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Introduction: How Climate and Competitiveness Fit Together

> *The Senate strongly believes that the proposals under negotiation, because of the disparity of treatment between Annex I Parties and Developing Countries and the level of required emission reductions, could result in serious harm to the United States economy, including significant job loss, trade disadvantages, increased energy and consumer costs. . . .*
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> — Byrd-Hagel Resolution (S Res 98), July 1997

During the final year of climate negotiations leading up to the signing of the Kyoto Protocol in December 1997, the US Senate, on a vote of 95–0, unanimously passed the Byrd-Hagel resolution—sponsored by Senators Robert Byrd (D-WV) and Chuck Hagel (R-NE)—voicing concern that a US commitment to cap greenhouse gas emissions would be unfair and ineffective unless developing countries took similar steps. The sense of the Senate instructed the US administration not to sign onto the protocol unless it mandated "new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period." The agreement that emerged from Kyoto did not meet that test and was never submitted to the US Senate for ratification.

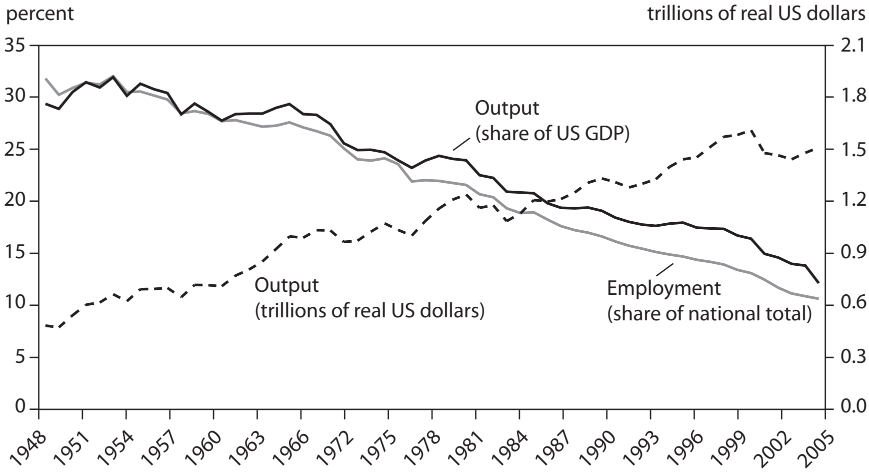
In the decade since the Kyoto Protocol was signed, attitudes toward climate change in the United States have shifted dramatically. The Fourth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC), released in 2007, brought a new sense of certainty that the Earth's temperature is warming as a result of human activity. Discussion in the press, through documentary film and by advocacy groups, has expanded public awareness of the policy challenge global climate change presents. In state houses around the country, legislators have begun tackling those policy issues at a local level, and strong popular support for nationwide action has prompted dozens of hearings in both the House of Representatives and Senate. Yet as the US Congress starts drafting federal climate legislation, many of the same concerns raised about the Kyoto Protocol are still front and center in the policy debate. Specifically,

- concern that a climate regime that omits greenhouse gas emissions caps on some large emitters will be *environmentally ineffective,* as rapid growth in major emerging economies will render emissions reductions in the United States irrelevant; and
- concern that the US economy will suffer from the *loss of investment, market share, and jobs* in industrial sectors sensitive to the additional cost of reducing carbon emissions.

Progress made in international climate negotiations suggests that post-Kyoto agreements (to take effect in 2013) will ask more of developing countries than the Kyoto Protocol did. Yet commitments will likely vary considerably by country, given differences in levels of economic development, political conditions, obligations stemming from historic emissions, and responsibilities arising from future emissions. The question for US policymakers drafting legislation today is how to address domestic concerns during a period of uncertainty about the shape of the multilateral framework to come. Of particular concern is the effect climate policy would have on carbon-intensive US manufacturing. Many of these industries are already under pressure from international competition, particularly large emerging economies such as China, India, and Brazil that are not bound to reduce emissions under the current international climate framework. As the US Congress takes up domestic climate legislation, policymakers are looking for ways to avoid putting US carbon-intensive manufacturing at a competitive disadvantage vis-à-vis countries without similar climate policy, lest a decline in industrial emissions at home is simply replaced by increases in emissions abroad.

In considering measures to level the playing field for carbon-intensive US manufacturing industries under a domestic climate regime, policymakers seek to (1) prevent a decline in output by US producers in the face of higher costs, (2) guard against "emissions leakage" (migration of US industrial emissions to other parts of the world) from a loss of market share to more carbon-intensive foreign producers, and (3) create incentives for other countries to reduce emissions. This book evaluates the effectiveness of a wide range of policy options in achieving these goals as well as their impact on other industries, the overall environmental effectiveness and economic efficiency of domestic climate policy, and the prospects for reducing emissions internationally.

Figure 1.1 Manufacturing's declining role in the United States, 1948–2005



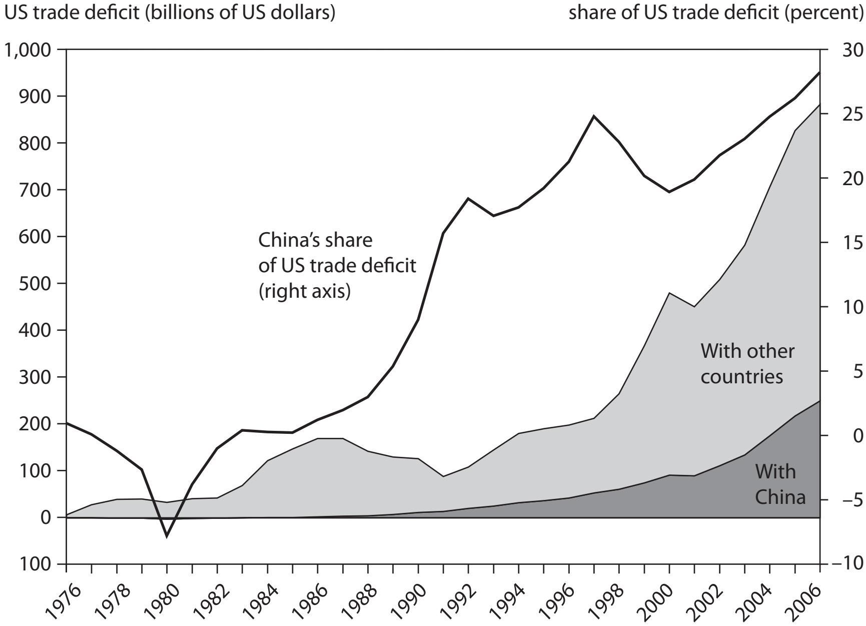
Sources: US Department of Commerce, Bureau of Economic Analysis, Industry Economic Accounts, 2007; US Department of Labor, Bureau of Labor Statistics, Current Employment Statistics Survey, 2007.

Background

Several recent studies have attempted to quantify the impact of various US climate policy scenarios on the US economy. Estimates of the change in overall economic output in 2030 range between 0.5 percent above and 1.5 percent below the projected baseline, depending on how the policy is designed (Paltsev et al. 2007; EIA 2007a, 2007b; Murray and Ross 2007; Aldy 2007). The cost incurred by assigning a price to greenhouse gas emissions will not be distributed evenly, and policymakers are concerned that the manufacturing sector will be particularly hard hit.

Manufacturing contributed \$1.5 trillion to the \$12.5 trillion in total US GDP in 2005. While in absolute terms, manufacturing-sector output expanded by 50 percent over the past three decades, its growth was much slower than that of the economy as a whole. As a result, the manufacturing sector's share of US GDP has declined since 1975, from 23.3 to 12.1 percent in 2005 (figure 1.1). Employment in manufacturing has seen both a relative and absolute decline, with the sector shedding 5 million jobs since the late 1970s. The past decade has been particularly rough on US manufacturing, with overall output stagnating and employment falling by 17 percent while nationwide GDP and employment have grown by 37 and 14 percent, respectively.

Figure 1.2 US trade deficit and China's share, 1976–2006



Source: United Nations Comtrade database, 2007.

The expansion of international trade looms large in the public discourse on the fate of American manufacturing. While trade liberalization has added between $800 billion and $1.5 trillion to the US economy as a whole, it has also put domestic industries under increased pressure from overseas competition (Bergsten and the Institute for International Economics 2005). And while technological change may have contributed more to the decline in manufacturing employment in recent years, an expanding US trade deficit is a very visible and politically powerful symbol of the difficulties facing American producers. Of particular concern to US manufacturers is the competitive challenge presented by Asia, in particular China. The US-China bilateral trade deficit has grown from $40 billion to $250 billion over the past decade (figure 1.2), prompting congressional hearings, new legislation, and trade complaints lodged both domestically and with the World Trade Organization (WTO).

The climate debate is taking place against this backdrop of heightened anxiety over globalization in general and US-China trade in particular. While there is growing support for US federal climate policy, a number of manufacturing companies and industrial unions have expressed concern that such policy could disadvantage American producers vis-à-vis foreign competition and put further strain on industries already under significant cost pressure.[1] In addition, the largest source of anxiety for American manufacturers—China—now rivals the United States as the world's largest source of annual carbon dioxide (CO_2) emissions. And while the majority of the emissions added to the atmosphere over the past century came from the industrialized world, the United States in particular, over the next century the majority will come from the developing world, China in particular. If the developed world acts alone, US policymakers fear that their industry, and the corresponding emissions, may just pack up and relocate to countries with lower carbon costs, thus undermining the policy's effectiveness.

In response to these concerns, many policy proposals currently being considered attempt to level the playing field for those manufacturing industries particularly vulnerable to cost increases that would result from reducing greenhouse gas emissions, by either lowering costs for domestic producers or raising costs for foreign producers.

Identifying Vulnerable Industries

Before discussing the policy options for addressing competitiveness and emissions leakage, it is important to clarify which industries in the United States are most vulnerable. To date, analysis on this point has been fairly limited. Charging firms for the CO_2 they emit through a carbon tax or limiting the total allowable emissions through a cap-and-trade system will increase the price of carbon-intensive energy. (For an overview of these two approaches to domestic climate policy, see box 1.1.) The degree to which increased energy costs translate into a decline in industrial output and employment depends on four variables:

1. *energy intensity of production*: The impact of rising energy prices on a given firm is determined, in part, by how significant energy is as a share of total production costs. For relatively energy-intensive industries like steel and cement, energy purchases account for between 10 and 20 percent of total costs, while for transportation equipment (e.g., cars and trucks) and electronics manufacturing, energy accounts for less than 1 percent (table 1.1).
2. *potential for efficiency improvement*: The extent to which increased energy prices translate into higher overall production costs is determined by the firm's ability to improve the energy efficiency of production through technological improvement.

1. Andrew G. Sharkey III, American Iron and Steel Institute, statement before the Environment and Public Works Committee, US Senate, November 13, 2007; Robert C. Baugh, executive director AFL-CIO Industrial Union Council and chair, AFL-CIO Energy Task Force, testimony before the Environment and Public Works Committee, US Senate, November 13, 2007.

Box 1.1 Carbon tax versus cap and trade

When considering limitations on greenhouse gas emissions, policymakers have typically focused on two market-based regulatory mechanisms: taxes and caps with trading.

A carbon tax directly associates a price to the carbon content of fossil fuels—coal, petroleum products, and natural gas—used for electricity generation, transportation, residential and commercial space heating, industrial processes, and other activities. A carbon tax makes carbon-intensive activities and consumption more expensive, encouraging behavioral changes such as fuel switching, reduced consumption, and infrastructure investments in low-carbon technologies. Taxing negative externalities, generally preferred by economists, addresses emissions throughout the entire economy. As a result, a tax incentivizes the most cost-effective reductions available in every sector while minimizing regulatory involvement. Moreover, it provides some economic certainty for industry regarding the cost of the program, as the price of carbon is clearly set at the outset. Economic certainty, however, comes at the expense of environmental certainty: It is unknown how much carbon mitigation will take place at a fixed price. Finally, as it generates revenue for government, a carbon tax helps reduce the tax burden on "goods" such as employment and income, increasing overall economic efficiency. For instance, the United Kingdom's climate change levy is offset against employer taxes on labor, thus lowering the marginal cost of employment.

Another approach is for the government to set a target emissions level (cap) and allow firms to buy and sell (trade) permits under this cap. The government issues pollution permits corresponding to the cap through either free allocation or auction. In comparison to a tax, a cap provides greater environmental certainty, as the government sets the allowed level of greenhouse gas emissions. Conversely, there is less price certainty: Allowance prices are set by the market and fluctuate in line with demand for permits. Initially employed in the United States to reduce sulfur dioxide emissions, such a regulatory approach to carbon mitigation is currently in place in Europe, where the EU Emissions Trading Scheme began in 2005. Where allowances are auctioned, revenue can accrue to the government or can be earmarked to particular expenditures or tax cuts, as with a carbon tax. Where they are allocated for free, increased costs tend to lead to windfall profits in the power sector, as shown by the European Union's experience.

These approaches are not incompatible. A number of countries, particularly in Europe, use both carbon taxes and cap and trade.

Table 1.1 Manufacturing-sector energy demand by industry, 2002

Industry	Share of total manufacturing energy demand (percent)	Energy costs as share of value (percent)	Energy costs per employee (US dollars)
Food and beverage	5.42	1.49	5,324
Textiles	1.18	2.40	4,747
Apparel	0.16	1.01	1,202
Wood products	1.66	1.66	2,930
Paper	10.43	7.27	24,082
Pulp mills		21.73	95,881
Paper mills, except newsprint		9.74	45,037
Newsprint mills		18.89	90,430
Paperboard mills		17.30	76,458
Printing	0.43	1.38	1,914
Petroleum refineries	28.20	7.39	231,865
Chemicals	28.52	4.28	24,268
Petrochemicals		12.39	268,881
Alkalies and chlorine		31.79	146,205
Carbon black		15.50	84,495
Other inorganic chemicals		6.87	24,396
Basic organic chemicals		11.47	67,194
Plastic materials and resins		7.16	43,962
Nitrogenous fertilizers		19.19	152,334
Pharmaceuticals and medicines		0.66	4,356
Nonmetallic mineral products	4.67	5.45	11,347
Glass		6.06	12,255
Cement		16.58	71,296
Lime		23.23	57,016
Ferrous metals	6.47	8.81	30,039
Iron and steel mills		11.62	47,207
Iron foundries		6.44	10,237
Nonferrous metals	2.72	4.79	13,570
Primary aluminum smelters		19.83	83,222
Aluminum foundries		3.51	6,074
Other nonferrous metals		2.87	9,598
Fabricated metal products	1.71	1.77	2,685
Machinery	0.78	0.80	1,792
Computers and electronics	0.89	0.46	1,304
Electrical equipment	0.76	0.68	1,445
Transportation equipment	1.89	0.60	2,396
Furniture and related products	0.28	0.79	1,003

Source: US Department of Energy, Energy Information Administration, Manufacturing Energy Consumption Survey, 2002.

3. *ability to switch to low-carbon energy sources*: In addition to reducing the amount of energy required per unit of output, firms can also reduce carbon costs by switching to less carbon-intensive fuel sources.

4. *product demand elasticity*: The degree to which energy price increases not mitigated through efficiency improvements or fuel switching affect performance of a given industry is determined by the firm's ability to pass along costs to consumers. The "demand elasticity" of a given product to changes in price depends on the availability of substitutes—either the same good from a foreign producer or a different but interchangeable good from any producer.

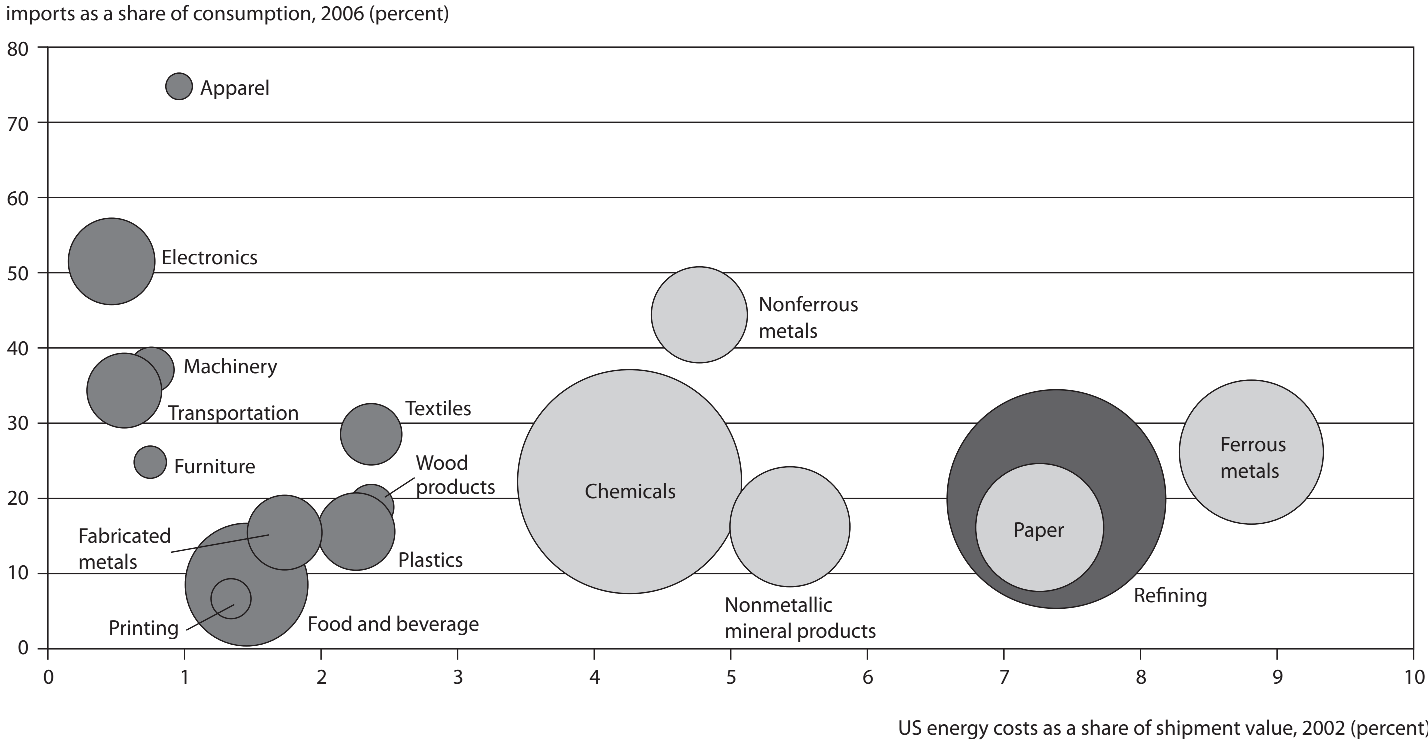
The relative importance of these factors in determining the fate of an industry relies a great deal on timing. In the short term, most firms have limited ability to improve the efficiency of capital stock or switch to alternative sources of energy. How much of the energy cost increase the firm must absorb then depends on the immediate availability of substitutes for the firm's products. Over the medium and long terms, firms have greater ability to seek out lower-carbon fuel sources and develop more energy-efficient technology.

Figure 1.3 provides a rough layout of the exposure to increased carbon costs among manufacturing industries based on two of the four variables listed above. On the X-axis we rank the energy intensity of production in terms of energy costs relative to final sales value. The Y-axis shows the degree to which foreign substitutes are available in the market (measured in terms of imports as a share of consumption), which has direct bearing on domestic firms' ability to pass increased costs on to consumers. In chapter 3, we analyze where these imports come from and how carbon-intensive foreign production relative to US production is for each industry. The size of the bubbles indicates total CO_2 emissions from the industry grouping in 2002.

At the broadest level of industry classification, the six most energy-intensive US manufacturing industries are petroleum refining, paper and pulp, nonmetallic mineral products, chemicals, and ferrous and nonferrous metals. On average, these capital-intensive industries are less exposed to international trade than their labor-intensive peers like apparel, electronics, textiles, furniture, and machinery. That said, there are notable differences among the six: Imports account for more than 40 percent of demand for nonferrous metals, like aluminum and copper, significantly higher than the 13 to 15 percent import dependency in paper, with steel and chemicals in between at 23 and 22 percent, respectively. Even nonmetal mineral products (e.g., cement and glass), despite high weight-to-value ratios, are more exposed to trade than food, plastics, printed goods, and fabricated metals. In volume terms, the United States today imports roughly 25 percent of the cement it consumes.

This book focuses on these carbon-intensive industries, with the exception of petroleum refining, which is treated separately under most policy

Figure 1.3 US industry exposure to climate costs based on energy intensity and imports as a share of consumption



Note: The size of the bubbles indicates the total CO_2 emissions from the industry in 2002.

Sources: US Department of Commerce, Bureau of Economic Analysis, Industry Economic Accounts, 2007; US Department of Energy, Energy Information Administration, Manufacturing Energy Consumption Survey 2002.

proposals.[2] Combined, they account for more than half of all CO_2 emissions from manufacturing in the United States, though a considerably smaller share of total nationwide employment or economic output (table 1.2).

Resources for the Future (RFF) in Washington is engaged in an ongoing effort to quantify the impact of US climate policy on output from these industries through modeling and econometric analysis (Herrnstadt et al. 2007). Two initial studies, using different approaches, find that imposing a $10 per ton charge for CO_2 in the United States, but not in other countries, would result in a 0.5 to 6 percent decline in output from the carbon-intensive industries mentioned earlier. Work done in Europe on the impact of the EU Emissions Trading Scheme[3] shows a slightly lower decline in output, in part due to the use of free allocation of emissions allowances, of 0.3 to 2.1 percent resulting from a $10 per ton price for CO_2 (McKinsey & Company and Ecofys 2006, Carbon Trust 2007, Hourcade et al. 2007). Our study is intended to complement the quantitative work of RFF and others with a qualitative assessment. For the five industries included in our analysis, we evaluate various options for leveling the playing field for domestic producers under US federal climate policy in light of the nature of their energy needs, trends in global supply and demand, current international trade flows, and differences in the carbon intensity of production between countries and firms.

A Broader View of Competitiveness?

It is important to note that while our discussion, as well as that of the policy community, focuses on the impact of US climate legislation on carbon-intensive industries, it is a fairly narrow interpretation of US competitiveness.

If the world is indeed heading toward a carbon-constrained future, fundamental shifts within the economy to low-carbon energy technologies

2. Under a bill sponsored by Senators Joe Lieberman and John Warner, for example, importers of refined petroleum products are considered regulated entities and are responsible for the greenhouse gasses emitted during the refining process. As such, the competitiveness concerns facing carbon-intensive manufacturing like steel, aluminum, and cement, where imports face no compliance costs unless a trade measure is evoked against the specific country of origin, are less relevant for the refining sector.

3. The European Union launched a cap-and-trade system known as the EU Greenhouse Gas Emissions Trading Scheme (EU ETS) in 2005. It is aimed at reducing CO_2 emissions by capping the level of emissions allowed and distributing tradable allowances to industrial emitters. It is the first of its kind and is the world's largest multicountry, multisector greenhouse gas emissions trading scheme. It covers over 11,500 energy-intensive installations across the European Union, which represent close to half of Europe's emissions of CO_2. These installations include combustion plants, oil refineries, coke ovens, iron and steel plants, and factories making cement, glass, lime, brick, ceramics, pulp, and paper. For more information, see http://ec.europa.eu/environment/climat/emission.htm (accessed March 5, 2008).

Table 1.2 US carbon-intensive industries and key products, 2005

Sector[b]	Direct emissions: Million metric tons of CO_2	Direct emissions: Share of US total (percent)	Total emissions: Million metric tons of CO_2	Total emissions: Share of US total (percent)	Economic output: Billions of dollars	Economic output: Share of US GDP (percent)	Employment: Number of workers	Employment: Share of US total (percent)
Ferrous metals (steel ingots, bars, rods, plates, sheets, and tubes)	36	0.62	96	1.65	36.7[a]	0.29	250,100	0.19
Chemicals (olefins, aromatics, inorganics, and ammonia)	146	2.50	377	6.48	209.20	1.68	872,100	0.65
Nonmetal mineral products (hydraulic cement)	66	1.14	97	1.66	53.30	0.43	505,300	0.38
Nonferrous metals (aluminum ingots, bars, rods, plates, sheets, and tubes)	15	0.25	75	1.29	24.4[a]	0.20	144,200	0.11
Paper and pulp (paper and paperboard, cut and uncut)	64	1.11	159	2.74	54.60	0.44	484,200	0.36
Subtotal	327	5.62	804	13.82	378.20	3.04	2,253,900	1.69
All manufacturing	631	10.85	1,369	23.54	1,512.50	12.14	14,226,000	10.64

a. Bureau of Economic Analysis' "primary metals" category is split into ferrous and nonferrous metals.
b. Products in parentheses are included in this study.

Note: Standard International Trade Classification Codes of included products (version 2): Steel (672, 673, 674, 675, 676, 677, 678, 679), Chemicals (51111, 51112, 51113, 51122, 51123, 51124, 51211, 52218, 52323, 52213, 52251), Cement (6612), Aluminum (6841, 6842), and Paper (641, 642).

Sources: IEA (2007c); US Department of Commerce, Bureau of Economic Analysis, Industry Economic Accounts, 2007; US Department of Labor, Bureau of Labor Statistics, Current Employment Statistics Survey, 2007.

and more efficient practices will be needed. Past experience in renewable energy and efficient vehicle technologies has seen companies profit from strong regulatory environments at home to build competitive advantage abroad. Loose or uncertain policy structures will not serve US companies well in the medium to long term, as other countries will build markets for the products and services that will be required in a low-carbon world. Such concerns have led many major US companies to call for strong mandatory climate policy.[4]

In addition, policymakers should carefully weigh the cost of measures to protect carbon-intensive industry for the economy as a whole. Certain policy options may shield domestic producers of goods like steel, aluminum, and chemicals but do so at the expense of taxpayers, consumers, or downstream industries that rely on those goods and that compete internationally as well. And building US competitiveness in the low-carbon energy technologies needed to stabilize the climate will require not only a clear domestic regulatory environment but also a significant amount of investment in infrastructure, education, and research and development. The economic and fiscal costs of protecting carbon-intensive manufacturing must be measured against these longer-term strategic goals.

Finally, while there are costs associated with US action to reduce carbon emissions, there are also costs associated with inaction or delay. Estimating the financial costs associated with the impacts of climate change is notoriously difficult, but the United Nations Framework Convention on Climate Change (UNFCCC 2007a) calculates that the cost of adaptation globally will run to tens of billions of US dollars per year by 2030. While the poorest countries will disproportionately feel these impacts, the United States will by no means be immune from significant damage (Ruth, Coelho, and Karetnikov 2007).

Though we focus on leveling the playing field for carbon-intensive industries under various US climate policy scenarios, when possible, we assess legislative options in light of their broader costs and impact on overall US economic dynamism.

Options for US Policy Design

The design of US federal climate policy is still in the early stages. While current proposals adopt a cap-and-trade system, there is also support for a carbon tax (box 1.1). Good analysis of the relative strengths and weaknesses of both approaches abounds.[5] This book remains agnostic as to

4. See, for instance, the US Climate Action Partnership's Call to Action at www.us-cap.org.

5. For a good summary of the discussion on a cap-and-trade system versus carbon tax, see Parry and Pizer (2007).

which regulatory system should or will be adopted. We discuss policy options under both systems for dealing with industrial competitiveness and emissions leakage concerns.

Broadly speaking, the principal policy options currently under consideration to level the international playing field for carbon-intensive industries can be divided into three types:

1. *cost containment mechanisms*: aim to reduce the pressure on carbon-intensive industries by limiting the cost of complying with climate legislation, even if it undermines the stated environmental goal.
2. *trade measures*: do not limit costs on the covered companies but seek to indirectly apply similar costs to competing companies in other countries through the treatment of traded goods at the border, so as to reduce competitive disadvantage for domestic companies and to incentivize international harmonization of standards.
3. *coordinated international action*: seek to reduce the pressure on domestic carbon-intensive industries by encouraging major trading partners to impose similar costs on their companies directly.

We discuss each of these options in the following chapters. Chapter 2 looks at the ability of cost containment mechanisms to protect various carbon-intensive manufacturing industries given differences in the energy needs of each. Chapter 3 evaluates the effectiveness of trade measures in doing the same, given the source of US imports and the carbon intensity of US production compared with major trading partners. Chapter 4 addresses the role international agreements can play in leveling the carbon playing field and the likelihood of reaching such agreements through multilateral negotiations. Chapter 5 highlights key conclusions and offers recommendations for US policymakers in light of the assessment made in this book.