore and Nickel Ore Mining (212234)

Notes:
1. Petroleum refining is not depicted because it is explicitly excluded from H.R. 2454's allocations to "trade-vulnerable" industries. Also, 91 other sectors, with 130 $MMTCO_2e$ of emissions, are not depicted due to lack of trade intensity data. One of these, iron and steel pipe and tube manufacturing from purchased steel (331210; 2.6 $MMTCO_2e$) is expected to be eligible based on language in the bill. Four others meet the energy-intensity threshold, each with 2 to 3 $MMTCO_2e$ of emissions: beet sugar manufacturing, broadwoven fabric finishing mills, steel foundries (except investment), and metal heat treating. Twelve sectors with a calculated trade intensity greater than 100% are depicted here with an intensity of 100% (the maximum possible intensity). The two copper sectors (212234 and 331411) do not meet the energy or trade intensity thresholds specified in H.R. 2454 but are expected to be eligible based on other language in the bill.
2. Energy intensity and trade intensity measures are as defined in H.R. 2454 and elsewhere in this report.
Source: EPA analysis.

B. Emissions of Energy-Intensive Trade-Exposed Industries

While accounting for a relatively small share of manufacturing output and employment, the "presumptively eligible" industries' greenhouse gas emissions were about 730 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) in 2006 (the most recent year for which key data sources are available), or about half of U.S. manufacturing greenhouse gas emissions and 10 percent of total U.S. emissions in that year.[8] In turn, relatively few industries account for the bulk of the "presumptively eligible" industries' emissions. The top five industries on an emissions basis (iron and steel, cement, other basic organic chemicals, petrochemicals, and paper mills) account for half of the "presumptively eligible" industries' emissions, and the top ten industries account for three-quarters of those emissions.

The emissions estimates presented in Table 1 are based on data from the Manufacturing Energy Consumption Survey (MECS), the Annual Survey of Manufactures, the Economic Census, the Environmental Protection Agency, and the Bureau of Economic Analysis.[9] While these data provide the best available estimates of recent emissions, there is considerable uncertainty as to what the emissions of the "presumptively eligible" industries will be in 2014, when they would first be directly covered by the cap-and-trade program proposed in H.R. 2454. Over time, the emission intensity of these industries' production processes is expected to continue to decline as new technology emerges and investments in energy efficiency continue to be made (see Figure 7) putting downward pressure on emissions. At the same time, increases in manufacturing activity in key sectors could have a countervailing effect on emissions.

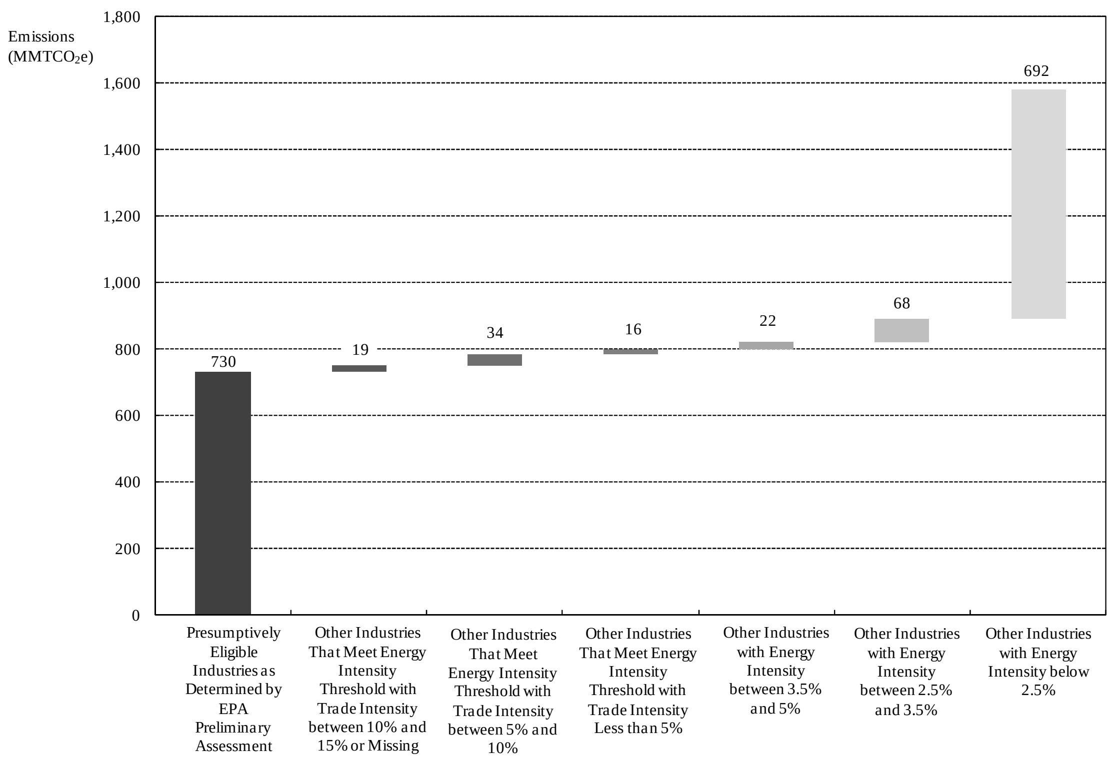
H.R. 2454 allows for the administrative determination of eligibility for additional sectors based on changes in international trade patterns and based on "individual showings," whereupon

[8] Carbon dioxide equivalent is a measure of emissions that expresses non-CO_2 greenhouse gas emissions in terms of the number of tons of CO_2 that would have the same global warming potential over a given timeframe as those non-CO_2 emissions. This report assumes a 100-year timeframe, consistent with H.R. 2454. While the vast majority of the emission estimates are based on 2006 data, estimates for ten of the "presumptively eligible" industries, representing 6% of total emissions from "presumptively eligible" industries, are based on 2007 data.

[9] The MECS offers some of the best available data on individual industries' energy-related emissions, but it does not provide data for all "presumptively eligible" industries. It was possible to use data from the 2006 MECS to estimate direct combustion emissions and indirect electricity emissions for 25 of the "presumptively eligible" industries, which account for 90% of the total estimated direct combustion and indirect electricity emissions of all "presumptively eligible" industries.

industries and subsectors of industries can petition for eligibility.[10] Figure 3 presents the emissions of all manufacturing industries, aggregating those not deemed "presumptively eligible" into various categories of trade and energy intensity. Figure 3 offers some insight into the quantity of emissions associated with certain industries or subsectors that might ultimately be deemed eligible for allowance rebates. For example, there are about 19 $MMTCO_2e$ of emissions associated with those industries that meet the 5 percent energy intensity threshold but have trade intensities that are either between 10 and 15 percent, or are not reported in government trade databases. Two examples of these industries are Steel Foundries and Broadwoven Fabric Mills. On the other hand, it is noteworthy that the vast majority of manufacturing's remaining emissions are in industries with energy intensities well below the 5 percent threshold. Therefore, it is unlikely that subsequent eligibility determinations, such as those arising from "individual showings", would dramatically affect the scope of emissions associated with those industries that are deemed eligible for allowance allocations under H.R. 2454.

Figure 3. Emissions of "Presumptively Eligible" Industries and of Remaining Six-Digit Manufacturing Industries with Various Energy and Trade Intensities

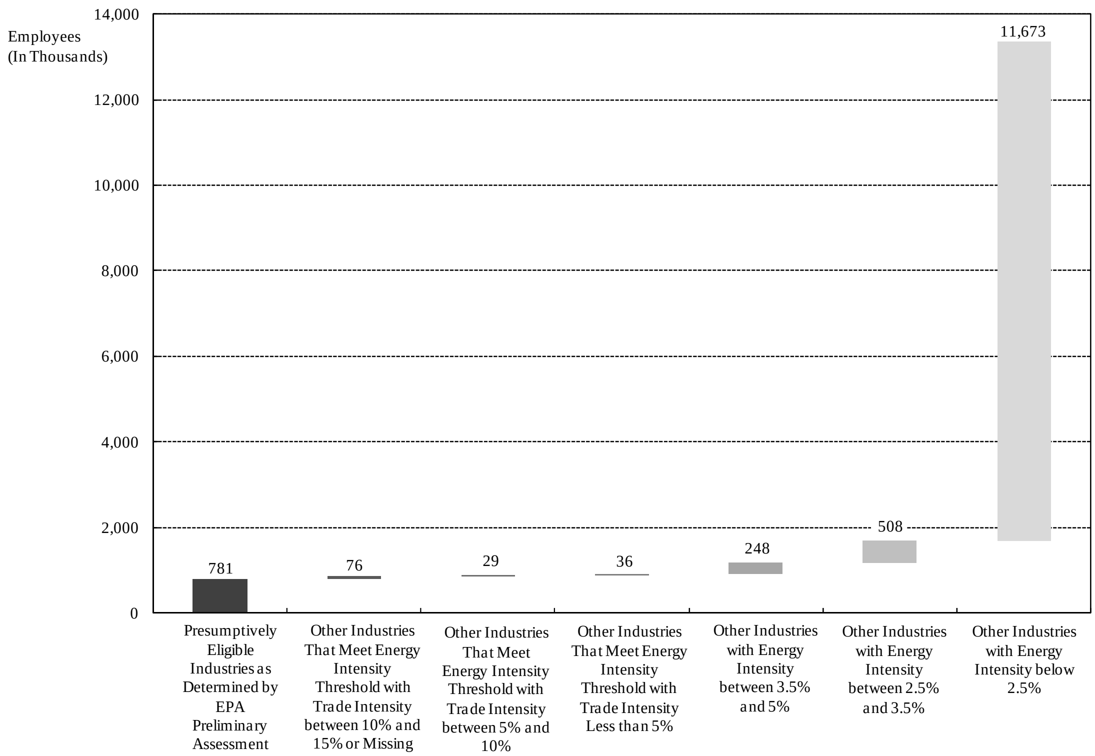


Source: EPA analysis.

[10] S. 1733 also provides these options.

Figure 4 differs from Figure 3 by presenting the number of employees, rather than emissions, in all manufacturing industries, again aggregated into the "presumptively eligible" industries and into various categories of trade and energy intensity for those industries not deemed presumptively eligible. The U.S. manufacturing sector employed over 13 million people in 2007, representing about 10 percent of total nonfarm employment. This figure shows that the overwhelming majority — nearly 95 percent — of employees in the manufacturing sector fall outside the "presumptively eligible" industries. Indeed, 88 percent of manufacturing employees work in industries with energy intensities below 2.5 percent.

Figure 4. 2007 Employment in "Presumptively Eligible" Industries and in Remaining Six-Digit Manufacturing Industries with Various Energy and Trade Intensities



Source: EPA analysis and 2007 Economic Census.

IV. Factors Affecting Potential Leakage in Energy-Intensive Trade-Exposed Industries

Through the requirement that firms surrender emission allowances to cover every ton of their emissions, a cap-and-trade program introduces important incentives for firms to switch to less emission-intensive production methods. At the same time, the allowance requirement can also increase a firm's production costs, both through the cost of switching to less emission-intensive processes and through the cost of having to surrender valuable allowances to cover the remaining emissions associated with producing the firm's goods. This latter effect is important in minimizing the cost of meeting national emission targets because it ensures that the resulting market prices of emission-intensive products provide consumers with appropriate incentives to shift to less emission-intensive products and to use emission-intensive products more efficiently.

Yet, in the case of energy-intensive trade-exposed industries, in addition to encouraging consumers to use emission-intensive products more efficiently, changes in domestic production costs of emission-intensive goods can cause shifts in manufacturing activity and associated emissions to countries that have not yet implemented comparable climate policies. These shifts can occur through both increases in imports to meet domestic demand for emission-intensive goods and reductions in exports from the United States to other markets.

Absent any mitigating policy measures like those proposed in H.R. 2454, the extent to which a domestic cap-and-trade program would lead to economic and emission leakage in a particular industry will depend on how much such a program would affect the industry's domestic production costs, and on the extent to which a given change in those costs would lead to increased imports or reduced exports. Both considerations are addressed in turn below.

A. Impacts of a Cap-and-Trade Program on Industries' Production Costs

In the absence of any mitigating policy measures like those proposed in H.R. 2454, the primary determinants of a cap-and-trade program's effect on an industry's production costs are the emission allowance price, the emission-intensity of the industry's production — taking into account both its direct emissions and its indirect emissions from its electricity use — and the industry's ability to shift to less emission-intensive production methods. The higher the allowance price, the more emission-intensive the industry's production, and the less able an industry is to shift to less emission-intensive production methods, the greater will be the cap-and-trade program's impact on the industry's production costs.

In addition to the above factors, through its broader effects on the economy, a cap-and-trade program can have other indirect effects on industries' production costs. In particular, a cap-and-trade program can affect the cost of various raw materials (*e.g.*, steel) that an industry uses. Through its effect on the demand for various fuels, such as coal and natural gas, a cap-and-trade program can also affect the underlying price of those fuels (*i.e.*, the price excluding any allowance costs) beyond the effect directly arising from the emission allowance requirement.

A primary concern of many in industry, particularly those that use natural gas as a feedstock, is a cap-and-trade program's effect on the demand for and underlying price of natural gas.[11] However, it is important to recognize that a cap-and-trade program will not necessarily increase the underlying price of natural gas. In fact, it could reduce the underlying price of natural gas. A cap-and-trade program will reduce demand for natural gas in some applications by making energy efficiency improvements and renewable energy more economically attractive. At the same time, demand for natural gas could increase in other applications where natural gas use becomes more attractive than using coal or oil. Reflecting these countervailing effects, over the years, economic modeling has reached varying conclusions about whether and to what extent a cap-and-trade program would increase or reduce the total demand for and price of natural gas.

Most current modeling projects relatively small impacts on the underlying price of natural gas, with a majority of studies projecting a small decline. For example, in its core scenario analysis, EPA's modeling of H.R. 2454 projects that the underlying price (without allowance value) of natural gas decreases 0.6 percent in 2015 and 1.5 percent in 2020 relative to business-as-usual (BAU) levels.[12] Across all scenarios that EPA examined, using different assumptions about the deployment of energy technologies and implementation of energy efficiency provisions, EPA's projections of changes in the underlying delivered price of natural gas (excluding allowance costs) during this time frame range from a 1.5 percent reduction to a 0.4 percent increase relative to BAU. In sum, EPA's analysis generally finds that the cap-and-trade program, the Combined Efficiency and Renewable Electricity Standard, and additional energy efficiency provisions in H.R. 2454 will lead to an expansion of renewable energy and energy efficiency that is expected to ease demand for natural gas and lower its underlying price. The core scenario in the EIA analysis of H.R. 2454 projected that wellhead natural gas prices

[11] While natural gas for "non-emissive" uses (*e.g.*, as a feedstock) would not be subject to the requirement to submit allowances for emissions under H.R. 2454, there could still be competitiveness impacts on industries that use natural gas as a feedstock if the demand for and price of natural gas is affected by the cap-and-trade program.

[12] Environmental Protection Agency (2009), *EPA Analysis of the American Clean Energy and Security Act of 2009*.

would increase by 3.9 percent in 2015 and fall by about 5.6 percent in 2020 relative to BAU.[13] Across all 11 scenarios that EIA examined, in all but one, it projected increases in wellhead natural gas prices ranging from 0.5 and 4.7 percent in 2015, and decreases in prices ranging from 1.3 to 8.6 percent in 2020.[14] In analyzing H.R. 2454, the climate modeling group at the Massachusetts Institute of Technology projected modest reductions in underlying natural gas prices (excluding allowance costs) relative to BAU levels in both 2015 and 2020.[15]

While a cap-and-trade program may increase or decrease the demand for and the underlying price of natural gas, because coal and petroleum products are more carbon-intensive fuels, a cap-and-trade program is unambiguously expected to reduce the demand for and underlying price of those fuels. For example, in its core scenario, EPA's modeling results from ADAGE show that the underlying prices for petroleum products and coal decrease by 0.3 percent and 2.2 percent respectively in 2015 relative to BAU projections. Both EIA and MIT also project reductions in the underlying prices of these fuels.

Despite these considerations, the allowance price and emission intensity remain the dominant factors determining cost impacts. In the criteria that it establishes for determining industries that are "presumptively eligible" for allocations to "trade-vulnerable" industries, H.R. 2454 develops a greenhouse gas (GHG) intensity metric that captures these two factors. In particular, the H.R. 2454 GHG intensity measure is calculated by multiplying a $20 allowance price by an industry's direct emissions and indirect emissions associated with electricity consumption, and then dividing this value by the value of the industry's output. Figure 5 presents each manufacturing sector's GHG intensity metric as calculated under H.R. 2454.

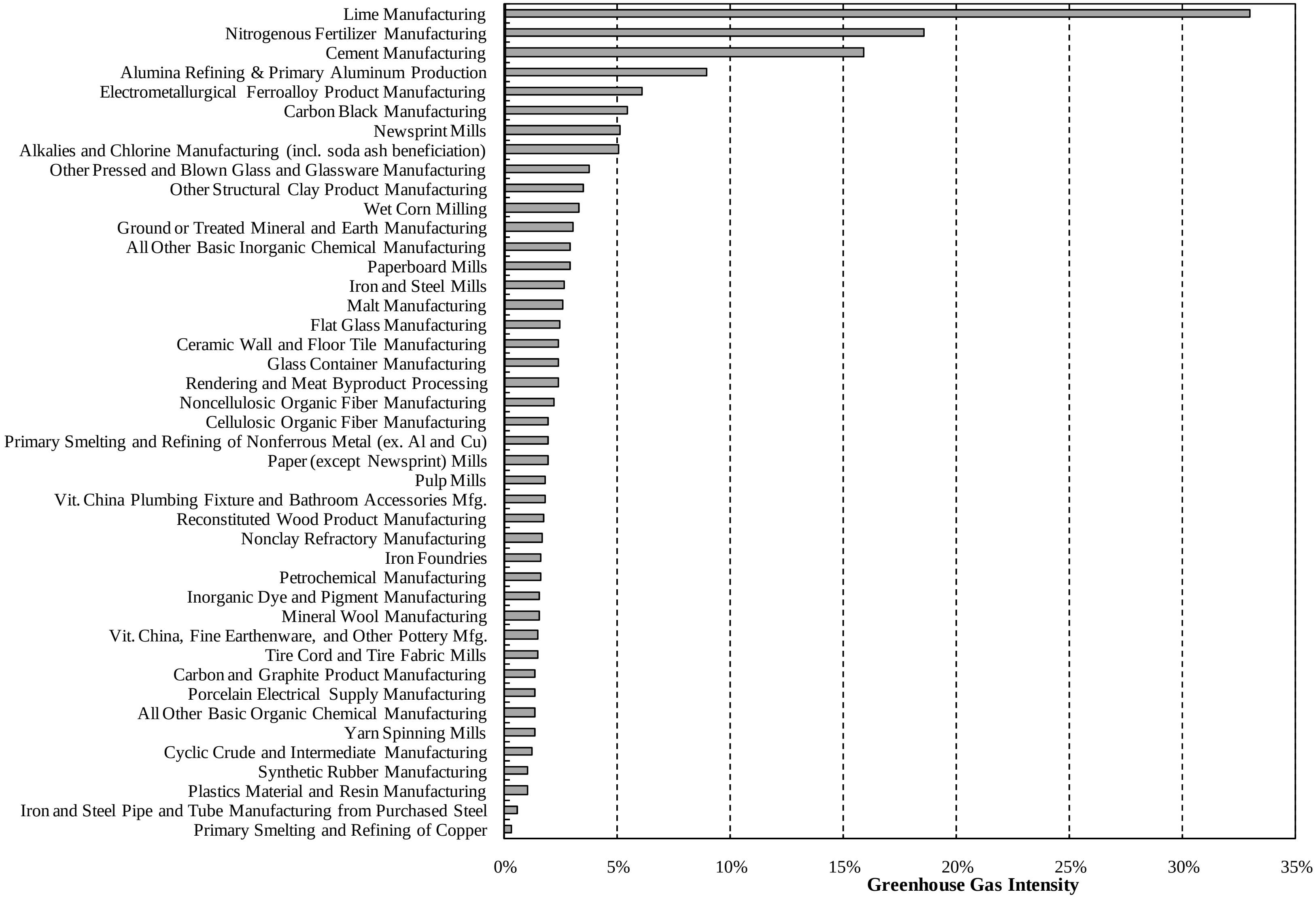
Under a cap-and-trade program like that in H.R. 2454, the actual increase in production costs that manufacturers would incur could be less than — potentially significantly less than — what is depicted in Figure 5, even before accounting for the allocations that are specifically designed to mitigate those impacts. There are at least two reasons why this is the case.

[13] Energy Information Administration (2009), *Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009*. Because wellhead prices are lower than delivered prices, these percentage changes are not directly comparable with the above estimates from the EPA analysis.

[14] The one scenario in which prices were projected to rise beyond these ranges was an extreme, worst case scenario in which, through 2030, no international emission reduction offsets would be available and several key clean energy technologies (e.g., nuclear, and carbon capture and storage) could not be expanded beyond business-as-usual levels.

[15] S. Paltsev, J. Reilly, H. Jacoby, and J. Morris (2009), *The Cost of Climate Policy in the United States*, MIT Joint Program on the Science and Policy of Global Change, Report No. 173, updated in September 2009.

Figure 5. H.R. 2454's Greenhouse Gas Intensity Measure for the "Presumptively Eligible" Manufacturing Industries



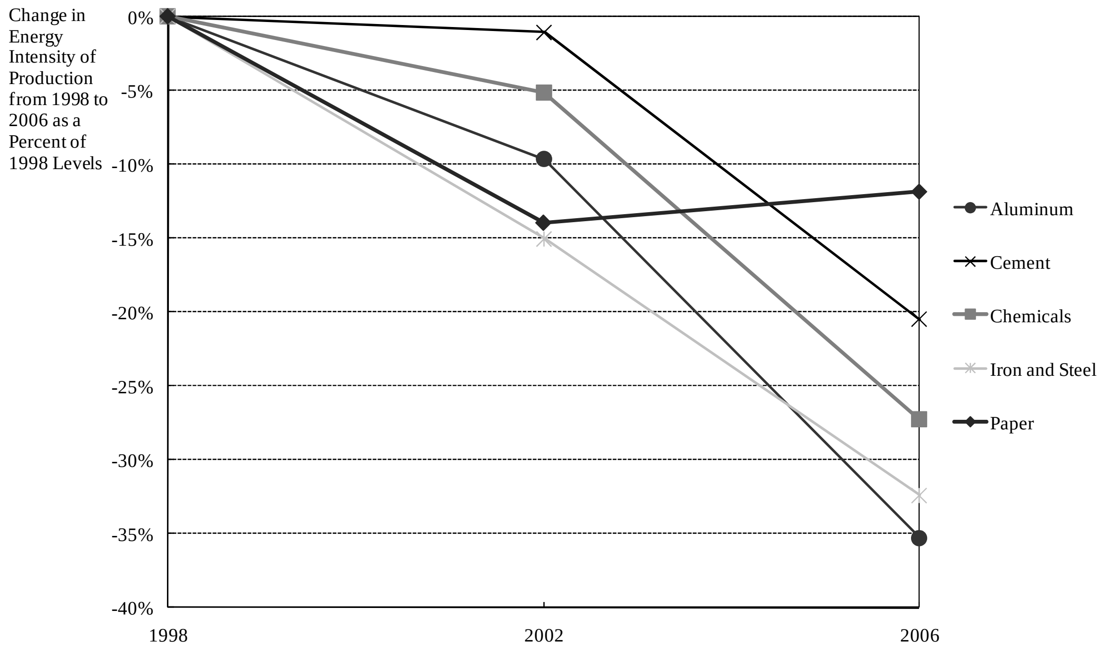
Note: The H.R. 2454 greenhouse gas intensity measure is calculated by multiplying a sector's direct emissions and indirect emissions associated with electricity consumption by an allowance price of $20 per ton, and dividing by the sector's value of shipments.
Source: EPA anaylsis.

First, while H.R. 2454's GHG intensity metric reflects the impacts of a $20 allowance price, EPA's analysis of H.R. 2454 produced an allowance price projection that, in 2005 dollars, begins at $13 in 2015, and does not reach $20 per ton until 2025, which would imply proportionately lower near-term impacts on production costs of energy-intensive trade-exposed industries. Second, Figure 5 is generally based on 2006 data and, going forward, if industries continue their historical trend, they will realize significant reductions in the energy- and emission-intensity of their production, reducing the impact of the allowance requirement on their production costs.

Speaking to the latter, Figure 6 shows changes in the energy intensity of production in five energy-intensive sectors from 1998 to 2006. During this period, energy intensity fell between 10 and 35 percent in these sectors. Despite these past reductions in emission- and energy-intensity, significant opportunities for further reductions remain, as state-of-the-art energy management practices evolve, new technologies become commercially available, and existing technologies are more widely deployed.[16] Recognizing these opportunities, many companies and industry groups have set aggressive forward-looking goals as part of voluntary initiatives such as EPA's ENERGY STAR, Climate Leaders, and industrial non-CO_2 programs, and the Department of Energy's Climate VISION program. As Figure 7 depicts, the Energy Information Administration projects that the emission intensity of some of the key energy-intensive sectors will fall over the coming decade even in the absence of a cap-and-trade program, and would fall even more under H.R. 2454. The primary drivers of these projected improvements include: the on-going shift from the use of virgin raw materials to the less emission-intensive use of recycled raw materials, particularly in the aluminum, paper, and iron and steel industries; process improvements, such as the shift from a wet to a dry process in the cement industry; the penetration of more energy efficient systems and practices (*e.g.*, combined heat and power, efficient motors, waste heat recovery); and the increased use of lower carbon fuels like natural gas and renewables. Overall, taking into account both changes in output and emission intensity, EIA projects that the total energy-related CO_2 emissions of the six sectors depicted in Figure 7 would decline nearly 20 percent from 2006 to 2020 under business-as-usual circumstances, and nearly 30 percent under H.R. 2454.

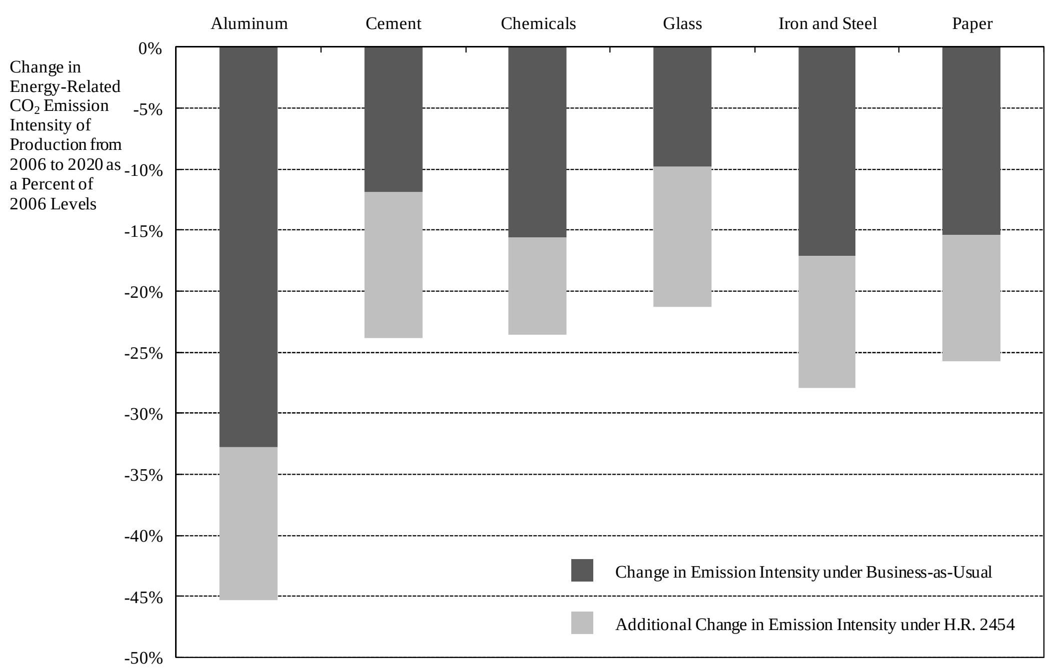
[16] Resources and reports on industrial energy efficiency can be found at http://www.energystar.gov/index.cfm?c= industry.bus_industry_info_center, and http://www.eere.energy.gov/.

Figure 6. Changes in the Energy Intensity of Production from 1998 to 2006 in Five Energy-Intensive Industrial Sectors



Note: Energy intensity of production is equal to a sector's direct and indirect energy use divided by the real value of its shipments, using industry-specific adjustments for inflation.
Source: EIA analysis of the Manufacturing Energy Consumption Survey.

Figure 7. EIA Projections of Changes in the CO_2 Emission Intensity of Production from 2006 to 2020 under Business-as-Usual Circumstances and under H.R. 2454 in Six Energy-Intensive Industrial Sectors



Note: Emission intensity of production is equal to a sector's energy-related direct and indirect carbon dioxide emissions divided by its value of shipments in real 2000 dollars. Reductions in emission intensity result from reductions in both on-site energy use and the emission-intensity of purchased electricity. In addition to reflecting the effect of the cap-and-trade program's incentives for emission reductions, the reductions in emission intensity under H.R. 2454 partly reflect the effect of energy efficiency provisions in the bill.
Source: Energy Information Administration, *Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009*, August 2009.

At a $20 allowance price, a cap-and-trade program would increase the production costs of most energy-intensive industries' by no more than a few percentage points even in the absence of any mitigating policy measures. As Figure 5 depicts, however, a small number of these industries would experience more substantial impacts on their production costs absent any mitigating policy measures. Moreover, within the industry categories that are depicted here, there can be significant variation in subsectors' or individual facilities' energy intensity (and hence emission intensity) of production. For example, among iron and steel mills, integrated mills employing basic oxygen furnaces have been found to be nearly three times more energy intensive than electric arc furnaces, another common method of steel production.[17,18]

Finally, it is important to recognize that impacts on production costs do not directly translate into impacts on industry competitiveness, profitability, and emission leakage. Even among those industries that experience the same percentage increase in production costs, differences in competitive conditions may allow some industries to pass more of those costs on to consumers than others, leading to varying impacts on industry profitability. Likewise, because profit margins (as a percent of revenue) can vary across industry, while the relatively small impacts on production costs depicted for most industries in Figure 5 may have little effect on some industries' profitability and ability to compete in a global marketplace, those same production cost impacts may more substantially affect the profitability and competitiveness of other industries where profit margins are lower.

B. Determinants of Leakage Resulting from Increased Domestic Production Costs

Many emission-intensive industries have various characteristics that make them relatively immobile in the face of small changes in production costs that might encourage firms to relocate to other countries.[19] Even among those emission-intensive industries that are considered trade-exposed, several factors can influence the extent to which a given industry is susceptible to

[17] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (2005), *Steel Industry Marginal Opportunity Study*, prepared by Energetics, Inc., pp. 3, 7.

[18] Note that while both integrated and electric arc steelmaking are combined into a single six-digit NAICS code for the purposes of industrial classification and for the determination of eligibility for allowance rebates under H.R. 2454, they are considered separate sectors within H.R. 2454 when determining the rate of allocation provided per unit of output. See Section VI.A.1 for further discussion of how these per-unit allocation rates are determined.

[19] J. Ederington, A. Levinson, and J. Minier (2005), "Footloose and Pollution-Free," *Review of Economics and Statistics* 87: 92-99; and J. Aldy and W. Pizer (2009), *The Competitiveness Impacts of Climate Change Mitigation Policies,* Pew Center on Global Climate Change. http://www.pewclimate.org/international/CompetitivenessImpacts.

competition from imports and to competition in export markets. As a result, in the face of similar increases in domestic costs, some trade-exposed industries may experience far smaller increases in imports or reductions in exports than others. A few examples of these factors are:

- Existing cost advantages: Due to access to inexpensive raw materials, advanced technologies, highly skilled labor, or other advantages, some domestic industries or firms may already enjoy a cost advantage relative to their international competitors that would remain even in the face of an increase in domestic production costs.[20]

- Fixed plant costs: Firms with a significant share of their investments in large, fixed physical structures, such as large manufacturing plants, may also be less sensitive to increases in production costs because the costs of relocation may outweigh the gains to locating in a less stringent regulatory environment.[21] For the same reason, they may be less exposed to international competition from other firms in the face of increased domestic costs if the capital investments required to build new capacity in foreign countries are large compared with the increase in domestic production costs.

- Transportation costs: Because of transportation costs, industries that produce products with a relatively low value per unit of weight, such as cement, would be less affected by a given increase in domestic production costs than would those that produce products with a relatively high value per unit of weight, such as steel. Likewise, because of transportation costs, even within an industry there may be geographic variation in the susceptibility of firms to international competition, with firms that serve markets near major ports being more susceptible to international competition than those that serve markets further inland.[22]

- Availability of spare international production capacity: In the near-term, an increase in domestic production costs may not have a significant effect on the competitive position of a domestic industry if globally there is little spare production capacity.[23]

- Uncertainty about future conditions: Many of the "presumptively eligible" sectors are capital intensive. As a result, foreign competitors may be reluctant to make

[20] JC. Hourcade, D. Demailly, K. Neuhoff, and M. Sato (2007), *Climate Strategies Report: Differentiation and Dynamics of EU ETS Industrial Competitiveness Impacts.*

[21] Ederington *et al.* (2005).

[22] Hourcade *et al.* (2007).

[23] *Ibid.*

significant investments in response to increases in production costs in the United States if there are significant uncertainties regarding future market conditions, including their domestic regulatory regimes.[24] Given the long lifetimes of these capital investments and the relative level of capital abundance in developed countries, a brief period of differentiation in domestic regulatory programs may not justify expansion by foreign competitors.[25]

- Product differentiation: In some industries, domestic producers may have an advantage of producing products that best meet domestic needs, either due to the unique needs of specific domestic customers, or due to regulatory product quality standards.[26]

- Agglomeration economies: While the sources of agglomeration economies are varied (*e.g.*, knowledge spillovers, labor market pooling, proximity to firms that produce inputs or purchase outputs), their effect is the same — firms will have an incentive to locate near one another. Industries with significant agglomeration economies may be insensitive to increases in production costs if the gain from remaining close to other firms in the industry outweighs the gains from relocating to a region with less stringent greenhouse gas regulations.[27]

Any impacts of a cap-and-trade program on the international competitiveness of energy-intensive trade-exposed industries will occur against a backdrop of widely varying existing trade flows and trends therein. For some of the key industries that would likely be deemed eligible for allocations to "trade-vulnerable" industries under H.R. 2454, Figure 8 depicts trends in imports as a share of domestic consumption for the decade from 1998 to 2007, the most recent year for which domestic production data are available. Over this period, import penetration increased the most in the aluminum industry, which also had the highest level of import penetration throughout the period.[28] By contrast, the cement industry had the lowest import penetration throughout the period and, while that penetration rate varied throughout the period, in 2007 it was effectively the same as in 1998. Figure 9 depicts trends in exports of those industries.

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[24] *Ibid.*

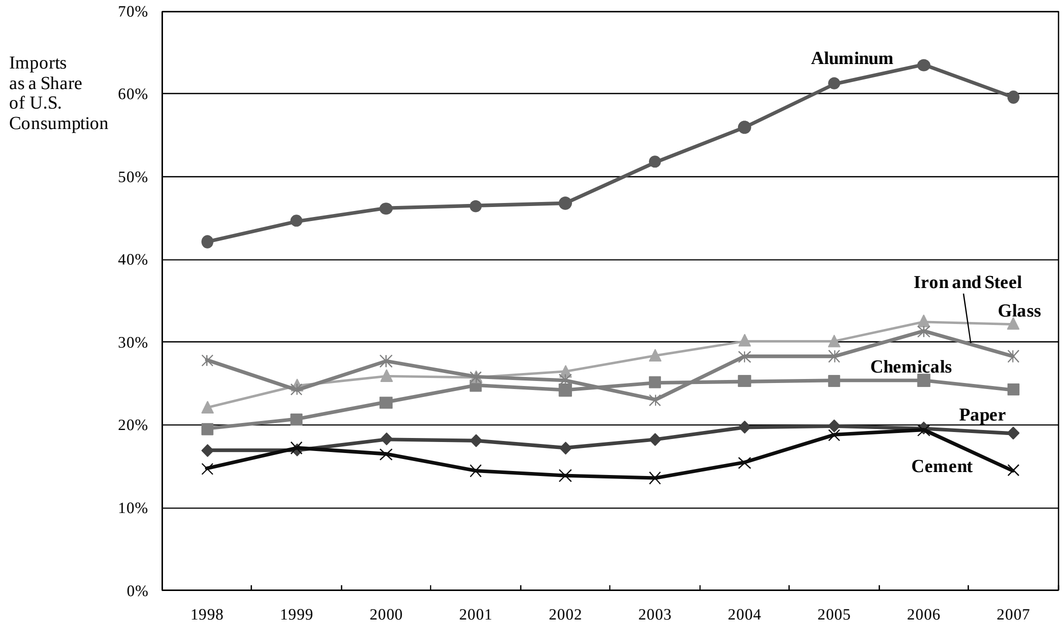
[25] W. Antweiler, B.R. Copeland, and M.S. Taylor (2001), "Is Free Trade Good for the Environment?" *American Economic Review* 91(4): 877-908.

[26] Hourcade *et al.* (2007).

[27] Ederington *et al.* (2005).

[28] Note that these statistics represent aggregated values for each broad sector, and some "presumptively eligible" industries' trade patterns could differ significantly from those of the aggregated sector within which they fall.

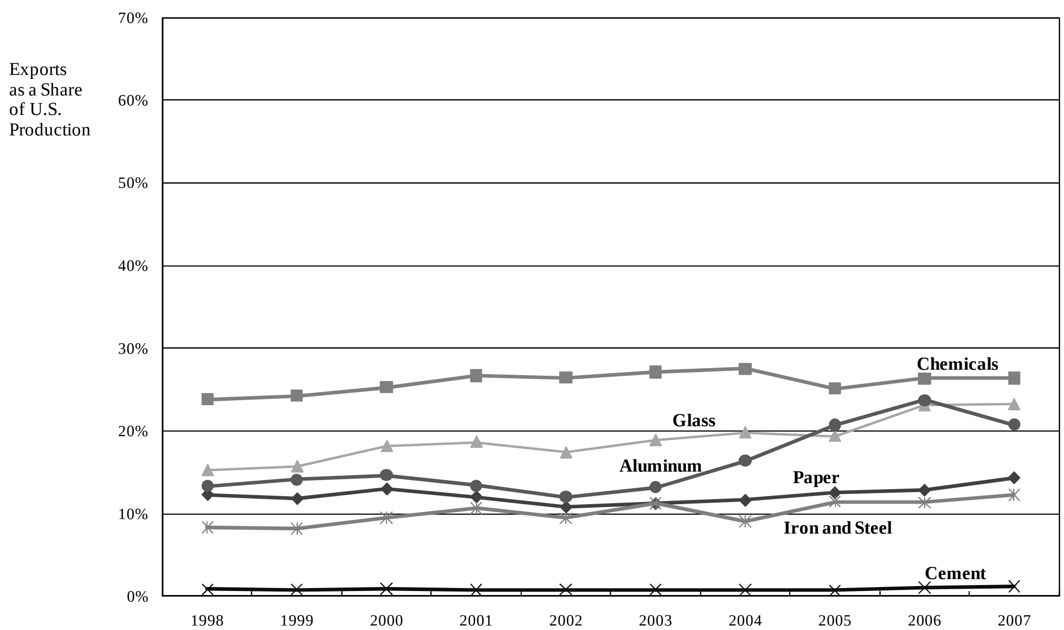
Figure 8. Imports as a Share of U.S. Consumption for Various "Presumptively Eligible" Industries



Note: Values are calculated as the dollar value of the sector's imports divided by the dollar value of the sum of its domestic production and net imports. The six-digit presumptively eligible sectors included in the sector categories are: Aluminum (Alumina Refining and Primary Aluminum Production); Cement (Cement Manufacturing); Chemicals (Petrochemical Manufacturing, Inorganic Dye and Pigment Manufacturing, Alkalies and Chlorine Manufacturing, Carbon Black Manufacturing, All Other Basic Inorganic Chemical Manufacturing, Cyclic Crude and Intermediate Manufacturing, All Other Basic Organic Chemical Manufacturing, Plastics Material and Resin Manufacturing, Synthetic Rubber Manufacturing, Cellulosic Organic Fiber Manufacturing, Noncellulosic Organic Fiber Manufacturing, and Nitrogenous Fertilizer Manufacturing); Glass (Flat Glass Manufacturing, Other Pressed and Blown Glass and Glassware Manufacturing, and Glass Container Manufacturing); Iron and Steel (Iron and Steel Mills); and Paper (Pulp Mills, Paper Mills, Newsprint Mills, and Paperboard Mills).

Source: U.S. Census Bureau and U.S. International Trade Commission data.

Figure 9. Exports as a Share of U.S. Production for Various "Presumptively Eligible" Industries



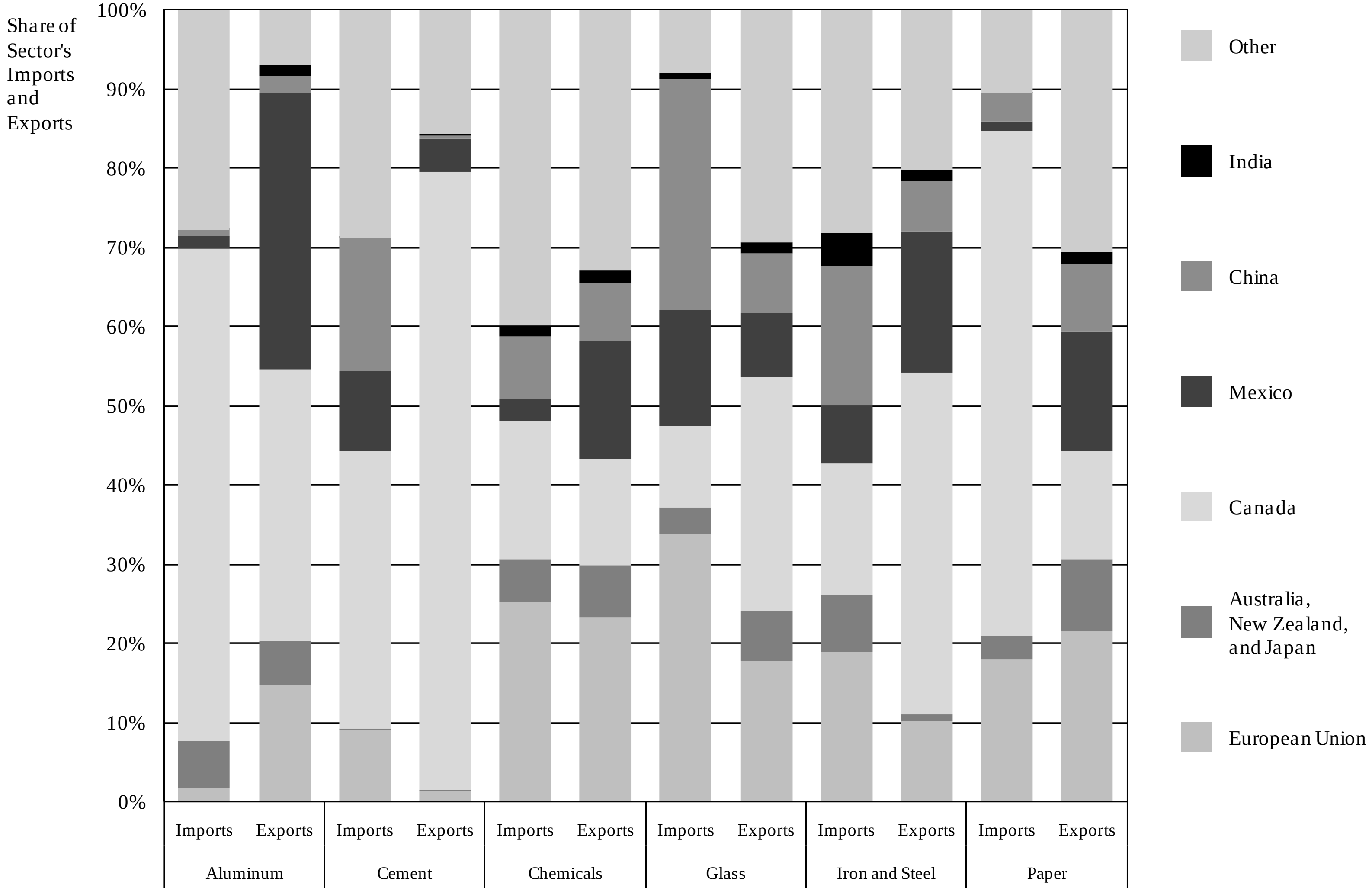
Note: Values are calculated as the dollar value of exports divided by the dollar value of the industry's domestic production. The six-digit presumptively eligible sectors included in the sector categories are: Aluminum (Alumina Refining and Primary Aluminum Production); Cement (Cement Manufacturing); Chemicals (Petrochemical Manufacturing, Inorganic Dye and Pigment Manufacturing, Alkalies and Chlorine Manufacturing, Carbon Black Manufacturing, All Other Basic Inorganic Chemical Manufacturing, Cyclic Crude and Intermediate Manufacturing, All Other Basic Organic Chemical Manufacturing, Plastics Material and Resin Manufacturing, Synthetic Rubber Manufacturing, Cellulosic Organic Fiber Manufacturing, Noncellulosic Organic Fiber Manufacturing, and Nitrogenous Fertilizer Manufacturing); Glass (Flat Glass Manufacturing, Other Pressed and Blown Glass and Glassware Manufacturing, and Glass Container Manufacturing); Iron and Steel (Iron and Steel Mills); and Paper (Pulp Mills, Paper Mills, Newsprint Mills, and Paperboard Mills).

Source: U.S. Census Bureau and U.S. International Trade Commission data.

If the United States adopts a cap-and-trade program, the extent to which this raises concerns about international competitiveness and leakage in a particular industry also depends critically on the specific countries that are sources of import or export competition. The key concern regarding a domestic cap-and-trade program's international competitiveness impacts is that it could put U.S. industry at a disadvantage relative to industry in those countries that do not adopt comparable regulations, such that manufacturing activity and emissions may shift to those countries. Yet, our trading partners in the European Union are already subject to mandatory greenhouse gas regulations, and several other major trading partners likely will adopt comparable regulations in the near future, particularly if the United States adopts a cap-and-trade program. For example, Canada and Mexico have discussed such coordination of cap-and-trade programs at the North American Leaders Summit this year. Thus, concern about leakage focuses only on trade with those countries that may not adopt comparable regulations in the near-term.

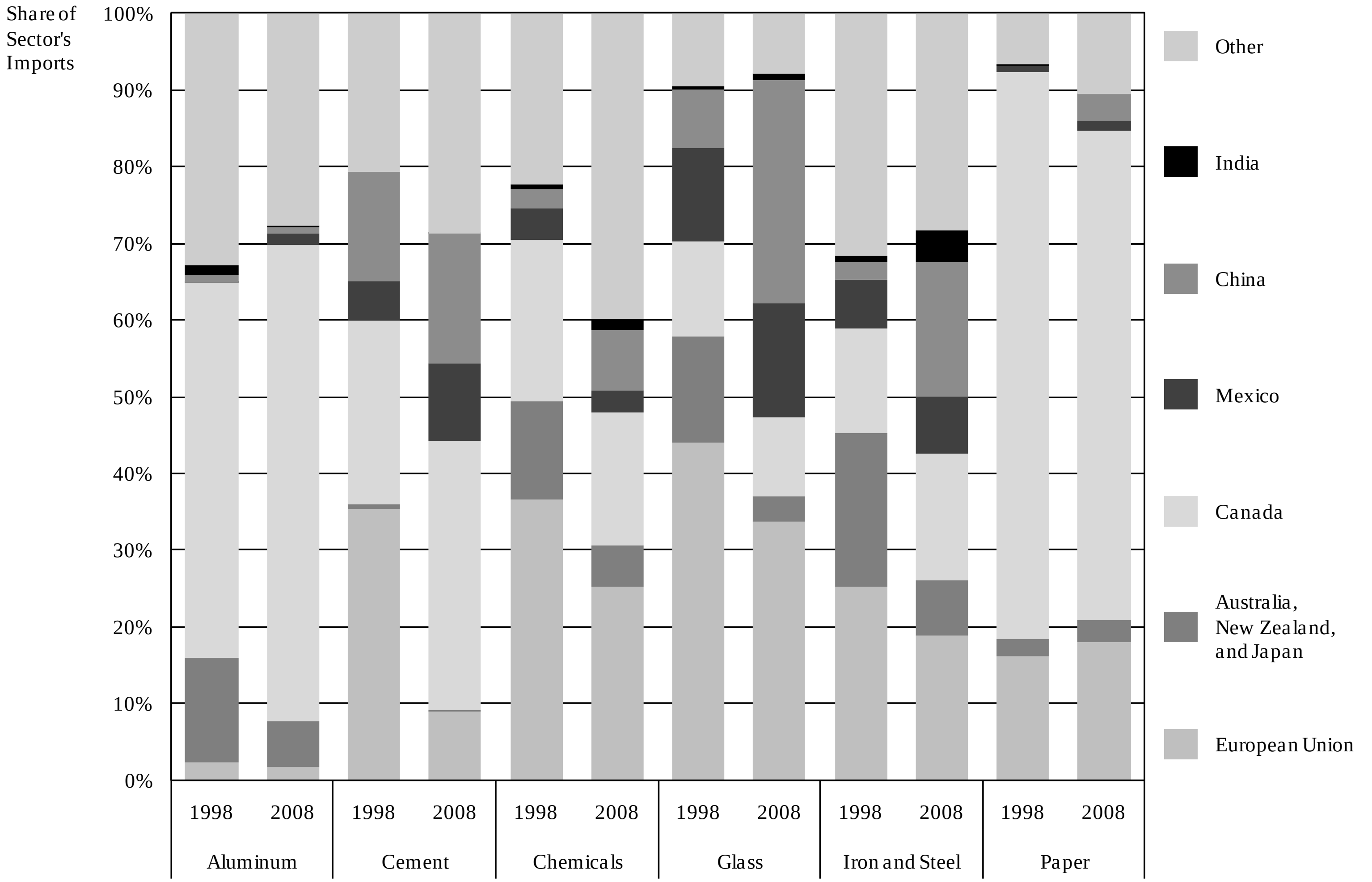
Figure 10 depicts the distribution of U.S. imports and exports by origin and destination for several "presumptively eligible" industries. Overall, half of our imports and half of our exports for these goods come from or go to the European Union, Canada, Australia, Japan, and New Zealand. However, as Figure 10 illustrates, there is significant variation in the pattern of trade across industries. In addition, there is substantial variation in trade patterns across specific industries within some of the broader sectors depicted in Figure 10, such as the chemicals sector. It should also be noted that, in some sectors, the share of trade that is with developing countries has increased over the past decade (see Figure 11), a trend that may continue into the future.

Figure 10. Distribution of U.S. Imports and Exports by Origin and Destination in 2008 for Various "Presumptively Eligible" Industries



Note: Six-digit presumptively eligible sectors included in industry categories depicted above are: Aluminum (Alumina Refining and Primary Aluminum Production); Cement (Cement Manufacturing); Chemicals (Petrochemical Manufacturing, Inorganic Dye and Pigment Manufacturing, Alkalies and Chlorine Manufacturing, Carbon Black Manufacturing, All Other Basic Inorganic Chemical Manufacturing, Cyclic Crude and Intermediate Manufacturing, All Other Basic Organic Chemical Manufacturing, Plastics Material and Resin Manufacturing, Synthetic Rubber Manufacturing, Cellulosic Organic Fiber Manufacturing, Noncellulosic Organic Fiber Manufacturing, and Nitrogenous Fertilizer Manufacturing); Glass (Flat Glass Manufacturing, Other Pressed and Blown Glass and Glassware Manufacturing, and Glass Container Manufacturing); Iron and Steel (Iron and Steel Mills); and Paper (Pulp Mills, Paper Mills, Newsprint Mills, and Paperboard Mills).
Source: U.S. International Trade Commission data.

Figure 11. Distribution of U.S. Imports by Origin in 1998 and 2008 for Various "Presumptively Eligible" Industries



Note: Six-digit presumptively eligible sectors included in industry categories depicted above are: Aluminum (Alumina Refining and Primary Aluminum Production); Cement (Cement Manufacturing); Chemicals (Petrochemical Manufacturing, Inorganic Dye and Pigment Manufacturing, Alkalies and Chlorine Manufacturing, Carbon Black Manufacturing, All Other Basic Inorganic Chemical Manufacturing, Cyclic Crude and Intermediate Manufacturing, All Other Basic Organic Chemical Manufacturing, Plastics Material and Resin Manufacturing, Synthetic Rubber Manufacturing, Cellulosic Organic Fiber Manufacturing, Noncellulosic Organic Fiber Manufacturing, and Nitrogenous Fertilizer Manufacturing); Glass (Flat Glass Manufacturing, Other Pressed and Blown Glass and Glassware Manufacturing, and Glass Container Manufacturing); Iron and Steel (Iron and Steel Mills); and Paper (Pulp Mills, Paper Mills, Newsprint Mills, and Paperboard Mills).
Source: U.S. International Trade Commission data.

V. Experience in the European Union Emission Trading Scheme

The European Union Emission Trading Scheme (EU ETS) provides valuable lessons regarding a greenhouse gas cap-and-trade program's impacts on energy-intensive industry. The EU ETS covers the emissions from four broad sectors: iron and steel, certain mineral manufacturing industries (including the cement industry), energy production (including electric power facilities and direct emissions from oil refining), and pulp and paper. The first phase of the program ran from 2005 to 2007, and the program's emission target was tightened for a second phase from 2008 to 2012. The EU has also announced targets for a Phase III, which would mandate an emission reduction of at least 21 percent compared with 2005 levels by 2020.

Prospective studies of the EU ETS have shown that concern over the system's potential impacts on trade flows should be limited to a small set of industrial sectors. For example, a study of trade impacts in the U.K. identified six main sectors as either "significantly or plausibly of concern."[29] These include iron and steel, aluminum, nitrogen fertilizer, cement and lime, basic inorganic chemicals (*e.g.,* chlorine and alkalies) and pulp and paper. EU-wide, a recent study found overall leakage of EU emissions is unlikely to be greater than 1 percent, but that impacts on EU production and imports could be significantly larger in the iron and steel and cement sectors.[30] At the same time, the literature on the EU ETS provides support for the conclusion that output-based allocations, like those proposed in H.R. 2454, could significantly mitigate the competitive impacts of a cap-and-trade program. For example, studying Europe's cement sector, Demailly and Quirion (2006) concluded that, if the EU cement producers received output-based allowance allocations at a rate equal to 90 percent of the industry's historical emission intensity, then imports to the EU would be "insignificantly impacted" under an EU cap-and-trade program even if allowance prices reached as high as €50 per ton of CO_2.[31] The study further found that the impacts on net imports become more significant (*i.e.*, over 5 percent) when the output-based allocation rate is a lesser percentage of the industry's historical emission intensity (*i.e.*, 75

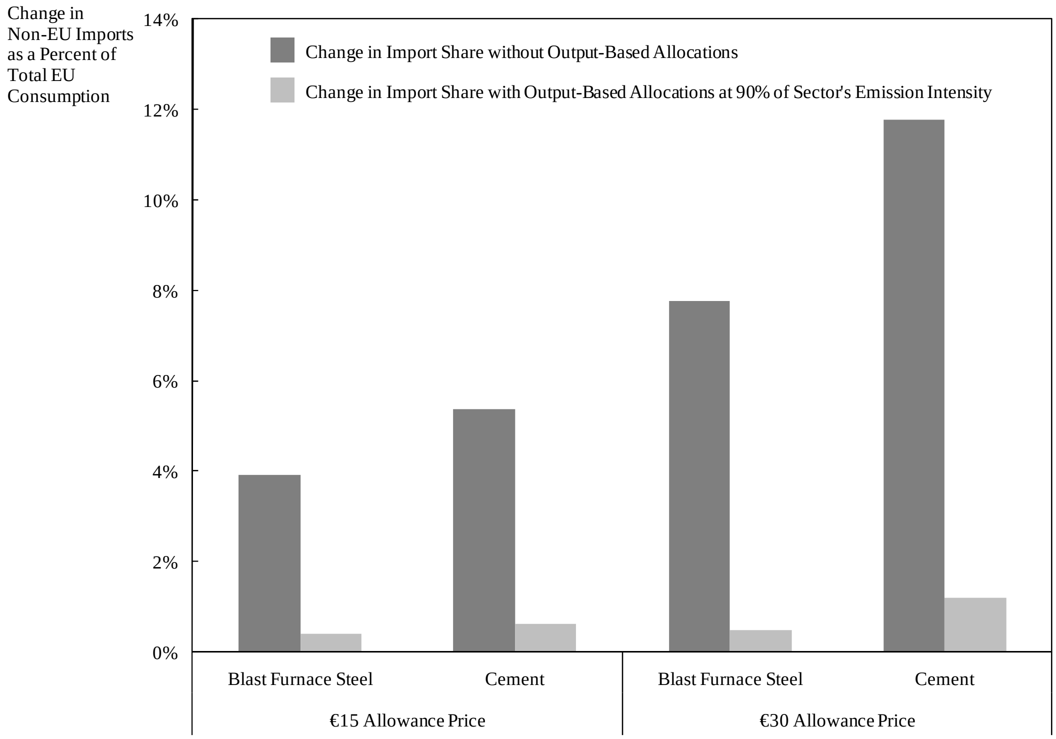
[29] M. Grubb, T. Brewer, M. Sato, R. Heilmayr, and D. Fazekas (2009), *Climate Policy and Industrial Competitiveness: Ten Insights from Europe on the EU Emissions Trading System*, German Marshall Fund. Available at: http://www.gmfus.org/publications/article.cfm?id=640&parent_type=P.

[30] Carbon Trust (2008), *EU ETS impacts on profitability and trade, a sector by sector analysis*. Available at: http://www.carbontrust.co.uk/Publications/publicationdetail.htm?productid=CTC728&metaNoCache=1.

[31] D. Demailly and P. Quirion (2006), "CO_2 abatement, competitiveness and leakage in the European cement industry under the EU ETS: Grandfathering vs. output-based allocation," *Climate Policy* 6: 93-113.

percent or less). Finally, an analysis by the Carbon Trust in the U.K. found that, even in highly energy-intensive sectors such as blast furnace steel, output-based allocations can significantly reduce the increases in imports that could otherwise result from the EU ETS (Figure 12).[32]

Figure 12. Estimates of the Effect of Output-Based Allocations in Mitigating the European Union Emission Trading Scheme's Effect on Blast Furnace Steel and Cement Imports from Non-EU Countries under Alternative Allowance Prices



Note: Values presented here are derived from values for "complete pass-through" scenario presented in Charts 10 and 14 of the Carbon Trust report.
Source: Carbon Trust, *EU ETS Impact on Profitability and Trade: A Sector by Sector Analysis*, 2008.

While various studies have examined the potential for future impacts of the EU ETS on the international competitiveness of a limited set of European industries, it is important to note that retrospective studies of the first few years of the EU ETS have shown no competitive impacts from the program thus far. Baron et al. (forthcoming) examine data on imports to and exports from the EU in 2005 and 2006 in key energy-intensive trade-exposed sectors, including steel, cement, refining, and aluminum.[33] The authors find no statistical evidence that the EU ETS

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[32] Carbon Trust, 2008

[33] See R. Baron, R. Lacombe, P. Quirion, J. Reinaud, N. Walker, and R. Trotignon (forthcoming), "Competitiveness under the EU Emissions Trading Scheme," in A. Denny Ellerman, Frank J. Convery, and Christian De Perthuis, *Pricing Carbon: The European Union Emissions Trading Scheme*, Cambridge: Cambridge University Press. Also available at: http://www.aprec.fr/documents/wpcompetitiveness.pdf.

affected trade flows in those sectors. Moreover, the authors note that in sectors where imports increased (*e.g.*, steel and aluminum), other factors, such as increases in consumption, may explain these increases. Other recent assessments of key sectors have found similar results.[34] Authors of these retrospective studies caution, however, that the early years of the EU ETS may not be representative of future impacts because of volatile and relatively low emission allowance prices, modest emissions targets, over-allocation of allowances to many facilities, long-term power contracts that precluded passing on all allowance costs, and other factors.

VI. Provisions in H.R. 2454 and Other Legislation that Can Mitigate Competitiveness Impacts

H.R. 2454 includes several provisions that could mitigate the potential impacts of a cap-and-trade program on the international competitiveness of domestic manufacturing. These provisions are discussed below.

A. Allowance Allocations

1. Output-Based Allocations (or Rebates) to "Trade-Vulnerable" Industries

As was described earlier in this report, the most important measure included in H.R. 2454 to address competitiveness impacts in the near-term is the provision that would freely allocate (or rebate) emission allowances to certain energy-intensive sectors using a continuously updating output-based formula. Allowance rebates would be provided both for direct emissions — combustion emissions from fossil fuel use as well as process-related emissions — and for indirect emissions associated with the purchase of electricity. Rebates for direct emissions would be provided to the covered entities within an eligible sector (*i.e.*, those entities that are required to submit allowances for their direct emissions). Rebates for indirect emissions would be provided to each entity within an eligible sector regardless of whether or not that entity has an emission allowance compliance obligation under the cap-and-trade program.[35] In each year, rebates for direct emissions would be calculated by multiplying an eligible entity's average

[34] See, for example, G. Cook (2009), "Climate Change and the Cement Industry," Working Paper, Climate Strategies, September 18. Available at http://www.climatestrategies.org/our-reports/category/32/222.html. See also J. Reinaud (2008), *Issues behind Competitiveness and Carbon Leakage, Focus on Heavy Industry*, International Energy Agency (IEA) Information Paper, OECD/IEA, October.

[35] H.R. 2454 establishes an emissions eligibility threshold of 25,000 tons CO_2e annually for facilities within certain industrial sectors; entities within these sectors that fall below the threshold do not face a compliance obligation for their direct emissions.

output in the two prior years by the average direct GHG emissions per unit of output for all entities within that entity's sector, where the latter estimate is updated every four years based on a four-year average. Rebates for indirect emissions would be calculated by multiplying an eligible entity's average output in the two prior years by the sector-average electricity use per unit of output (the "electricity efficiency factor"), which is updated every four years, and then multiplying the product by an entity-specific estimate of the emission intensity of that entity's electricity use in the prior year.[36] This last emission-intensity value is adjusted to account for any mitigation of rate impacts due to allocations to electricity local distribution companies (discussed further below). Each time they are updated with new data, the sector-wide direct GHG intensity value and the electricity efficiency factor described above are not permitted to increase relative to prior years, and the entity-specific value for the emission intensity of electricity consumption is not allowed to increase if that increase is the result of a change in the entity's source of electricity supply.

Allocations for indirect emissions associated with electricity purchases begin with the start of the cap-and-trade program in 2012. Allocations to eligible industrial sectors for their direct emissions begin in 2014, when the coverage of the cap-and-trade expands to begin including direct emissions from industrial facilities. The total number of allowances available for allowance rebates to eligible sectors for their direct and indirect emissions is equal to about 15 percent of the overall cap in 2014, and this number declines in tandem with the overall cap from 2014 to 2025. After 2025, H.R. 2454 specifies a default phase-out schedule for both the entity-specific allocations and the total pool of allowances set aside for these allocations. This default schedule would lead to a complete phase-out of those allocations by 2035, but that phase-out schedule can be delayed by the President based on considerations relating to the state of global action to reduce greenhouse gas emissions.

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[36] A numerical illustration may be useful. Suppose that Steely Steel Corp. produced 90,000 tons of steel two years ago and 110,000 tons of steel last year for an average output of 100,000 tons per year. If the steel sector's average direct GHG emissions per unit of steel over the last four years was 1 ton of CO_2e emissions per ton of steel, Steely Steel Corp. would receive allowance rebates for 100,000 tons of direct emissions (100,000 tons of steel x 1 ton CO_2e/ton steel). In addition, if the sector-average electricity use for the steel sector was 0.4 megawatt-hours (MWh) per ton of steel, and if the emission intensity of the electricity purchased by Steely Steel Corp. over the last year was 0.5 tons of CO_2e emissions per MWh, Steely Steel Corp. could receive allowance rebates for up to 20,000 tons of indirect emissions (100,000 tons steel x 0.4 MWh/ton steel x 0.5 tons CO_2e/MWh). As noted in the paragraph above, however, this allowance rebate for indirect emissions would be adjusted to account for any mitigation of electricity rate impacts through allocations to electricity LDCs.

By freely distributing a specified number of allowances to firms for every additional unit of output they produce based on the average emission rate in the sector, these allocations offset the average effect that the cap-and-trade program would otherwise have on the production costs of recipients in each sector, and therefore on their international competitiveness and emission leakage. Importantly, the distribution of allowances within a sector on the basis of each firm's on-going production levels, rather than on the basis of their emissions or fuel use, maintains the incentives that a cap-and-trade program creates for each firm to reduce the emission-intensity of its production, and for market share within a sector to shift toward those firms that are the least emission intensive. Because all firms within a sector receive the same allocation per unit of their output and they still must surrender allowances to cover every ton of their emissions, even with these allocations, less emission-intensive firms still gain the same advantage over their more emission-intensive competitors as they would in a cap-and-trade program that does not provide such allocations. Output-based allocations simply shift downward the cap-and-trade program's effects on *all* firms’ production costs on a consistent, industry-wide basis.

The primary benefit of output-based allocations is that they reduce emission leakage that can otherwise undermine the environmental effectiveness of a domestic cap-and-trade program, and at the same time they avoid the economic losses associated with that leakage. Yet, because these allocations accomplish this by mitigating the cap-and-trade program’s effects on domestic production costs of emission-intensive goods, these allocations also diminish incentives for consumers to reduce their use of emission-intensive goods, and thereby forego some cost-effective domestic emission reductions. The allocations also involve the free distribution of allowances whose value could instead be devoted to other uses, including support for low-income consumers, clean energy technology, or deficit reduction. To minimize overall costs, it is therefore important to narrowly target these allocations to trade-exposed goods and to choose the level of allocation that balances these costs and benefits.

2. Allocations to Electricity and Natural Gas Local Distribution Companies (LDCs)

Provisions to distribute allowances to electricity and natural gas local distribution companies (LDCs) would also benefit energy-intensive trade-exposed industries. H.R. 2454 allocates about 30 percent of the value of allowances to electricity LDCs annually from 2012 to 2025, distributing them ratably among LDCs, 50 percent on the basis of emissions, and 50 percent on the basis of electricity deliveries, with the delivery component allocated on an updated basis every 3 years from 2015. The additional 9 percent of allowances given annually to natural gas LDCs from 2016 to 2025 are allocated ratably on the basis of historical deliveries, with an adjustment every 3 years starting in 2019 to account for changes in the size of each utility's customer base. Emission allowances allocated to electricity and natural gas LDCs must be used for the benefit of retail ratepayers, and ratepayer benefits must be distributed ratably among ratepayer classes based on deliveries to each class. In providing rebates to residential and commercial customers, LDCs are instructed not to provide rebates that are based solely on the quantity of electricity or natural gas delivered, which would amount to rate reductions. Among other potential approaches, one alternative to such a rebate would be to provide a fixed rebate that is unrelated to a customer's electricity consumption. LDCs are, however, allowed to use allocations to reduce industrial customers' electricity rates.

As with the output-based rebates, the LDC allocations offset a portion of the effect that the cap-and-trade program would otherwise have on the production costs of domestic manufacturers, and therefore mitigate competitiveness impacts. Indirect emissions from electricity consumption account for more than one-quarter of the total emissions of the "presumptively eligible" energy-intensive trade-exposed industries. Moreover, EPA analysis suggests that the size of the allocations to electricity LDCs during the coming decade would be on the order of 80 percent of the electricity sector's emissions. Therefore, the allocation to electricity LDCs could mitigate a significant portion of the costs that energy-intensive trade-exposed industries might otherwise experience under a cap-and-trade program. Further, because the output-based allocations to eligible energy-intensive trade-exposed industries would be provided for both direct emissions *and* indirect emissions associated with the purchase of electricity, any residual impacts on electricity costs left unaddressed by the LDC allocation should be offset by the output-based allocations.[37] On the other hand, the allocation to natural gas LDCs would likely provide minimal benefit to the energy-intensive trade-exposed industries, as this allocation will only benefit natural gas users that receive their gas from LDCs and whose emissions are not directly regulated under H.R. 2454. Most energy-intensive trade-exposed

[37] By adjusting the output-based allowance rebates for indirect emissions (associated with electricity purchases) to account for the value of allowances received through the LDC allocation, H.R. 2454 is designed to compensate sectors for the emissions associated with electricity purchases, but avoid doing so twice through output-based allocations and LDC allocations.

manufacturers likely would be covered entities whose direct emissions will be regulated. Thus, such manufacturers would be ineligible to benefit from the natural gas LDC allocation, although their use of natural gas resulting in direct emissions would still enable them to receive the output-based allocations.[38]

Some have raised concerns that energy-intensive industry and other electricity consumers will not benefit from the allocations to LDCs. In particular, some have pointed to the experience in the EU ETS, in which electricity rates rose despite significant allowance allocations to electric generators, leading many generators to realize windfall profits from those allocations.[39] However, the proposed LDC allocations fundamentally differ from the EU ETS allocations. In particular, the LDC allocations would go to electric utilities that, by law, are subject to economic regulation by public utility commissions that dictate the rates those utilities can charge and the profits they can earn. Thus, state (or local) public utility commissions will have the ability to dictate how the value of allocated emission allowances is used to benefit ratepayers. By contrast, the EU ETS freely allocated allowances to electricity generators, many of whom operate in competitive electricity markets and are not subject to economic regulation by utility commissions. Because these allocations were fixed at the outset of the EU ETS, the resulting increase in electricity rates and windfall profits in the EU ETS were consistent with what economic theory would predict.[40]

Although the LDC allocations are specifically structured and targeted to ensure that ratepayers — rather than electric utilities — ultimately benefit from them, it is difficult to predict exactly how the value of those allocations will be distributed across ratepayers. These

[38] Note that the non-emissive use of natural gas (*e.g.*, as a feedstock) will not create a compliance obligation for entities whose direct emissions are regulated. Further, if allowances have been previously retired for the emissions that would have resulted from the combustion of natural gas — as might happen if the natural gas was sold by an LDC to a non-covered entity — but this natural gas is used instead as a feedstock, a compensatory allowance would be issued to make up for the allowances that were retired.

[39] For example, see J. Sijm, K. Neuhoff, and Y. Chen (2006), "CO_2 Cost Pass-Through and Windfall Profits in the Power Sector," *Climate Policy,* 6(1): 49-72.

[40] In particular, if allowances are allocated based on historical emissions or some other factor unrelated to on-going production levels, then an unregulated firm operating in a competitive market will make pricing and production decisions as if it had to purchase every allowance that it must use to cover its emissions. Even though the firm benefits from the allocation, because the level of the allocation is unaffected by future production decisions, it is equivalent to a one time gain that does not affect the firm's on-going production costs. If the firm generates emissions with each unit of output that it produces, to cover those emissions, it still has to surrender valuable allowances that it could have otherwise sold. As a result, its pricing decisions will reflect the value of those allowances despite the fact that it may have received the allowances for free.

distributional decisions will be made by each LDC and the regulatory commission that oversees it. As a result, similar firms in the same energy-intensive trade-exposed industry that are served by different LDCs may experience very different benefits from the LDC allocations. In addition, while the LDC allocations can help achieve particular distributional objectives, these distributional benefits come at the expense of increasing the nationwide cost of the cap-and-trade program.[41] Specifically, to the extent that LDCs use the allocations in ways that reduce electricity rates for their customers, or that are perceived to do so, this will diminish the incentives that consumers face to reduce their electricity use or to rely on self-generated electricity, such as through combined heat and power. By diminishing these incentives, the allocations will reduce the cap-and-trade program's ability to realize some cost-effective emission reductions associated with electricity conservation and onsite electricity generation, and will thereby require greater reliance on other, more costly emission reductions to achieve the national emissions cap. Thus, in evaluating and designing LDC allocations, it is important to consider the complexities involved in achieving desired distributional objectives through LDC allocations, as well as the tradeoffs between the distributional benefits and economic costs of those allocations.

3. Comparison of Allocations with Emissions of "Presumptively Eligible" Industries

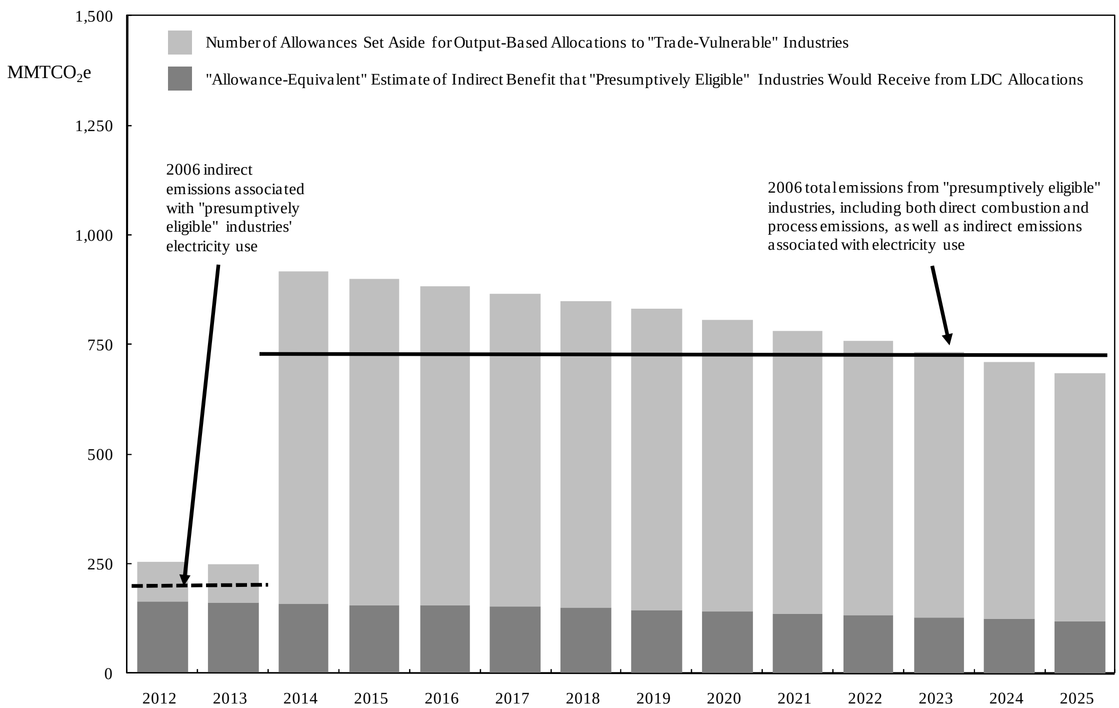
In establishing the output-based allowance rebates to energy-intensive trade-exposed industries, as noted above, H.R. 2454 limits the overall number of allowances that are set aside for these allocations. While the bill uses an allocation formula for eligible firms that is based on the average emission-intensity of their industry's production, if more allowances are needed in sum to fulfill this allocation formula across all eligible industries than are set aside for the allocations, each firm's allocation would be pro-rated down accordingly. If this were to occur,

[41] Estimates of the extent that the LDC allocations will raise the cap-and-trade program's cost vary significantly depending on several assumptions, including assumptions about how significant the foregone opportunities for emission reductions from reduced electricity use are, and assumptions about the cost of alternative means of reducing emissions, including the use of international emission reduction offsets. One analysis by Dallas Burtraw and others at Resources for the Future found that LDC allocations raise a cap-and-trade program's allowance prices — a proxy for the program's cost — by nearly 30 percent and that more than two-thirds of that increase is attributable to the effect of LDC allocations on incentives for reducing electricity use in the commercial and industrial sectors. By contrast, while EPA's analysis of H.R. 2454 did not directly address the impact of LDC allocations on allowance prices, the results from the different scenarios it examined imply that LDC allocations would raise allowance prices by only 2 percent. See R. Sweeney, J. Blonz, and D. Burtraw (2009), "The Effects on Households of Allocation to Electricity Local Distribution Companies," June 5; and Environmental Protection Agency (2009), *EPA Analysis of the American Clean Energy and Security Act of 2009*, June 23.

firms would receive allocations at a rate below the average emission-intensity of their industry's production.

Figure 13 compares the total direct and indirect emissions of the "presumptively eligible" industries in 2006 with the combination of the total number of allowances that H.R. 2454 sets aside for output-based allocations to those industries, and an estimate of the "allowance-equivalent" benefit that those industries would receive from the electricity LDC allocations. Figure 13 presents this comparison through 2025. After 2025, the number of allowances that are set aside for the output-based allocations will depend in large part on Presidential determinations regarding the timing of the phase-out of those allocations.

Figure 13. Comparison of the "Presumptively Eligible" Industries' 2006 Emissions with the Number of Allowances Set Aside for Output-Based Allocations and the Estimated "Allowance-Equivalent" of the Indirect Benefits from Allocations to Electricity Local Distribution Companies in H.R. 2454



Note: Emission estimates are from Table 1. H.R. 2454 does not begin to cover these industries' direct emissions until 2014. The horizontal line in 2012 and 2013 therefore reflects their indirect electricity emissions only. While the maximum number of allowances available for output-based allocations to "trade-vulnerable" industries is known with certainty, the indirect benefit that these industries will receive from the LDC allocations is uncertain. The estimated "allowance-equivalent" value of the indirect benefit from the LDC allocation shown here is calculated by multiplying the total LDC allocation by the "presumptively eligible" industries' share of total 2007 electricity sales in the United States, based on the 2007 Economic Census and EIA data on nationwide retail electricity sales.

Figure 13 demonstrates that, taking into account the potential to carry over unused allowances from one year to the next, as H.R. 2454 provides for, the number of allowances available through the LDC allocations and output-based allocations would exceed the 2006 emissions of the eligible industries through 2025. Of course, the adequacy of the allowance set asides will ultimately depend on how those set asides compare with the *future* emissions of the eligible industries. As was noted in Section III.B, anticipated continued reductions in the emission-intensity of the eligible industries' production methods will tend to reduce the future emissions of those industries relative to recent levels. On the other hand, findings that additional sectors would be eligible for allocations (*e.g.*, through "individual showings") and increases in eligible industries' production levels relative to 2006 levels (*i.e.*, relative to levels prior to the recent economic recession) would increase their future emissions. While projections of the total greenhouse emissions of the "presumptively eligible" industries are unavailable, as noted previously, EIA projects that the total energy-related CO_2 emissions of the six key energy-intensive trade-exposed sectors depicted in Figure 7 would decline nearly 20 percent from 2006 to 2020 under business-as-usual circumstances, and nearly 30 percent under H.R. 2454.

B. International Reserve Allowance Program

H.R. 2454 also includes an international reserve allowance program provision that could be applied to imports of emission-intensive goods from foreign producers that have not been subject to comparable greenhouse gas regulations. In particular, importers of energy- and emission-intensive goods may be required to surrender "international reserve allowances" to reflect the greenhouse gas emissions associated with the production of those goods, adjusted downward as appropriate to reflect any benefit that domestic producers are receiving from the output-based allocations provided to "trade-vulnerable" industries and from the LDC allocations. Under H.R. 2454, beginning in 2020, if a multilateral agreement on climate change has not been reached, this international reserve allowance program could go into effect for covered industrial sectors where 15 percent or more of imports are from countries that do not meet particular criteria relating to their greenhouse gas regulations, emission-intensity, and emission levels.

While both output-based allocations and the international reserve allowance program can minimize the differential in product prices between energy-intensive goods produced in countries with greenhouse gas regulations and those produced elsewhere, the two policy mechanisms do so in very different ways. Output-based allocations would be likely to lower the cost of domestic production in a country with greenhouse gas regulations, offsetting the price increase for domestically produced goods that would otherwise occur under a cap-and-trade regime. This should minimize differences in product prices for domestically-produced and foreign-produced goods in both domestic and international markets. The international reserve allowance program in H.R. 2454, on the other hand, would be likely to raise the cost of certain imports from countries without comparable greenhouse gas regulations, allowing both domestic and imported covered goods to carry a carbon price that is intended to reflect the emissions associated with their production, raising the price of both domestic and foreign energy-intensive goods in domestic markets. It is also important to consider that an international reserve allowance provision could raise possible issues of consistency with international obligations that could result in retaliatory actions by trading partners that could result in higher costs for the export of U.S. goods.

C. Cost Containment Mechanisms

Cost containment mechanisms can also mitigate competitiveness impacts on energy-intensive trade-exposed industries by reducing the overall cost of complying with a cap-and-trade program. H.R. 2454 and other recent climate proposals include several provisions that can lower the overall costs of a cap-and-trade program, including banking and borrowing of allowances and emissions offsets. In the case of offsets, EPA analysis of H.R. 2454 has shown that the use of domestic and international offsets can reduce the cap-and-trade program's overall costs, assuming appropriate institutional capacity.[12]

D. Additional Provisions that Benefit Manufacturing

Several additional provisions in H.R. 2454 would either directly or indirectly improve the international competitiveness of energy-intensive trade-exposed industries:

- Clean Energy Deployment Administration. The bill would authorize $7.5 billion in bonds to initially capitalize a Clean Energy Deployment Administration (CEDA) — commonly referred to as the "Green Bank" — to promote domestic deployment of clean energy technologies. Among its several goals would be the promotion of "domestic production of commodities and materials (such as steel, chemicals, polymers, and cement) using clean energy technologies so that the United States will become a world leader in environmentally sustainable production of the commodities and materials." The CEDA would be authorized to pursue its goals through providing both direct and indirect financial support. Direct support would include direct loans, letters of credit, and loan guarantees, while indirect support could include credit support and facilitation of certain financing transactions.

- Bonus allowances for carbon capture and sequestration (CCS) at industrial facilities. Starting in 2014, H.R. 2454 sets aside allowances — reaching 5 percent annually after 2020 — to distribute to entities that deploy commercial-scale technologies that capture and store at least 50 percent of potential carbon emissions. Up to 15 percent of these CCS bonus allowances can be awarded to industrial sources. Such bonus allowances could reduce the costs that energy-intensive industries face to reduce their emission-intensity.

- Clean Energy Manufacturing Revolving Loan Fund. This provision, based on Senator Sherrod Brown's Investments for Manufacturing Progress and Clean Technology (IMPACT) proposal, would provide incentives to small- and medium-sized manufacturers for the production of clean energy technologies and for the improvement of energy efficiency. The Department of Energy would be given $15 billion a year in 2010 and 2011 to award grants to States to establish revolving loan funds that would provide loans to small- and medium-sized manufacturers. These loans could finance the cost of reducing the energy intensity or greenhouse gas emissions of an eligible facility. Loans could also finance the cost of reequipping, expanding, or establishing a manufacturing facility to produce clean energy technology or energy-efficient products.

- Clean energy and efficiency manufacturing partnerships. H.R. 2454 would authorize an average of $300 million to be appropriated annually for the next 5 years to the Secretary of Commerce for the Hollings Manufacturing Partnership Program and would reduce the cost share requirement for participating manufacturers. This partnership program provides support to manufacturers to undertake clean energy manufacturing initiatives, including "reducing energy intensity and greenhouse gas production, including the use of energy intensive feedstocks."

- Worker adjustment assistance and training. H.R. 2454 would distribute 0.5 percent of the value of allowances annually to finance worker adjustment assistance. Workers "employed in … energy-intensive manufacturing industries" are eligible to apply for such assistance, which would include adjustment benefits and new job training.

E. Provisions from the American Recovery and Reinvestment Act of 2009 that Benefit Manufacturing

In addition to the provisions in H.R. 2454, several provisions in the American Recovery and Reinvestment Act (ARRA) of 2009 benefit energy-intensive trade-exposed sectors by supporting retooling and increased efficiency at industrial facilities and by creating demand for energy intensive primary materials (*e.g.*, steel for windmill blades). Relevant investments and incentives provided by ARRA include:

- <u>Advanced Energy Manufacturing Facility Investment Tax Credit</u>. ARRA authorizes up to $2.3 billion in tax credits for qualified investments to re-equip, expand, or establish facilities designed to manufacture advanced energy technologies including, among others: renewable energy technologies, fuel cells, microturbines, energy storage systems for electric/hybrid vehicles, energy efficiency technologies, smart grid equipment, plug-in hybrid vehicles, and equipment to capture and sequester carbon dioxide. The tax credit would be equal to 30 percent of the value of the qualifying investment.

- <u>Clean Renewable Energy Bonds</u>. ARRA authorizes an additional $1.6 billion of bonds to finance facilities that generate electricity from wind, closed-loop biomass, open-loop biomass, geothermal, small irrigation, hydropower, landfill gas, marine renewable, and municipal waste combustion facilities.

- <u>Advanced Battery Manufacturing Grants</u>. ARRA allocates $2.0 billion for grants to U.S. manufacturers of advanced battery systems and car batteries. Funding could go toward the production of lithium ion batteries, hybrid electrical systems, and system components.

- <u>Loan Guarantees for Renewable Energy and Transmission</u>. ARRA allocates $4.0 billion for a program to deploy renewable energy and electric power transmission. This amount is expected to leverage as much as $40 billion in loan guarantees for investments in renewable energy projects and related transmission systems.

- <u>Industrial Energy Efficiency</u>. The Department of Energy has announced the award of $156 million in ARRA funds for energy efficiency improvements in major industrial sectors. The program is designed to reduce energy consumption in manufacturing and information technology sectors. One of the major focuses of the program will be investment in technologies that will reduce energy costs and make U.S. industry more competitive. Among the projects to be funded will be combined heat and power projects, district energy systems, waste energy recovery systems, and efficient industrial equipment.

- Payments for Specified Energy Property in Lieu of Tax Credits. ARRA authorizes the Department of the Treasury to make payments to eligible persons that either place in service particular types of energy property in 2009 or 2010, or, under certain circumstances, begin construction on such property in 2009 or 2010. These payments are generally equal to 10 or 30 percent of the eligible cost basis of the property, depending on the type of property. Those that apply for these payments must forego tax credits that they could otherwise receive under sections 45 and 48 of the Internal Revenue Code. The types of energy property that are eligible for these payments include, among others, various renewable energy generation facilities, microturbines, and fuel cells.

- Training. ARRA includes several provisions that would provide funding for job training, including $500 million for research, labor exchange, and job training projects that prepare workers for careers in energy efficiency and renewable energy.

VII. Economic Modeling of Competitiveness Impacts and Associated Leakage

While the United States does not yet have experience with a greenhouse gas cap-and-trade program to draw on for retrospective studies of emission leakage and associated competitiveness impacts, the economics literature has employed several analytical approaches to assess the anticipated effects of climate policy on domestic energy-intensive trade-exposed manufacturing industries. These studies generally find that, on average, impacts are likely to be modest. This section briefly reviews prior economic analyses of these issues and then describes and presents the results from new modeling performed for this report.

Prior analyses by Aldy and Pizer, and by Ho, Morgenstern, and Shih offer examples of two different approaches that have been used to examine competitiveness impacts, the former relying on a statistical approach that uses historical data, and the latter using simulation modeling.[42] Notably, both studies focus on competitiveness impacts that would exist *in the*

[42] Aldy and Pizer (2009); and M. Ho, R. Morgenstern, and J.S. Shih (2008), "Impact of Carbon Price Policies on U.S. Industry," Discussion Paper DP-08-37, Resources for the Future.

absence of any mitigating policy measures like those incorporated in H.R. 2454. Aldy and Pizer examine the past impacts of higher domestic energy prices on energy-intensive trade-exposed industries in order to predict how those industries might be affected by a $15 per ton of CO_2 emissions allowance price in 2012. They estimate that the short-run decline in domestic production in the iron and steel, aluminum, cement, glass, and paper industries will be relatively small, ranging between 1.6 and 3.4 percent, of which only a portion would reflect the impacts of reduced international competitiveness, as is described further below.[43] Ho, Morgenstern, and Shih also examine the short-run impacts of a cap-and-trade program on these industries, focusing on a $10 per ton of CO_2 allowance price. They find that most energy-intensive trade-exposed industries would experience a drop in domestic output of between 1 and 3 percent, but that a limited set of those industries would experience greater impacts. For example, they project that cement manufacturers would experience a 4.1 percent decline in domestic production and that petrochemical manufacturers would experience a 7.7 decline in domestic production.[44] The authors estimate that short-run impacts on industry profits will be even smaller, falling by less than one percent in each of the energy-intensive trade-exposed industries that they examine. The authors further project smaller impacts on domestic production in the long run, when the economy can fully adjust to climate policy by investing in low-carbon equipment and processes. While these studies use different methods, they reach common conclusions that, on average, the effects of a cap-and-trade program on domestic production levels of energy-intensive trade-exposed industries are modest.

These studies also highlight that the changes in the domestic production levels of energy-intensive trade-exposed industries under a cap-and-trade program will not solely arise from changes in international competitiveness. Rather, some — and, for certain industries, most — of the change in their domestic production levels will result from a decrease in the domestic consumption of their products as the U.S. economy moves to less emission-intensive goods, not from a loss of international competitiveness. For instance, Aldy and Pizer find that, for some industries, absent any mitigating policy measures, changes in international competitiveness could

[43] We use the term "short-run" to describe analyses that assume capital is fixed. "Long-run" studies are those that allow for capital turnover, accounting for how industries will adjust to a carbon price through eventual investments in new low-carbon equipment and processes.

[44] The authors note that they do not account for process emissions (*i.e.*, those not associated with fuel combustion), so their estimates likely understate impacts on cement manufacturers and others with significant process emissions.

account for as little as one-fifth of the change in domestic production levels under a cap-and-trade program, but that it could account for a greater share in other industries. Ho, Morgenstern, and Shih find that changes in international competitiveness would account for between 40 and 50 percent of the decrease in domestic production of primary metals, nonmetallic minerals, and chemicals and plastics.

It is also notable that, although impacts will be more significant in some industries than in others, on the whole across all industries these studies project small declines in U.S. manufacturing output and very low levels of associated leakage. Aldy and Pizer find that a $15 allowance price would have virtually no impact on manufacturing employment and would lead to a 1.3 percent decline in total manufacturing output, with about half of this decline in output associated with a shift in production abroad.

To examine a domestic cap-and-trade program's effects on the international competitiveness of, and emission leakage from, energy-intensive trade-exposed industries, and to assess the efficacy of provisions in H.R. 2454 to address those impacts, we have drawn on both existing modeling by EPA and EIA, as well as new modeling conducted for this report. Specifically, based on the relative strengths of the respective models, the EPA and EIA modeling were used as a basis for assessing the broad economy-wide effects of a cap-and-trade program, including the allowance prices that would be expected to emerge from a cap-and-trade program like that in H.R. 2454. Using this foundation, a multi-region, multi-sector model of the global economy was employed to examine international competitiveness impacts of a domestic cap-and-trade program on several energy-intensive trade-exposed industries under various policy scenarios. These policy scenarios differed according to the degree of global action to address climate change, and according to the domestic measures that are adopted to mitigate competitiveness impacts.

The new modeling in this report was performed using the Fischer-Fox Emissions and Trade (FFEAT) model, which is based on the GTAP 7 database[45] of the global economy. While producing results that are consistent with prior EPA and EIA modeling, the new modeling

[45] GTAP (Global Trade Analysis Project) is a global network of researchers who conduct quantitative analysis of international economic policy issues, especially trade policy. They cooperate to produce a consistent global economic database, covering many sectors and all parts of the world.

conducted for this report builds on that prior modeling in ways that make it possible to glean various insights that cannot be obtained from the EPA or EIA modeling alone. For example, the new modeling makes it possible to examine climate policy and trade impacts on industrial sectors at a more disaggregated level than is possible in the EPA modeling. In addition, while the EIA modeling can also examine impacts on industrial production at a more disaggregated level than is possible in the EPA modeling, unlike the EIA modeling, the modeling conducted for this report makes it possible to differentiate those impacts on specific sectors' production levels that are attributable to changes in international competitiveness from those that are attributable to changes in domestic demand for emission-intensive products. Moreover, the new modeling conducted for this report examines certain policy scenarios that were not examined in prior EPA and EIA modeling, allowing for an improved understanding of how competitiveness impacts are influenced by different levels of global action to address climate change, and by particular domestic policy measures.

The remainder of this section provides an introduction to the model that was employed, describes the scenarios that were examined, details the particular industrial sectors that were evaluated, and then presents the conclusions from the modeling exercise.

A. Overview of Economic Model

The FFEAT model is a refinement of a model that has been used in prior peer-reviewed research.[46] It is similar to EPA's ADAGE model, which EPA employed in analyzing H.R. 2454, in the sense it accounts for both the direct and indirect (or "general equilibrium") effects of a cap-and-trade program on both the domestic economy and international trade flows.[47] However, the FFEAT model differs from ADAGE in several important respects. On the one hand, it provides greater sectoral disaggregation, which enhances efforts to examine impacts on specific energy-intensive trade-exposed industries. On the other hand, it does not have the capacity to examine the effects of a cap-and-trade program that develop over time, such as the cumulative effect of investments in response to a policy change. Rather, it focuses on initial effects of a policy change. Additionally, the FFEAT model does not account for many features of a cap-and-

[46] See C. Fischer and A. Fox (2007), "Output-Based Allocation of Emissions Permits for Mitigating Tax and Trade Interactions," *Land Economics*, 83: 575-599.

[47] The international economic data used in ADAGE is drawn from the GTAP database.

trade program that are necessary to reliably project the allowance price that would prevail in a given year under a program like that in H.R. 2454.[48] Nonetheless, if a particular allowance price is assumed based on other modeling efforts, such as those by EPA and EIA, the FFEAT model can be used to examine the economic implications of that allowance price on energy-intensive trade-exposed industries.

The FFEAT model accounts for some of the potential adjustments to the production processes of industry — and economic activity more broadly — that would be expected in response to a cap-and-trade program. The kind of adjustments that are accounted for are those that can be expected over a "medium-run" time horizon. From the perspective of energy-intensive trade-exposed industries, if climate legislation were enacted in the coming months, this time horizon is broadly consistent with the time that would elapse between the enactment of legislation and the initial years in which those industries' emissions would be covered under H.R. 2454's cap-and-trade program.

Unlike other models that evaluate a policy's effects against a continually adjusting "baseline" projection of how the economy would otherwise evolve into the future, the FFEAT model evaluates a policy's effects as if it were imposed on the structure of the global and domestic economy that existed in 2004. To the extent that the economy evolves in important ways between 2004 and the year in which a domestic climate policy is implemented, the FFEAT model can over- or understate the relative impacts on particular sectors or countries. For example, the model will tend to overstate impacts on those sectors that experience a significant decline in emission intensity (*e.g.*, a decline arising from technological progress) between 2004 and the implementation of a domestic cap-and-trade program, especially to the extent that the emission intensities of these sectors fall relative to their foreign competitors. Moreover, while the FFEAT model accounts for adjustments in the use of existing technologies and other production inputs in response to a climate policy, it does not account for potential technological change that could be spurred by a domestic climate policy. By using a 2004 baseline, the FFEAT model also excludes the effects that recent legislation — including the Energy Independence and Security Act of 2007 and the American Recovery and Reinvestment Act of 2009 — would have in

[48] For example, the model does not currently have the capability to account for the availability of offsets, or to model how opportunities to bank and borrow emission allowances would affect allowance prices in any given year.

increasing the efficiency of manufacturing and growing a clean energy economy. On the other hand, due to the aggregated nature of the sectors modeled in the GTAP framework, the model may understate impacts on more narrowly-defined industries that are particularly emission intensive. Another important caveat is the increasingly important role of international trade in the U.S. economy, particularly trade with developing countries. As trade intensity increases over time, increasingly trade-exposed sectors are likely to see greater impacts from a policy change than the modeling presented here would suggest, especially in scenarios where other countries do not adopt comparable climate policies.

While these various factors can influence the magnitude of certain policy impacts that are identified in this modeling, they are unlikely to substantially influence the modeling's central finding: that measures like those incorporated in H.R. 2454 can effectively mitigate a cap-and-trade program's impacts on domestic energy-intensive trade-exposed industries even if those industries face competition from firms in countries that have not yet adopted comparable regulations.

B. Policy Scenarios

As noted above, unlike models used by EPA and EIA, the FFEAT model currently cannot estimate the allowance price that would emerge under a cap-and-trade program that, like the one proposed in H.R. 2454, provides for the use of emission reduction offset credits and allowance banking. As a result, the analysis presented here simply assumes an allowance price of $20 per ton in order to examine a cap-and-trade program's impacts on domestic manufacturing. The $20 allowance price has been adopted for illustrative purposes in examining competitiveness impacts, and does not reflect a specific projection of allowance prices under H.R. 2454. However, it is broadly consistent with EPA, Congressional Budget Office, and EIA projections of allowance prices under H.R. 2454 in the latter half of the next decade, once energy-intensive trade-exposed industries would be fully covered by the cap-and-trade program. The FFEAT model is then used to explore the implications of different policy scenarios that are defined by the extent of global adoption of greenhouse gas regulations and by the measures taken at home to address competitiveness concerns.

1. Levels of Global Action

To examine a domestic cap-and-trade program's impact on the international competitiveness of U.S. energy-intensive trade-exposed industries, we examine a few possible scenarios of international engagement in reducing greenhouse gas emissions.

- *United States and Developed Country Action*: This scenario — the primary one on which we focus — offers a realistic representation of the near-term outlook for global engagement in addressing climate change. In line with past EPA analyses, in this scenario it is assumed that, with the exception of Russia, all other countries that were assigned emission targets under the Kyoto Protocol (Annex I countries) adopt mandatory emission targets. Indeed, as participants in the European Union Emission Trading Scheme, the majority of these countries have already adopted mandatory limits. It is further assumed that the emission allowance price in the United States and Annex I countries is the same, at $20 per ton. This common allowance price could emerge if each country develops a cap-and-trade program and those programs are linked either directly or indirectly, such as through the use of the same pool of international offset credits.

- *Unilateral United States Action*: This scenario is presented to provide a basis for comparison in evaluating how the international competitiveness impacts of a domestic climate policy on U.S. industry are mitigated by the adoption of greenhouse gas regulations in other developed countries, such as the European Union.

- *Developed Country Action without the United States*: Like the prior scenario, this scenario is used only to better understand international competitiveness impacts. Specifically, it is used to isolate the effects of the United States adopting a cap-and-trade program in the context of the primary policy scenario in which both the United States and other developed countries act.

2. Domestic Measures to Mitigate Competitiveness Concerns

The modeling presented here specifically examines the effect of two provisions in H.R. 2454 that can reduce a cap-and-trade program's impacts on the international competitiveness of energy-intensive trade-exposed industries: allocations to electricity LDCs and the output-based allocations (or rebates) to eligible "trade-vulnerable" industries. While other provisions in H.R.

2454 could also influence the international competitiveness of domestic industry, these two provisions are the most economically significant and could be incorporated in the current modeling framework in the available timeframe for this exercise.

In modeling the electricity LDC allocations in this exercise, it is assumed that the level of those allocations is equal to about 80 percent of the electricity sector's emissions. This is generally consistent with EPA's findings regarding the relative level of those allocations during the first decade of H.R. 2454's operation — the period of interest in this exercise. Furthermore, it is assumed that the LDC allocations would have the effect of reducing the electricity rates that industrial consumers face, as is allowed for in H.R. 2454.

In modeling the output-based allocations to eligible industrial sectors, consistent with H.R. 2454, we assume that firms in each eligible sector would receive a per-unit-of-output allocation that is equal to their sector's average emission intensity of production, considering both their sector's direct emissions as well as indirect emissions from electricity consumption. That is, we assume that a sufficient number of allowances are set aside to fulfill the allocation formulas for "trade-vulnerable" industries established in H.R. 2454.[49] Further, as provided for in H.R. 2454, in this modeling, the output-based allocation for indirect emissions are reduced to reflect the benefit that firms receive through the LDC allocations, so that the indirect emissions of the eligible industries are fully covered by a mix of LDC and "trade-vulnerable" industry allocations.

C. Energy-Intensive Trade-Exposed Industries Examined in Modeling

The GTAP modeling framework employed by FFEAT allows for the examination of a policy's impact on 50 aggregated economic sectors. Of these, in the context of this modeling, the five sectors considered energy-intensive trade-exposed industries that would be eligible for

[49] As was noted in Section VI.A.3, considering both the output-based allocations to "trade-vulnerable" industries and the indirect benefit those industries would receive from the LDC allocations, the number of allowances set aside for these allocations exceed the 2006 emissions of the "presumptively eligible" industries. Whether there are, in fact, sufficient allowances to cover eligible industries emissions in the future will depend on whether additional industries are found to be eligible, and on future trends in the eligible industries' emissions. While future increases in output would tend to increase their emissions, continued reductions in the emission intensity of their production would have the opposite effect. Moreover, the emissions estimates depicted in Figure 13 reflect 2006 levels. Any consideration of the potential for increased emissions in the future resulting from increased production levels would therefore need to consider the effects of the recent economic recession on production levels.

output-based allocations are: chemicals, rubber, and plastics; pulp, paper, and print; nonmetallic minerals; iron and steel; and nonferrous metals. These aggregated sectors encompass 37 of the six-digit NAICS industries that are likely to be deemed “presumptively eligible” for output-based allocations, as described in Section III (see Table 2). In turn, these 37 industries account for 92 percent of the emissions and output of the “presumptively eligible” industries. The remaining nine industries fall within aggregated GTAP sectors that are not considered to be energy-intensive trade-exposed industries for purposes of the modeling exercise because those nine industries represent such a small fraction of the aggregated GTAP sectors in which they fall.

Because of the aggregation of economic activity in the GTAP database, the sectors considered to be energy-intensive and trade-exposed in the modeling include additional industries beyond just the narrowly-defined “presumptively eligible” six-digit NAICS industries that they include. In certain GTAP sectors, such as iron and steel, the “presumptively eligible” industries account for nearly two-thirds of the economic activity represented by that GTAP sector. However, in other sectors — such as paper, pulp, and print, and nonferrous metals — the “presumptively eligible” industries account for less one-quarter of the economic activity represented by the GTAP sector.

As a result of the aggregated nature of the GTAP sectors, their GHG and trade intensities tend to be lower than the corresponding intensities of the “presumptively eligible” industries within them. Consequently, this particular feature of the modeling may understate the average impacts on the international competitiveness of the “presumptively eligible” industries that would be expected to result from a cap-and-trade program without any mitigating policy measures. As noted previously, other features of the modeling can lead it to overstate these impacts.

Table 2. GTAP Energy-Intensive Trade-Exposed Sectors and Corresponding "Presumptively Eligible" Six-Digit NAICS Industries

GTAP Energy-Intensive Trade-Exposed Sector	GTAP Sector's Trade Intensity[1]	GTAP Sector's GHG Intensity[1]	Estimate of "Presumptively Eligible" Industries' Share of Corresponding GTAP Sector's Output	"Presumptively Eligible" Industries in Corresponding GTAP Sector[2]	Industry's Trade Intensity[1]	Industry's GHG Intensity[1]
Chemicals, Rubber and Plastics	33.1%	1.3%	29.0%	325110: Petrochemical Manufacturing	16.8%	1.6%
				325131: Inorganic Dye and Pigment Manufacturing	43.4%	1.5%
				325181: Alkalies and Chlorine Manufacturing (incl soda ash beneficiation)	29.2%	5.0%
				325182: Carbon Black Manufacturing	25.7%	5.4%
				325188: All Other Basic Inorganic Chemical Manufacturing	58.3%	2.9%
				325192: Cyclic Crude and Intermediate Manufacturing	102.2%	1.2%
				325199: All Other Basic Organic Chemical Manufacturing	49.4%	1.3%
				325211: Plastics Material and Resin Manufacturing	37.8%	1.0%
				325212: Synthetic Rubber Manufacturing	56.8%	1.0%
				325221: Cellulosic Organic Fiber Manufacturing	90.5%	1.9%
				325222: Noncellulosic Organic Fiber Manufacturing	40.3%	2.2%
				325311: Nitrogenous Fertilizer Manufacturing	83.0%	18.5%
Pulp, Paper, and Print	11.7%	0.7%	24.3%	322110: Pulp Mills	90.3%	1.8%
				322121: Paper (except Newsprint) Mills	17.1%	1.9%
				322122: Newsprint Mills	67.7%	5.1%
				322130: Paperboard Mills	25.1%	2.9%
Nonmetallic Minerals	19.7%	2.7%	30.8%	327111: Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories Mfg.	59.9%	1.8%
				327112: Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing	94.0%	1.4%
				327113: Porcelain Electrical Supply Manufacturing	40.7%	1.3%
				327122: Ceramic Wall and Floor Tile Manufacturing	69.0%	2.4%
				327123: Other Structural Clay Product Manufacturing	26.9%	3.5%
				327125: Nonclay Refractory Manufacturing	45.5%	1.7%
				327211: Flat Glass Manufacturing	51.1%	2.5%
				327212: Other Pressed and Blown Glass and Glassware Manufacturing	58.3%	3.7%
				327213: Glass Container Manufacturing	20.9%	2.4%
				327310: Cement Manufacturing	18.6%	15.9%
				327410: Lime Manufacturing	3.7%	33.0%
				327992: Ground or Treated Mineral and Earth Manufacturing	16.8%	3.0%
				327993: Mineral Wool Manufacturing	18.1%	1.5%
Iron and Steel	21.9%	2.3%	63.6%	331111: Iron and Steel Mills	33.3%	2.6%
				331112: Electrometallurgical Ferroalloy Product Manufacturing	77.0%	6.1%
				331210: Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	N/A	0.6%
				331511: Iron Foundries	15.4%	1.6%
Nonferrous Metals	34.3%	1.4%	22.9%	331311: Alumina Refining	69.7%	9.0%
				331312: Primary Aluminum Production (GHG intensity reflected in Alumina Refining)	64.1%	
				331411: Primary Smelting and Refining of Copper	54.6%	0.3%
				331419: Primary Smelting and Refining of Nonferrous Metal (except Copper and Aluminum)	135.4%	1.9%

Notes:

1. Trade and GHG intensities are calculated in the same manner as in Table 1.

2. Nine of the "presumptively eligible" industries fall within other GTAP sectors that are not considered energy-intensive trade-exposed sectors in this modeling based on the energy and trade intensity of the vast majority of economic activity in those sectors. These nine industries account for less than eight percent of the total emissions and shipments of all "presumptively eligible" industries.

D. Assessment of a Cap-and-Trade Program's Impacts on International Competitiveness and Associated Leakage under Alternative Policy Scenarios

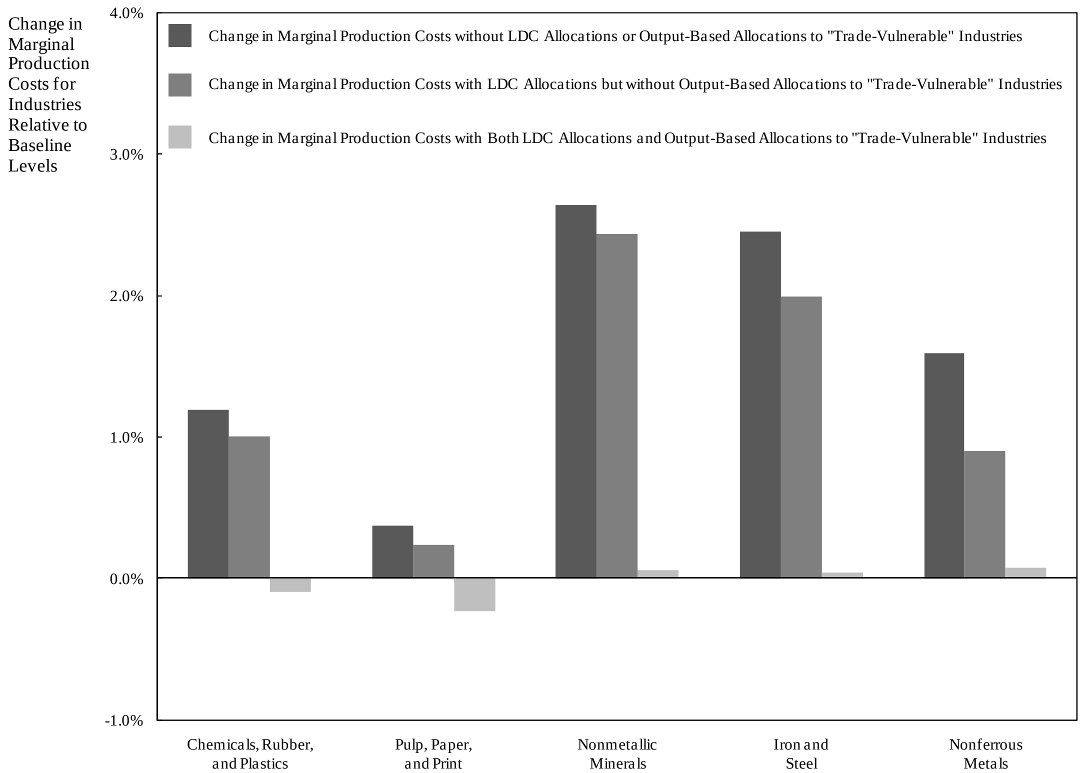
A cap-and-trade program's impacts on the international competitiveness of energy-intensive trade-exposed industries and the resulting emission leakage flow from the program's effects on the production costs of those industries. The greater a cap-and-trade program's net impact on domestic industries' production costs relative to their foreign competitors, the greater will be the resulting competitiveness impacts and leakage. In light of this, the discussion below first focuses on the net impacts of a cap-and-trade program on the production costs of domestic industries, as well as the efficacy of both the output-based allocations and the LDC allocations in mitigating those impacts. The discussion then proceeds to examine the changes in trade flows and emission leakage that would result without the output-based allocations and LDC allocations, and then those changes that would result with those allocations.

1. Effectiveness of LDC Allocations and Output-Based Allocations in Mitigating a Cap-and-Trade Program's Impacts on Industries' Domestic Production Costs

Figure 14 depicts the projected change in marginal production costs in each energy-intensive trade-exposed sector resulting from a cap-and-trade program with a $20 allowance price under three different policy scenarios. The dark gray bar on the left of each cluster shows the change in production costs without LDC and output-based allowance allocations. Differences between the changes in production costs depicted in Figure 14 and the GHG intensity measures presented in Table 2 reflect the indirect effects on production costs arising from the cap-and-trade program's broader impacts on the economy. In some cases, these indirect effects lead to greater increases in production costs than suggested by the sector's GHG intensity alone. For example, in addition to experiencing increased energy expenditures, industries that rely on other energy-intensive industries for intermediate inputs, such as cement or steel, may also see their production costs rise from increased costs for these intermediate inputs. In other cases, indirect effects — such as changes in underlying fuel prices or reduced economy-wide demand for key raw materials — can lead to lesser increases in production costs than suggested by a sector's GHG intensity alone. Note that, in this scenario, there is considerable variation in the cap-and-trade program's impacts on the five sectors' production costs, indicative of — though less substantial than — the variation that can also be expected across the more narrowly defined "presumptively eligible" industries, as shown in Figure 5.

The gray bar in the middle of each cluster shows how the introduction of LDC allocation mitigates the increase in production costs experienced by each sector.[50] Note that, while the LDC allocation mitigates impacts on the production costs of all energy-intensive trade-exposed industries, the degree of mitigation varies dramatically, dampening the increase in costs by more than half for the nonferrous metals sector and by just one-tenth for the nonmetallic minerals sector. This variation reflects the different contributions of electricity consumption to each sector's total direct and indirect emissions.

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



The light gray bar on the right of each cluster shows the change in production costs with both LDC allocations and output-based allocations. As this bar indicates, together, the LDC allocations and output-based allocations almost fully offset the cap-and-trade program's impacts on marginal production costs for three sectors, and more than fully offset those impacts for the two remaining sectors.

[50] Consistent with the discussion in Section VI.A.2, the LDC allocation is modeled as covering 80 percent of the indirect emissions associated with electricity consumption.

Some have suggested that the LDC allocations and output-based rebates will be insufficient to fully mitigate the increase in production cost borne by energy-intensive trade-exposed industries even if the output-based rebates are provided at a rate equal to each sector's average emission-intensity. The rationale given for this argument is that these allocations will not directly address the cap-and-trade program's *indirect* impacts on industries' production costs, such as through effects on underlying fuel prices (*e.g.*, driven by a change in overall demand for natural gas and other fuels) or on the prices of key inputs other than energy.

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. At least two factors explain this conclusion. First, while some indirect effects of a cap-and-trade program can increase its effect on the production costs of affected industry, others, such as reductions in the nationwide demand for certain fossil fuels, can dampen a program's impacts on these industries' production costs. Second, in addition to the direct benefits that these allocations provide to recipients, they also provide indirect benefits, such as through their effects on the prices that industries face for various emission-intensive raw materials (*e.g.*, steel). Of course, under alternative assumptions regarding the factors that drive a cap-and-trade program's broader economic effects, such as its impacts on underlying fuel prices, modeling may find that the output-based allocations do not fully offset the cap-and-trade program's impacts on affected industries' production costs. But, regardless, output-based allocations at a rate equal to the average emission intensity of an industry's production will clearly mitigate the vast majority of impacts on manufacturers.

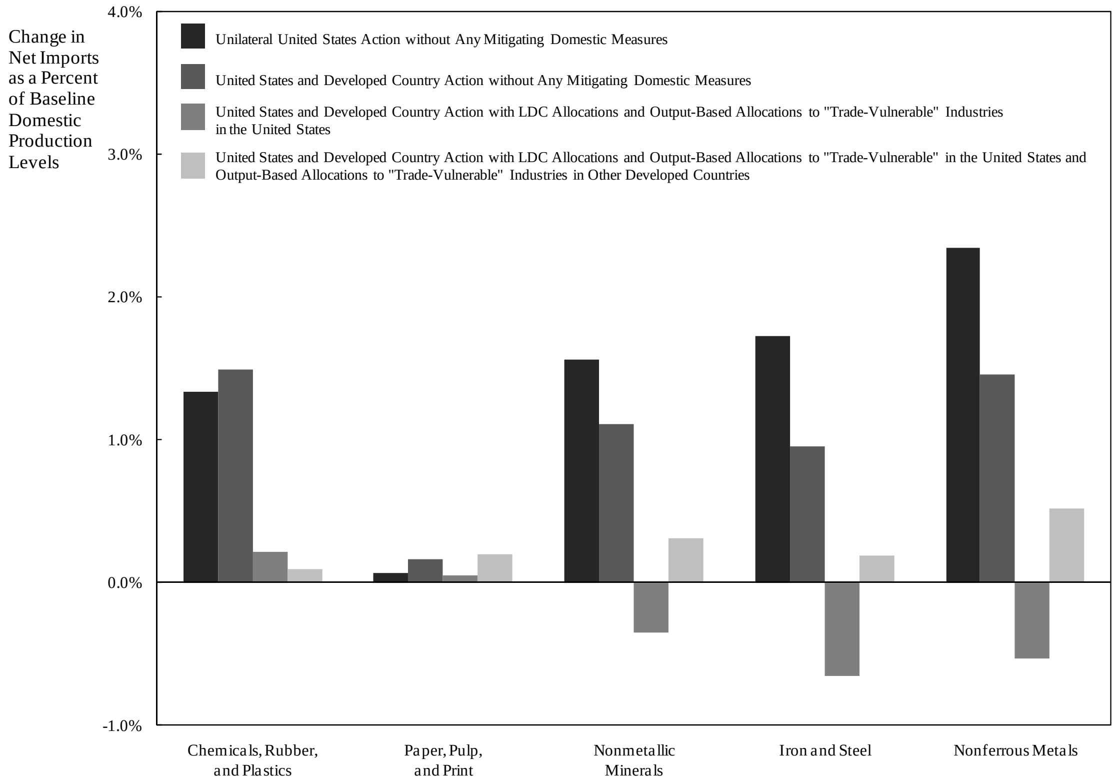
It should also be noted that, while the rightmost gray bars depict the combined effect of both the LDC allocations and the output-based rebates, it would be possible to achieve the same effect on energy-intensive industries' production costs through output-based rebates alone if those rebates were provided at a rate that addressed all indirect emissions, and not just the residual emissions left unaddressed by the LDC allocations. This would circumvent the potentially challenging task of evaluating the effective benefit that firms receive from LDC allocations and deducting this benefit from the output-based rebates. Indeed, H.R. 2454 is written so that the output-based rebates will increase to the extent the LDC allocation is reduced, though greater reliance on these rebates to cover firms' indirect emissions may require adjusting the total number of allowances set aside for output-based rebates, as can be seen in Figure 13.

2. Effectiveness of LDC Allocations and Output-Based Allocations in Mitigating a Cap-and-Trade Program's Impacts on Changes in Trade Flows that Can Give Rise to Leakage

While the previous discussion showed that H.R. 2454's allocations to LDCs and "trade-vulnerable" industries can fully mitigate a cap-and-trade program's impact on the domestic production costs of energy-intensive trade-exposed industries, we now examine how well these allocations mitigate impacts on trade flows that give rise to leakage. Figure 15 summarizes the effect of different combinations of U.S. and developed country cap-and-trade and allocation policies on U.S. net imports of the goods produced by energy-intensive trade-exposed industries. In this figure, changes in net imports are expressed as a share of domestic U.S. production. Each of the five industries is shown as a separate cluster of bars, with bars in each cluster representing different assumptions about U.S. and developed country policies. As a starting point for understanding impacts, the leftmost (black) bar in each cluster shows the impact of the United States acting alone without any mitigating measures. While this scenario is not realistic — given that, among other considerations, the European Union has already adopted a cap-and-trade program — this is the scenario that is examined in many prior analyses of competitiveness impacts of a domestic cap-and-trade program.

Consistent with other studies of these industries discussed at the beginning of this section, Figure 15 shows an increase in net imports on the order of 1 to 2 percent of total domestic production if other developed countries do not take action to reduce their emissions and if no domestic measures are adopted to mitigate the cap-and-trade program's competitiveness impacts. In reality, most developed countries are taking or plan to take action to reduce greenhouse gas emissions through cap-and-trade or other market-based mechanisms, and this significantly reduces the international competitiveness impacts of a domestic cap-and-trade program. The second bar in each cluster shows the impact on net imports with the more realistic assumption of action by all developed countries. For industries with significant baseline levels of net imports — non-metallic minerals, iron and steel, and nonferrous metals — action by other developed countries reduces the impacts of a U.S. cap-and-trade program on net imports by one-quarter to one-half.

Figure 15. Changes in Total Net Imports of Energy-Intensive Goods under Alternative Policy Scenarios



We now turn to the effect of the allocations to LDCs and "trade-vulnerable" industries. In Figure 15 the right two bars in each cluster show what happens when we apply these mitigation measures in the case of action by all developed countries. We present two scenarios: one with LDC and output-based allocations in the United States alone (third bar), and another (the last bar) where other developed countries also employ output-based allocations for the "trade-vulnerable" industries at a rate equal to the average emissions-intensity of recipient industries' production. The two different scenarios reflect uncertainty regarding how the effects of existing and proposed allocation approaches in other developed countries, particularly in the European Union and Australia, will compare with those expected from the proposed LDC and "trade-vulnerable" industry allocations in H.R. 2454. For example, while the EU ETS is not tying its allocations to energy-intensive trade-exposed industries directly to their on-going production levels, plants will lose their otherwise fixed allocation if they shut down and allocations are also provided to new entrants. By attaching these conditions to allocations, the EU ETS allocations will have some — though not all — of the same effects as the output-based allocations proposed in H.R. 2454.

Overall, regardless of what steps other developed countries take to mitigate competitiveness impacts, the combination of allocations to LDCs and "trade-vulnerable" industries will dramatically reduce a domestic cap-and-trade program's effect on net imports within the energy-intensive trade-exposed industries.[51] As is depicted in Figure 15, if other developed countries do not adopt similar efforts to reduce the impact of climate policies on these industries, then U.S. net imports of these industries' goods could *decline* relative to a baseline in which no countries adopt climate policies. That is, when a U.S. cap-and-trade program includes these mitigation measures, net imports could be *lower* under the cap-and-trade program than they would be if neither the United States nor other developed countries adopted a cap-and-trade program. This result arises primarily from changes in trade flows between the United States and other developed countries that do not have similar policies to mitigate effects on energy-intensive trade-exposed industries.

When all developed countries adopt similar measures to reduce impacts on energy-intensive trade-exposed industries, net imports increase relative to a baseline in which no countries adopt climate policies. However, this increase is between just 0.1 and 0.3 percent of domestic production levels for four of the sectors, and reaches only 0.5 percent of domestic production levels in the iron and steel sector. These residual changes in net imports are a fraction of what would occur in the absence of the mitigation measures (*e.g.*, the left bar in each cluster in Figure 15) and are much smaller than the changes in imports and exports that these industries have experienced over the past decade in response to other economic factors (see Figure 8 and Figure 9).

As shown in Figure 14, the allocations to LDCs and "trade-vulnerable" industries essentially fully offset the cap-and-trade program's impact on the domestic production costs of energy-intensive trade-exposed industries. Consequently, the residual increases in U.S. net imports that occur when all developed countries adopt measures to mitigate competitiveness impacts result from the broader effects of climate policies on energy markets and the global economy, not from the direct impact of a cap-and-trade program's emission allowance

[51] While, in the absence of any mitigating policy measures, a cap-and-trade program's impact on more narrowly-defined industries can be significantly greater than the aggregated impacts shown in Figure 15, allocations to LDCs and "trade-vulnerable" industries can be equally effective in mitigating the vast majority, if not all, of these greater impacts. This point has been demonstrated in prior analyses of competitiveness impacts in the EU ETS (see Figure 12).

requirement on the production costs of energy-intensive trade-exposed industries. One of these broader effects that likely drive the residual changes in U.S. net imports is the effect of climate policies on developed countries' demand for fossil fuels. By reducing this demand, the adoption of climate policies in developed countries can slightly lower global energy prices (*e.g.*, world oil prices). In turn, these changes in world energy prices can affect the production costs of energy-intensive trade-exposed industries in developed and developing countries alike, leading to modest shifts in trade flows between the United States and its developed and developing country trading partners.

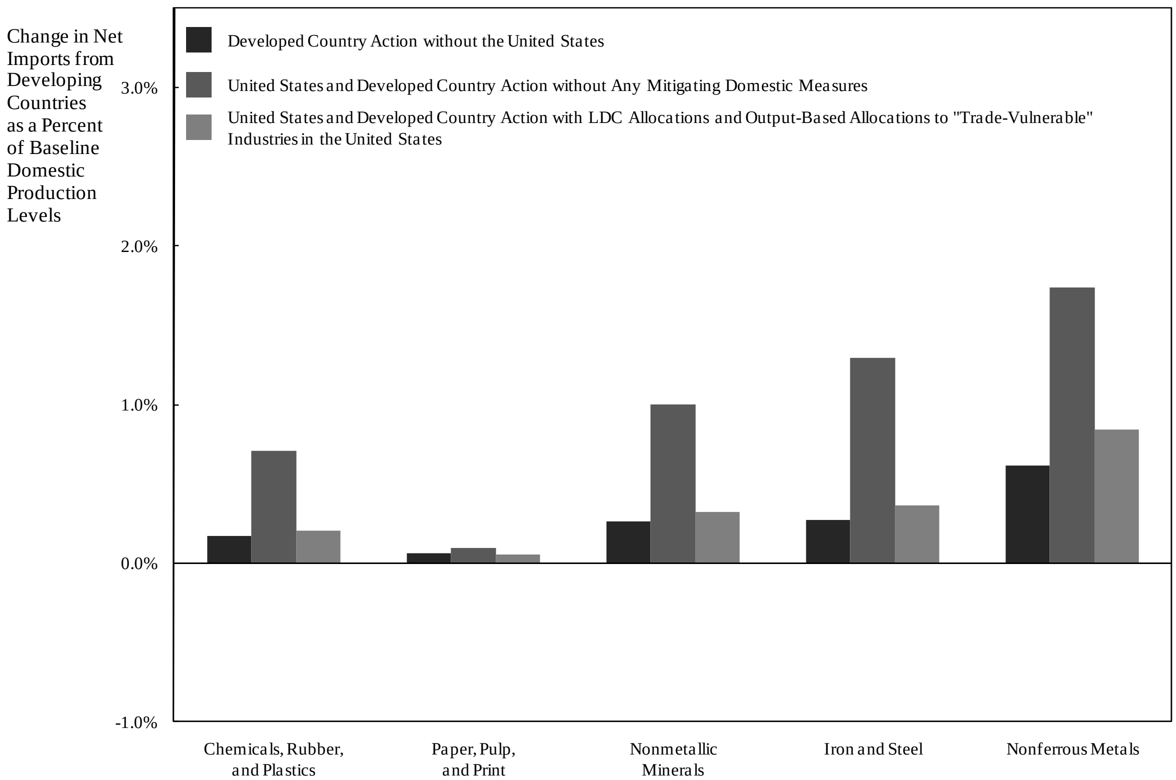
3. <u>Effectiveness of LDC Allocations and Output-Based Allocations in Promoting Real Reductions in Global Emissions from Energy-Intensive Trade-Exposed Industries</u>

Finally, we turn to the effectiveness of allocations to LDCs and "trade-vulnerable" industries in reducing emission leakage from U.S. industry, and thereby enhancing a U.S. cap-and-trade program's ability to achieve real reductions in global emissions. The predominant concern regarding emission leakage associated with a cap-and-trade program's impact on the international competitiveness of U.S. industry is that such a program will lead to a shift in manufacturing activity to developing countries that do not yet have comparable greenhouse gas regulations. In light of this, whereas Figure 15 depicted changes in *total* U.S. net imports, Figure 16 depicts changes in U.S. net imports from developing countries under three alternative policy scenarios.

As was previously noted, other developed countries already have adopted — or likely will soon adopt — mandatory climate policies. Through the broader economic effects that it can have on the global economy and world energy markets, the adoption of climate policies in other countries can have implications for U.S. trade flows even if the United States does not adopt a cap-and-trade program. In light of this, to realistically assess the competitiveness effects of U.S. adoption of a cap-and-trade program, it is important to identify and differentiate those changes in trade flows that are attributable to U.S. policy choices, and those that are attributable to actions that other developed countries have already taken, or may soon take, to reduce their emissions.

To realistically assess the incremental effect of the United States' adoption of a cap-and-trade program on its net imports from developing countries, the first bar in Figure 16 depicts how U.S. net imports from developing countries would change in response to the adoption of cap-and-trade programs *in other developed countries even if the United States itself does not adopt such a program*. Given the current state of, and outlook for, global action to address climate change, this scenario offers a good point of comparison in assessing leakage resulting from the U.S. adoption of a cap-and-trade program in this global context.

Figure 16. Effect of U.S. Adoption of a Cap-and-Trade Program on Net Imports of Energy-Intensive Goods from Developing Countries under Alternative Policy Scenarios



The second bar then shows how U.S. net imports from developing countries would change if the United States joins other developed countries in adopting cap-and-trade programs — still without any mitigating policy measures to address competitiveness impacts.[52] As is made evident by a comparison of the first and second bar in Figure 16, when both the United States and other developed countries adopt cap-and-trade programs, only a portion of the resulting change in U.S. net imports from developing countries depicted in the second bar is attributable to U.S. adoption of a cap-and-trade program. Some portion of that change (the

[52] This bar reflects the same scenario as was presented in the second bar of each cluster in Figure 15. Thus, the second bar in each cluster in Figure 16 shows the portion of the change in total net imports in the second bar in Figure 15 that is associated with changes in net imports from developing countries.

amount depicted in the first bar) would occur even if the United States did not adopt a cap-and-trade program.

Finally, the third bar depicts how U.S. net imports from developing countries change in response to the adoption of cap-and-trade programs in the United States and other developed countries if the United States employs the allocations to LDCs and “trade-vulnerable” industries set out in H.R. 2454. While U.S. net imports from developing countries still increase in the last policy scenario, the allocations to LDCs and “trade-vulnerable” industries offset nearly all of the increase in net imports that can actually be attributed to the U.S. adoption of a cap-and-trade program (the third bar is essentially the same height as the first bar in each cluster). That is, if the United States adopts a cap-and-trade program that includes the allocations to LDCs and “trade-vulnerable” industries, net imports from developing countries in the energy-intensive trade-exposed industries (third bar) will be essentially the same as they would be if developed countries adopt cap-and-trade programs without United States action (first bar).

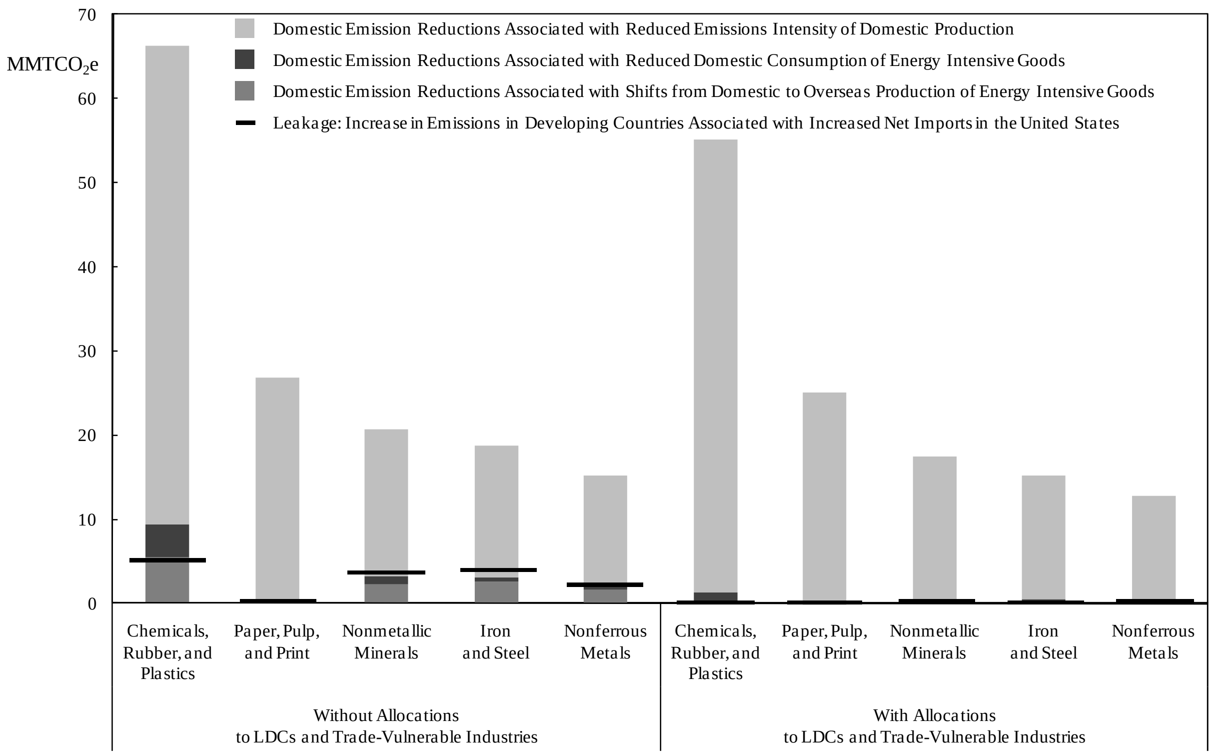
Figure 17 translates the changes in net imports from developing countries depicted in Figure 16 into associated emission leakage, comparing the level of this leakage with total emission reductions in each sector. For the reasons described above, Figure 17 evaluates the effects of a U.S. cap-and-trade program and the mitigating allowance allocations against a baseline in which the other developed countries act with or without the United States.[53] It then shows the emission reductions and emission leakage in each energy-intensive trade-exposed industry that arise from the U.S. adoption of a cap-and-trade program both without (the left-hand side) and with (the right-hand side) allocations to LDCs and “trade-vulnerable” industries.

We start with the estimated emission reductions against which leakage occurs. The emission reductions depicted by the columns in Figure 17 (which reflect both direct emissions and indirect emissions from electricity consumption) are decomposed into those reductions that arise from reductions in the emission intensity of domestic production and those that result from reductions in domestic production levels. In turn, the emission reductions arising from reductions in domestic production are further decomposed into those reductions in domestic

[53] That is, the emission reductions and leakage depicted here reflect the change in emissions and leakage in a scenario in which the United States and other developed countries adopt comparable cap-and-trade programs, relative to the level of emissions and leakage that would result from a scenario in which other developed countries adopt such programs but the United States does not.

production arising from reduced domestic consumption, and those arising from changes in net imports. Finally, the black line overlain on each column depicts emission leakage: the increase in emissions in developing countries arising from the cap-and-trade program's effects on U.S. net imports from developing countries.[54]

Figure 17. Estimated Emissions Reductions and Leakage from U.S. Energy-Intensive Trade-Exposed Industries without and with Allocations to LDCs and "Trade-Vulnerable" Industries



Note: To isolate the effects of U.S. adoption of a cap-and-trade program on domestic emission reductions and leakage, this chart depicts the *incremental* emission reductions and leakage that result from the U.S. adoption of a cap-and-trade program in the context of a policy scenario in which the United States and other developed countries adopt comparable climate policies. Specifically, the emission reductions and leakage depicted here reflect the change in emissions and leakage in a scenario in which the United States and other developed countries adopt comparable cap-and-trade programs, relative to the level of emissions and leakage that would prevail in a scenario in which other developed countries adopt such programs but the United States does not.

Figure 17 shows that the overwhelming majority of emission reductions in the energy-intensive trade-exposed sectors come from reductions in the emission intensity of domestic production (*e.g.*, from more efficient energy use and from fuel switching). This is noteworthy

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[54] There are two reasons why emission leakage, the increase in developing country emissions resulting from increased U.S. net imports from developing countries (depicted by the black line), can differ from the reduction in U.S. emissions associated with changes in U.S. net imports (depicted by the lowest component of each column in Figure 17). First, the reduction in U.S. emissions associated with changes in U.S. net imports reflects changes in total net imports, not just net imports from developing countries. Second, even if one were to isolate the change in U.S. emissions associated with changes in U.S. net imports from developing countries, this will differ from the associated emission leakage if the increase in net imports is from a country where the emission intensity of production differs from that in the United States.

because, as Figure 17 depicts, reductions in the emission intensity of domestic production will occur both with and without the output-based allocations to “trade-vulnerable” industries.[55] By contrast, emission reductions owing to changes in the level of domestic production are relatively small regardless of the allocation approach that is adopted. Absent any mitigating allocations, the left panel shows that leakage (the black line) is a varying share of these reductions, owing to the degree to which lower domestic production reflects increased net imports, the degree to which that change in net imports reflects trade with unregulated developing countries, and the emission intensity of developing country production vis-à-vis U.S. production. Even without the mitigating allocation measures, at just 15 MMTCO$_2$e across all five industries, the overall level of emission leakage associated with shifts in manufacturing activity from the United States to developing countries is quite small relative to the overall level of emission reductions that will be achieved under a domestic cap-and-trade program.

As the right-hand panel in Figure 17 depicts, however, the combination of allocations to LDCs and “trade-vulnerable” industries eliminate effectively all of the emission leakage that would otherwise arise from shifts in manufacturing activity to developing countries following the adoption of a U.S. cap-and-trade program. Of course, while these allocations preserve reductions in the emission-intensity of production that a cap-and-trade program can achieve, they forego opportunities to reduce emissions through reduced domestic consumption of emission-intensive goods, as is evident from the reduction in the size of the dark gray middle component of each column in moving from the left to the right panel. Nonetheless, this modeling suggests that, on average, for every ton of emission reductions from the reduced domestic consumption of emissions-intensive goods that these allocations forego, they avoid three tons of emission leakage.

VIII. Caveats and Next Steps

While this analysis has found that the allocation provisions in H.R. 2454 can effectively mitigate the adverse impacts that a cap-and-trade program might otherwise have on the international competitiveness of — and associated leakage from — industry, a key concern of many stakeholders is that impacts may be more pronounced for more narrowly defined industries

[55] However, as noted previously, the LDC allocations can reduce incentives that a cap-and-trade program would otherwise create for firms to reduce the electricity intensity of their production.

that have even higher emission intensities and/or trade sensitivities. However, the ability of output-based allocations to mitigate these impacts is relatively robust, hinging primarily on the ability of the allocation level to match an industry's emission level. Indeed, studies examining output-based allocations in the context of more narrowly defined industries in the European Union have come to similar conclusions (see Section V).

As more detailed economic models are adjusted to model climate policies, it may be possible to examine effects on more narrowly defined industries. Effects on individual firms will also vary, depending on their emission intensity relative to the industry average. Survey data could be used to look at intra-industry variation.

While this paper demonstrates that, on a theoretical basis, output-based allocations at the levels proposed in H.R. 2454 can effectively eliminate the competitiveness impacts and associated leakage resulting from the uneven imposition of climate policies throughout the world, the challenges of implementation have not been fully considered here. The conclusions of this paper rest on at least three key assumptions:

- That, in a timely manner, EPA will be able to obtain data from facilities on output levels, electricity use, and emissions associated with electricity use (in addition to data already planned via the Mandatory Reporting Rule);
- That such data can be generated at a sufficiently disaggregated level for EPA to develop meaningful benchmarks for output-based allocations; and
- That LDC allocations will indeed lead to the intended distribution of benefits to industrial firms across the country.

Though we believe these implementation challenges are surmountable, each requires careful consideration. Further discussion is beyond the scope of this paper.

The analysis prepared in this report relies heavily on the Manufacturing Energy Consumption Survey (MECS) that is fielded every four years by the Energy Information Administration. Increasing the frequency and expanding the scope of the MECS could greatly improve future analysis of this sort. Currently, some of the "presumptively eligible" industries are not covered in the MECS, so details about their energy use are not known. Furthermore, increasing the frequency of the survey to every two or three years together with enlarging the sample size would help to better understand how industry energy usage patterns react to changes that might be stimulated by regulations associated with climate change legislation. It would also greatly improve the accuracy of the estimated data.

This report represents a first step in the Administration's engagement on these issues and more work will need to be done both to continue to improve assessments of competitiveness impacts at more disaggregated levels, and to address the various implementation challenges presented by output-based allocations.

Appendix A: Acronyms

ADAGE	Applied Dynamic Analysis of the Global Economy: a dynamic computable general equilibrium model capable of investigating economic policies at the international and U.S. national, regional, and state levels
BAU	Business as usual
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EU ETS	European Union Emission Trading Scheme
GHG	Greenhouse gas
GTAP	Global Trade Analysis Project: a global trade model with a database that contains bilateral trade information for over 40 countries for 50 sectors.
LDC	Local distribution company
MECS	Manufacturing Energy Consumption Survey
$MMTCO_2e$	Million metric tons of carbon dioxide equivalent
MWh	Megawatt-hour
NAICS	North American Industry Classification System
U.S. ITC	United States International Trade Commission

Appendix B: Stakeholders and Other Groups Consulted in Preparing This Report

During the course of preparing this report, the Administration consulted with various stakeholders***** and other groups, including:

Aluminum Association

American Chemistry Council

American Forest and Paper Association

American Iron and Steel Institute

American Materials Manufacturing Alliance

Blue Green Alliance

Center for Clean Air Policy

Compressed Gas Association

Energy-Intensive Manufacturers' Working Group on Greenhouse Gas Regulation

United Steelworkers

World Resources Institute

***** Representatives of individual companies often accompanied representatives of trade associations in meetings with the Administration. Those individual companies are not listed here.

Appendix C: Letter from Senators Bayh, Specter, Stabenow, McCaskill, and Brown

September 11, 2009

The Honorable Carol Browner
Assistant to the President for Energy and Climate Change
The White House
Washington, D.C. 20500

Dear Ms. Browner:

Climate change is one of the most far-reaching economic challenges of our times. With sensible, comprehensive policies, mitigating the worst of its impacts will help create vibrant new industries and jobs, and leave us with a cleaner and more secure world.

Efforts to contain costs for energy-intensive and trade-exposed (EITE) manufacturers, if not properly considered, can harm other industries and raise the costs of reducing emissions for the whole economy. We are writing therefore to request assistance in assessing the EITE provisions in Section 782(e) of the America Clean Energy and Security Act of 2009, H.R. 2454.

First, we are seeking an analysis with the following elements:

1. Determination of which industrial sectors of the economy are likely to be eligible for allowance rebates under the EITE provisions of the bill and how many direct and indirect emissions can be attributed to manufacturing by facilities within these industrial sectors.

2. Assessment of potential competiveness impacts to energy intensive and trade exposed manufacturers if the United States adopts a climate change policy to address greenhouse gas emissions. We recognize that many factors affect competiveness, thus we seek to focus the assessment specifically and exclusively on the potential foreign competition losses from cap-and-trade adoption in the U.S. Such an assessment should make reasonable assumptions regarding the extent to which our trading partners have adopted comparable policies.

3. Identify additional data that, if provided, could improve the assessment of competitiveness impacts and allocation requirements, and greenhouse gas emissions from other countries. We ask that you proactively reach out to industrial stakeholders to determine if they would be willing to provide internal data that could improve the assessment of the impacts on their respective sectors.

4. Incorporate into the analysis other measures, including but not limited to those provisions in H.R. 2454 that may be beneficial to EITE industries, such as industrial energy efficiency incentives, allocations to Local Distribution Companies, and carbon capture and sequestration incentives.

We hope the analysis would also take into consideration results from economic models that capture international trade flows, such as those used by the U.S. Environmental Protection Agency, the Department of Energy, the Energy Information Administration, and the U.S. International Trade Commission. The Departments of Commerce and Treasury and the Office of the U.S. Trade Representative may also have analytical expertise that should be brought to bear on the overall analysis.

Second, industrial constituents have approached us with concerns that the EITE-related datasets referenced in H.R. 2454 contain errors that would result in them being treated contrary to the legislation's intent with regard to eligibility or future allocations. Some industries also claim that despite the output-based rebate, their sectors will still be substantially impacted by the cap-and-trade proposal as a whole. We, however, do not possess the technical capacity to evaluate these claims. Thus, we request that you create a process by which we can direct industrial firms to technical experts within the Administration to evaluate their concerns.

Third, we would like to request a proactive strategy to brief all industry stakeholders on the study, so they can gain a fuller understanding of all the likely provisions of a cap-and-trade bill that may help their industries.

We do not want this request to delay our leadership's desired schedule on climate change legislation. Given the scarcity of time, we therefore see an immediate need to begin work on this request. Schedules permitting, we respectfully request a meeting next week with the appropriate Administration officials and staff to develop a work plan for the points listed above.

Sincerely,

Evan Bayh
Sen. Evan Bayh

Arlen Specter
Sen. Arlen Specter

Debbie Stabenow
Sen. Debbie Stabenow

Claire McCaskill
Sen. Claire McCaskill

Sherrod Brown
Sen. Sherrod Brown

Cc: The Honorable Shara Aranoff, Chairman, U.S. International Trade Commission
The Honorable Steven Chu, Secretary of Energy
The Honorable Timothy Geithner, Secretary of the Treasury
The Honorable Lisa Jackson, Administrator, U.S. Environmental Protection Agency
The Honorable Ron Kirk, Ambassador, U.S. Trade Representative
The Honorable Gary Locke, Secretary of Commerce
The Honorable Richard Newell, Administrator, Energy Information Administration

Appendix D: Corrections Made to Report After Its Original Release

As described below, the report has been revised on February 23, 2010 to reflect revisions and corrections to data that were included in the original release of the report.

Revisions to emission estimates for the “presumptively eligible” industries

Together, the below revisions led to a net reduction in the estimate of the “presumptively eligible” industries’ total 2006 emissions from 746 to 730 $MMTCO_2e$. The changes in emission estimates are reflected in updated versions of Tables 1 and 2, and Figures 2, 3, 5 and 13.

- Revisions to 2006 MECS energy consumption estimates for certain industries led to a 5 $MMTCO_2e$ increase in total emissions across those industries.

- A correction to the natural gas emission factor applied to MECS estimates of industries’ natural gas consumption reduced the estimate of the “presumptively eligible” industries’ total emissions by 30 $MMTCO_2e$.

- Incorporation of newly-released 2007 Economic Census data for NAICS mining sectors 212210 and 212234 led to a 10 $MMTCO_2e$ increase in the estimate of those industries’ total emissions. Incorporation of the data also led to changes in those industries’ economic, energy-intensity, and trade-intensity data presented in Table 1 and Figures 2 and 3.

Incorporation of newly-available MECS-based emission estimates for several industries that are not deemed “presumptively eligible”

The incorporation of newly-available emission estimates, based on the 2006 MECS, for several industries that are not deemed presumptively eligible is reflected in emission estimates presented in Figures 2 and 3.

Correction to reporting of industries’ indirect emissions in the economic modeling in Section VII

A correction to how FFEAT model output is translated into estimates of each sector’s indirect emissions (i.e., emissions associated with electricity consumption) led to changes in the modeled sectors’ GHG intensity measures in Table 2, and to changes in the emission reduction estimates presented in Figure 17. This correction related only to the reporting of modeling results, and did not affect the modeling itself. No new modeling was performed in making this correction.

Corrections to text of the report

The above corrections to data resulted in the following corrections to text of the report:

Page 2, Line 13: "746" replaced with "730"

Page 12, Line 3: "746" replaced with "730"

Page 12, Line 5: "11" replaced with "10"

Page 12, Line 9: "over half" replaced with "half"

Page 12, Line 10: "over three-quarters" replaced with "three-quarters"

Page 12, Footnote 8, Line 4: "eight" replaced with "ten"

Page 12, Footnote 8, Line 5: "3%" replaced with "6%"

Page 12, Footnote 9, Line 4: "95%" replaced with "90%"

Page 13, Line 5: "20" replaced with "19"

Page 49, Line 4: "94" replaced with "92"

Page 61, Line 9: "13" replaced with "15"

Page 61, Lines 22-23: "2.5" replaced with "three"