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OCCASIONAL PAPER

Evaluating Options for U.S. Greenhouse-Gas Mitigation Using Multiple Criteria

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RAND

Environment, Energy, and Economic Development

A RAND INFRASTRUCTURE, SAFETY, AND ENVIRONMENT PROGRAM

This Occasional Paper results from the RAND Corporation's continuing program of self-initiated research. Support for such research is provided, in part, by the generosity of RAND's donors and by the fees earned on client-funded research.

Published 2009 by the RAND Corporation
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Preface

Choosing a set of policy responses to mitigate greenhouse gases (GHGs) responsible for climate change is one of the great challenges that the United States faces in the coming years. Many policy options emphasize overall cost-effectiveness in reducing GHG emissions. In the search for options that are effective and politically feasible, however, other concerns have comparable importance. Mitigating GHGs in practice will require balancing cost-effectiveness and other objectives that reflect the institutional and political realities of passing major federal legislation with widespread impacts on U.S. producers and consumers.

This paper develops a framework for evaluating GHG mitigation policy in the United States that balances several criteria. It draws on conceptual analysis and examples from U.S. energy policy to motivate an evaluative framework that incorporates a range of views of what constitutes "good" policy. It should be of interest to stakeholders in the GHG policymaking process and especially to those responsible for crafting U.S. climate policy.

This paper results from the RAND Corporation's continuing program of self-initiated independent research. Support for such research is provided, in part, by donors and by the independent research and development provisions of RAND's contracts for the operation of its U.S. Department of Defense federally funded research and development centers.

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Summary

Political support appears to be growing to establish national policies to curb greenhouse-gas (GHG) emissions. Much of the research on different options, particularly in environmental economics, is focused on their overall cost-effectiveness. In the policy arena, however, legislation that relies exclusively on cost-effectiveness as a criterion is probably not going to survive the give-and-take of the political process, especially when the legislation will have such large and differential impacts on a wide variety of producers and consumers.

Environmental-interest groups, elected officials, and the business community have not reached agreement on particular policies to tackle the challenge of substantially reducing GHG emissions. Some interests favor a mechanism to fix the amount of allowable emissions while permitting businesses to buy and sell emission allowances at market-set prices (a *cap-and-trade program*); others advocate for a tax on fossil energy or GHG emissions (a *carbon tax*) or for increased direct regulation. A carbon tax would establish a fixed price for each ton of GHGs emitted but would not establish the total amount of allowable emissions. Direct regulation would prescribe the amounts that power-plant operators, factory owners, automakers, appliance manufacturers, building owners, and others would be allowed to emit. Each of these policies comes with its own set of issues: how to allocate emission permits; which emission sources to tax and at what rates; which sectors to regulate and how; and whether and how to use revenues to assist those disadvantaged by the policies, to finance new energy resource development, or for other purposes.

This paper addresses these concerns by presenting a way to evaluate competing policies using a set of normative criteria. As background for developing these criteria, we reviewed three past attempts to develop policy in the related area of energy consumption, each using a different type of policy. These are the Partnership for a New Generation of Vehicles (PNGV), which involved direct federal investment in new technologies; the BTU (British thermal unit) energy tax, which attempted to tax energy output; and Corporate Average Fuel Economy (CAFE) standards, which regulate energy efficiency in new vehicles. These three initiatives met with varying degrees of success: PNGV produced concept vehicles but dissolved without bringing any to market, the BTU tax failed in Congress, and CAFE was successfully implemented, but the standards remained unchanged for many years.

The lessons drawn from these attempts, both failed and successful, can inform future decisions about the relative merits of certain types of policies—although three examples are not enough to establish these lessons definitively. The need for caution in drawing conclusions is also highlighted by the analytical disagreements surrounding whether taxation or regulation is more effective. Nevertheless, we draw the following general points from our review:

- Investments in technology must be consistent and predictable.
- What to tax is less important in policymaking than who pays the tax.
- It is difficult to achieve multiple goals with a single policy.
- A crisis can present a political opening for making policy that would otherwise fail.
- Technology solutions are easier to pass than price mechanisms because their costs are not explicitly revealed to the public.
- The greater the number of industries affected, the harder it is to pass legislation.
- Once in place, legislation may be hard to change.

Based on this review and additional conceptual reasoning, we developed four normative criteria to evaluate policies. These criteria—cost-effectiveness, fairness of distributional impacts, incentives for innovation, and adaptability of policy—acknowledge a range of important aspects of potential outcomes. Political viability is not separately identified in the list of normative criteria, but it is implicit in the other four. The argument advanced in this study is that it should be possible to modify suggested policy packages along different dimensions of the normative criteria to account for political realities.

We then developed three nominal policy packages—bundles of primary and supporting policies that would be adopted simultaneously—to evaluate against the four criteria. These policy packages are loosely based on existing proposals but are intended solely to illustrate the evaluative framework. The first is a comprehensive carbon tax on all fossil energy, levied on energy producers but assumed to be passed on, in part, to consumers, and whose revenues are used for deficit reduction. This represents the approach most often favored by economists as the most cost-effective. The second is a hybrid cap-and-trade program with free allowances to major fossil-energy users and some upstream suppliers, similar to proposals supported by industry. The third is a package of tighter regulations, including CAFE standards and other energy-efficiency standards in a variety of areas.

The carbon tax with deficit reduction fares best on cost-effectiveness and ranks in the middle on innovation and adaptability but low on distributional fairness and political viability. The inclusion of all energy sources is the main reason for cost-effectiveness. Innovation would be fostered by the market demand for lower-cost technologies, but it would not create a large incentive unless a large levy was imposed. While, in theory, a carbon tax can be raised or lowered, making it adaptable, in practice, adjusting tax rates often encounters resistance. The package is rated low on distributional fairness because deficit reduction does not target specific groups that would be adversely affected by higher energy costs, and it is considered the least politically viable because of its distributional impacts and general resistance to new taxes.

The cap-and-trade program with a significant number of allowances allocated for free shares the rankings of the carbon tax for similar reasons, with the exception that it appears to have higher political viability. This is because cap-and-trade programs with significant allocations of free allowances have been implemented successfully in other sectors to control emissions, and previous bills in Congress have received support from environmental advocates and from energy users who would not have to pay for baseline allowances.

The regulatory package ranks medium on distributional fairness and political viability and low on the other three criteria. Distributional fairness is higher than the other two packages if we assume that regulations will be targeted more heavily toward industries most able to afford investments to reduce emissions. Political viability is medium because, like cap-and-trade, regulations have been successfully introduced and the burden is not perceived to fall directly on consumers. Cost-effectiveness is low because regulations do not necessarily target industries with the lowest reduction costs and because oversight is needed. Innovation and adaptability are also low, since, in both cases, firms are more locked in to particular technological paths.

We next modified all three policy packages to demonstrate how their ratings for political viability could rise through changes in their design without reducing the ratings on any of the four criteria. The carbon tax could become more politically viable with revenue allocated to programs for technology development and adoption, as well as to assistance for low-income consumers or workers displaced from high-emitting industries or fossil-fuel production. Cap-and-trade could become more politically viable if more allowances were auctioned instead of given away and if revenues were used in a manner that addressed burden sharing. Finally, regulations could be coupled with tax credits to assist some industrial sectors. After these adaptations, all policy packages ranked medium or high in all criteria, except that regulations retained a low score on adaptability and remain less cost-effective than the other options.

The paper concludes with some broad recommendations for creating a successful policy package. These include the following:

- While seeking to rely on incentive-based GHG mitigation policy, include burden-sharing mechanisms that are transparent, means-tested, and limited in scope and duration.
- Couple the mitigation policy with a strategic framework for research, development, and demonstration (RD&D) to reduce long-term GHG emissions, including a clear role for public-sector financing from revenues generated by the mitigation policy.
- In making unavoidable and necessary compromises among competing criteria and interests when designing the policy, seek to limit irreversible commitments in order to maintain the ability to adapt to uncertain and changing future circumstances.

Acknowledgments

We thank Katherine Krumme and Martin Wachs for their valuable contributions and feedback.

Abbreviations

API	American Petroleum Institute
BTU	British thermal unit
CAFE	Corporate Average Fuel Economy
CO_2	carbon dioxide
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOT	U.S. Department of Transportation
EEED	Environment, Energy, and Economic Development Program
EISA	Energy Independence and Security Act of 2007
EPA	U.S. Environmental Protection Agency
EPCA	Energy Policy and Conservation Act
FY	fiscal year
GAO	U.S. Government Accountability Office
GDP	gross domestic product
GHG	greenhouse gas
GM	General Motors
IPCC	Intergovernmental Panel on Climate Change
ISE	RAND Infrastructure, Safety, and Environment
MAC	Market Advisory Committee
mpg	miles per gallon
MY	model year
NHTSA	National Highway Traffic Safety Administration

NOx	nitrogen oxide
NSF	National Science Foundation
OSTP	Office of Science and Technology Policy
PNGV	Partnership for a New Generation of Vehicles
R&D	research and development
RD&D	research, development, and demonstration
RD&T	research, development, and technology
RPS	renewable portfolio standard
SO_2	sulfur dioxide
SUV	sport-utility vehicle
UN	United Nations
USABC	U.S. Advanced Battery Consortium

CHAPTER ONE

Introduction

Interest in establishing national policies to limit U.S. emissions of greenhouse gases (GHGs) is evolving rapidly. A number of bills to establish a national emission-control system have been drafted for congressional consideration (Pew Center on Global Climate Change, 2008).[1] Congress also has passed two energy bills that include numerous provisions for increasing energy efficiency and stimulating renewable energy, thereby also reducing the GHG intensity of energy use.[2] Individual U.S. states and regional groups have started establishing their own plans for GHG mitigation.[3] For example, California has begun implementation of Assembly Bill 32, an ambitious GHG-reduction program that many see as offering national lessons for GHG policy. International efforts to extend and strengthen agreements for GHG mitigation are also continuing, as evidenced by negotiations for a successor to the Kyoto Protocol at the United Nations (UN) climate change conference held in December 2008 in Poznan, Poland.[4]

Growing interest in a national GHG-mitigation policy framework has not yet led to agreement on that framework among various stakeholders, however.[5] Most state-level and national programs being developed or under discussion contain a form of cap-and-trade system as a central pillar. Under cap-and-trade, a limit on aggregate emissions is combined with the ability to change individual emission ceilings through buying or selling of emission allowances. An allowance is a specified quantity of GHGs that a source may emit. For example, an allowance may take the form of 100 tons of carbon dioxide (CO_2). Emission sources would be required to own sufficient allowances to match their actual emissions. Cap-and-trade relies on the economic incentives created in this allowance market to reduce emissions, combined with a technically credible approach to monitoring emission sources, to achieve the environmental goal

1 These include the Lieberman-Warner Climate Security Act of 2008 (S.3036), the Low Carbon Economy Act (S.1766), the Climate Stewardship and Innovation Act (S.280), the Global Warming Pollution Reduction Act (S.309), the Global Warming Reduction Act (part of S.309), the Climate Stewardship Act (S.342), and the Safe Climate Act of 2007 (H.R.1590).

2 The Energy Policy Act of 2005 (Pub. L. No. 109-58) and the Energy Independence and Security Act of 2007 (EISA) (Pub. L. No. 110-140).

3 For details, see EPA (2008). Analysis of state and regional plans has been conducted by the Pew Center on Global Climate Change (undated).

4 The Kyoto Protocol is an international agreement that the United Nations Framework Convention on Climate Change adopted on December 11, 1997.

5 This paper uses *policy framework* to denote a broad approach to policy: for example, the primacy of a market-based approach over a regulatory approach. A policy package, discussed in more detail in Chapter Four, is a bundle of specific policies and includes more details, such as how to implement the policy and how to spend any revenue it generates.

(the emission cap) at a lower cost than other regulatory approaches.[6] For this reason, cap-and-trade programs are cost-effective.[7]

Beyond the general interest in cap-and-trade, there are a variety of different perspectives on what a national GHG-control program should contain. Within the general framework of cap-and-trade, there are important differences regarding which emission sources are to be limited and how allowances to emit are to be provided to different entities. For example, should only stationary sources, such as power plants, factories, and buildings, be included and not mobile sources, such as automobiles, buses, and trucks? Should allowances be allocated (given out free of charge)—and, if so, by Congress, the U.S. Environmental Protection Agency (EPA), or states? Or should they be auctioned?

An even more fundamental set of disagreements exists as to what other kinds of regulatory policies should be used to limit GHGs, especially in the transportation sector. A number of environmental organizations, for example, favor adding regulatory measures, such as renewable-fuel and energy-efficiency standards, to a cap-and-trade system in order to improve the environmental stringency of the overall control system.

Differences in views about the design of a GHG-control program are undergirded by differences in views about what a program should contain and what a program can contain. Many observers place cost-effectiveness—the ability to achieve meaningful emission reductions for a reasonable price—at the top of such a list of criteria. However, there are various normative perspectives on what characteristics other than cost-effectiveness are important to include in a GHG-control system. Prominent examples include views about the fairness of a policy system in distributing the cost burdens of GHG-mitigation costs and a control system's ability to stimulate innovation that will pave the way for more stringent controls without major cost increases in the future. In addition to these normative arguments, participants in the debate over GHG-mitigation policy have different views about what kinds of control systems are politically viable, given current attitudes toward climate-change risks and the options available for limiting GHG emissions.

In this paper, we identify several different normative criteria that can be applied to GHG-control systems and examine their implications for how packages of GHG policies might perform against several criteria. To motivate our focus, we note first that much of the focus in the analytical literature on GHG-control options has been on cost-effectiveness; yet, while this criterion is important and accepted in the debate, it is clear that other factors are also relevant. By explicitly considering other factors and the trade-offs or complementarities among them, we hope to provide a richer base for evaluating policy packages. For example, we are interested in highlighting ways that other important policy criteria might be addressed without a major loss of cost-effectiveness.

At the same time, there is much understandable concern among participants in the climate-policy debate as to what, if anything, might be politically viable. Against that backdrop, it is relatively easy to conclude that a policy package capable of being enacted necessarily has some claim on being seen as good. Yet, we know from theoretical reasoning and examples

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[6] Note that incentives come in various forms. Here, we refer to price signals generated by a market-based GHG policy, whereas elsewhere in the paper, we discuss incentives in the context of technology development and adoption, for example. We rely on this broad definition of incentives—general financial motivation—throughout the paper.

[7] By *cost-effectiveness*, we mean the relative cost of reducing a given unit of GHG emissions. For a more formal definition of cost-effectiveness and more information on economic terms, see Keohane and Olmstead (2007).

of other policy debates that normative criteria for good policies and practical criteria for viable policies do not always overlap in significant ways. By examining a range of normative criteria that we believe are important to consider in evaluating alternative packages of GHG policies, we hope to provide analytical support to policies that may do reasonably well at addressing a range of concerns. While such policies may be slower and more difficult to put in place, they also make better use of society's economic and political resources and thus are more robust over time. This is an important consideration, in that the initial design of GHG policy will have long-term implications for its effectiveness, and GHG mitigation to limit damages from climate change is inherently a long-term, adaptive process.

We first review three previous U.S. efforts to draw lessons for future efforts to develop GHG-mitigation policies. Drawing on the lessons of these prior examples as well as conceptual reasoning, we then develop and justify a set of general normative criteria for evaluating packages of GHG-mitigation policies. Our next step is to apply the criteria to nominal examples of policy packages, based loosely on options currently included in the debate, in order to illustrate how the criteria can help to distinguish among different options. We conclude with some general recommendations for designing actual policy packages.

CHAPTER TWO

Lessons from Previous Energy Policies: Three Examples

In this chapter, we review three previous initiatives with the capacity to reduce GHG emissions—though that was not their primary goal. These examples include technology-development, energy-taxation, and fuel-economy measures:

- The *Partnership for a New Generation of Vehicles (PNGV)* was a private-public partnership focused on technology improvements.
- The Clinton administration's *British thermal unit (BTU) tax* dealt with reducing carbon emissions through direct energy taxes.
- The *Corporate Average Fuel Economy (CAFE) standards* require that automobile manufacturers meet regulations that mandate minimum fuel efficiency in vehicle fleets.

In the discussion, we describe the politics surrounding each policy's adoption or rejection and explore the lessons it imparts for future GHG policymaking.

Partnership for a New Generation of Vehicles

The PNGV program encouraged collaboration between government and industry in the development of fuel-efficient vehicles. Its aim was to fund research and development (R&D) to produce a fleet of highly efficient cars by the year 2004. A representative from the U.S. Department of Commerce chaired the partnership, announced in 1993; it received funding and drew personnel from multiple government agencies and the Big Three automakers (General Motors [GM], Ford, and Chrysler). Because of its focus on technological research, the partnership also worked closely with companies feeding the automakers' supply chain.

The PNGV had mixed results: Several new technologies were developed over the course of the partnership, and each of the three companies produced a concept vehicle that met the target efficiency standards. The most obvious basis for criticism of the PNGV, however, is the partnership's failure to meet its most explicit and most ambitious target: the commercial development of vehicles with 70-mile-per-gallon (mpg) fuel efficiency. To a certain extent, the PNGV's failure was a result of the existing conditions: At the time, gasoline prices were low, so there was little market support for turning concept vehicles into marketable prototypes. Although the PNGV program, with its stated goals, ended in 2001, parts of the work were later taken over by the George W. Bush administration's FreedomCAR initiative, which focuses on hydrogen as well as petroleum technologies. The larger aim continues to be government funding of high-risk, longer-term technologies, with automakers supporting applied research.

Background of the Partnership

A RAND study of the PNGV program (Chapman, 1998), on which this section draws heavily, suggests that the impetus for PNGV collaboration grew out of several trends in the government and industry R&D communities of the early 1990s. On the heels of the Cold War and absent the need for weapon development on a large scale, there was concern in the national laboratories about the continuation of funding for scientists. Around the same time, near the end of the George H. W. Bush presidency, the Advanced Manufacturing Technology initiative was created under the Office of Science and Technology Policy (OSTP). Its goal was to streamline manufacturing R&D improvements in various federal agencies and departments, including the U.S. Department of Agriculture, U.S. Department of Commerce, U.S. Department of Defense (DoD), U.S. Department of Energy (DOE), U.S. Department of the Interior (DOI), EPA, Federal Emergency Management Agency, and National Science Foundation (NSF).

While the national laboratories viewed collaboration with industry as offering a degree of security against federal R&D downsizing, the automakers had an interest in countering their image as opponents to government (evidenced, especially, in their aversion to safety and environmental regulations). There is evidence that, to some degree, the industry partners saw the PNGV as an interesting (and well-funded) project but one that was not central to their own priorities. Automakers were reluctant to devote their own efforts to the venture because no market for highly efficient vehicles existed. At the same time, automobile companies had begun to turn their research focus to car batteries, both to improve technical functionality and to address a 1990 California mandate that 2 percent of cars sold in 1998 be zero-emission vehicles (with increasing percentages for future years) (see ARB, 2008).

There was also increasing attention given to the possibility of government-industry collaboration. To test this possibility, automakers and government formed the U.S. Advanced Battery Consortium (USABC) in 1991, and, as a result of a year of successful partnership, a number of other initiatives arose, such as the Vehicle Recycling Partnership and eventually, in 1992, the U.S. Council for Automotive Research.

These efforts, as well as the success of the prior collaborations, helped propel the formation of the PNGV in 1993. When Bill Clinton took office as president, one of the administration's focuses was government support of civilian high-tech projects. The administration also thought that improvements in fuel efficiency would help address the 1992 United Nations Framework Convention on Climate Change, to which the United States was party. On the Clinton team's recommendation, a round of discussions ensued between government agencies and automakers, and the full PNGV plan was announced in September 1993.

Chapman (1998, p. 10) notes that many of the precursors to and motivations behind the program existed well before 1993, so "the PNGV might have been launched a bit earlier. However, industry needed the assurance that the technical options were feasible and that it was possible to work productively in partnership with the government." He adds that the successful formation of the USABC program helped relieve some of the hesitation about government-industry collaboration.

Program Goals

The ultimate aim of PNGV research was a specific set of products: drastically more efficient vehicles that could be marketed to the public, with the same features and at the same cost as the contemporary fleet. The stated goals of the partnership were threefold, with a mix of general goals and a discrete quantitative benchmark against which the success of the program could later be measured (PNGV, 1995):

- Goal 1, the "manufacturing competitiveness goal," called for improvements in manufacturing processes for conventional as well as PNGV vehicles.
- Goal 2 sought the more rapid progression of PNGV-developed technologies into production vehicles.
- Goal 3 was to develop, by 2004, a fleet of vehicles with three times the fuel efficiency of 1994 vehicles; based on a prototypical family sedan, this worked out to about 72 mpg.

Participation and Funding

The PNGV program involved members from many federal agencies: Commerce, DoD, DOE, DOI, U.S. Department of Transportation (DOT), EPA, NSF, OSTP, National Aeronautics and Space Administration, Office of the Vice President, Office of Management and Budget, National Economic Council, and the Council on Environmental Quality. The government component of the partnership was chaired by the Under Secretary for Technology in the Department of Commerce.

On the industry side, GM, Ford, and Chrysler each brought several representatives into the PNGV management structure. There was little research collaboration between the three companies. While administration meetings involved all of the automakers, frequently breakout groups discussed each company's individual research agenda and progress.

During the initial stages of the collaboration (through spring 1994), an operational steering group guided the PNGV program. The group included members from each of the affiliated government agencies and the vice presidents for research, development, and technology (RD&T) from the three automakers. Its goal was to help forge the research collaboration among the participants. Through mid-1995, a technical task force, including representatives from government and the automakers, supervised a group of technical teams, each developing a particular technology. By 1996, each of the automakers had developed a prototype vehicle with technologies that offered a first step in the direction of PNGV goals, including the hybrid Dodge Intrepid ESX, Chrysler's fuel-cell power train (in 1997), Ford's Synergy 2010, and GM's EV1.

Funding for the PNGV program came from the participating agencies. To address concerns raised by members of Congress and others concerned about the creation of additional government programs as a form of "corporate welfare," the funding was explicitly drawn from existing budgets of the individual agencies. Specifically, funds were allocated from five agencies with existing PNGV-related activities: DOE, NSF, Commerce, EPA, and DOT. It is estimated that about 1,000 scientists from government and industry participated in the research efforts (Chapman, 1998, p. 61).

As a result of this arrangement, the PNGV had no central budget, and it is difficult to track exactly how much funding went into the program over the years of its existence. The U.S. Government Accountability Office (GAO) estimates that, from 1995 to 1999, the partnership received a total of about $1.25 billion in federal funds, about half of which came from DOE (GAO, 2000). Another set of estimates from the National Research Council cites figures of $814 million from government and $980 million from industry (NRC, 2001).

Specific Technologies

Although the PNGV budget was largely in the hands of government agencies, the technical leadership and determination of research priorities were left to the automakers. For the PNGV program, the industry partners laid out a set of general goals (e.g., 0 to 60 mph in 12 seconds or less), which was then approved by the government.

Candidate projects for PNGV funding were divided into one of six technology areas: energy conversion, energy storage, materials, manufacturing, system engineering, and "everything else." According to the GAO report (2000, p. 16), a large percentage (about 84 percent) of total funding went into technologies that would increase energy efficiency.

Program Results

The success of the PNGV program was, at best, mixed: While concept vehicles emerged, no automaker produced a marketable prototype. The program was officially canceled in 2001.

The PNGV program is largely considered a disappointment, especially in the public sphere, for failing to meet its most advertised, ambitious goal of tripling fuel efficiency in marketable vehicles. While each of the automakers ultimately introduced concept cars incorporating hybrid-electric power trains and compression-ignition, direct-injection engines that met the 72-mpg benchmark, the cars never advanced beyond the prototype stage. These cars (the Ford Prodigy, the Chrysler ESX3, and the GM Precept) used a number of technologies advanced by PNGV research, including reduced mass and aerodynamic drag. In addition, the PNGV helped accelerate the development of hybrid power trains for pickup trucks and sport-utility vehicles. This technology can reduce fuel consumption by 10 to 30 percent (NRC, 2001). Viewed another way, even if PNGV technology was not directly marketable, the program may have provided a form of insurance against changing future conditions; this depends, however, on whether the PNGV prompted new technology development.

The PNGV also faltered because it did not take EPA emission standards into account. The prototype vehicles developed through the PNGV had higher emission levels for nitrogen oxide (NOx) and particulate matter than the standards the EPA was to phase in by 2004 (NRC, 2001). Critics also argued that the focus on diesel technologies in these prototypes (and the bent toward diesel in the PNGV research agenda) served to promote a highly polluting fuel (Sperling, 2001).

The degree to which these technologies would have existed without government funding is unclear and would be difficult to ascertain. Critics argue that automakers would have initiated some of this research independently, and certainly Toyota and Honda introduced non-PNGV commercial hybrid cars not much later. The existence of a specific "stretch goal" may have provided some stimulus to innovation beyond what the automakers might have attempted without federal support. On the other hand, the National Research Council noted in its last annual review of the program that

> the combination of 80 mpg and affordability appears out of reach. . . . [N]o reasonable amount of funding would ensure achievement of all aspects of Goal 3. . . . [T]hat has been clear for some time. Breakthrough ideas and talented people are more stringent constraints than money to achieving this goal. (NRC, 2001, pp. 6, 9–10)

Clinton BTU Tax

As part of the Clinton administration's 1993 economic plan, a new form of taxation was proposed that would tax different energy sources based on their heat content as measured in BTUs.[1] The BTU tax had two purposes. First, debt reduction was a major theme during the 1992 presidential race, and the BTU tax was one of Clinton's proposed mechanisms for raising revenues for this purpose. Under Clinton's proposal, all revenues would have been allocated toward reducing the deficit. Second, it was touted as a means of promoting energy efficiency, reducing environmental damage, and limiting dependence on foreign fuel by raising the price of energy consumption.

How the Tax Was to Work

Clinton's proposed BTU tax was to be based on the energy content of the energy source measured in BTUs. The tax was to be imposed on coal, natural gas, liquefied petroleum gases, and gasoline, as well as nuclear and hydro-generated electricity. For the purpose of calculating the tax charge, the actual BTU content of coal was to be used. For other fuel sources, the national average BTU content for the fuel type was to be applied. Nuclear and hydro-generated electricity were to be assigned a BTU value based on the BTUs required to produce electricity via fossil fuel so as to not overly advantage non–carbon-based sources of electricity.

A base tax rate of $0.257 per million BTUs was to be applied to all fuel types. Petroleum products were to be subject to an additional $0.342-per-million-BTU tax, for a total tax of $0.599 per million BTUs. This would effectively raise the price of gasoline by $0.075 per gallon, supplementing the preexisting federal gasoline tax (Greenhouse, 1993). The proposed tax was to be applied at the same rate to both imported and domestic energy and would grow at a rate tied to the U.S. gross domestic product (GDP). Exemptions were made for exported fuels and electricity, bunker and jet fuels used in international transportation, biomass, and wind- and solar-generated electricity, as well as nonfuel uses of fossil fuels, including asphalt, lubricants, and waxes (Hoerner and Muller, 1996). The U.S. Department of the Treasury projected that, once the plan was fully implemented in 1996, the BTU tax would generate $22 billion annually (Moore, 1993).

The point at which tax collection occurred was to vary by energy source according to a complicated system. For refined-petroleum products, the tax would be applied after refining. This was considered a major concession to the oil industry because a considerable amount of oil is consumed in the refining process and this energy use would not be taxed. Natural gas would be taxed at the "city gate," thus also exempting suppliers from paying tax on gas used to operate the pipeline system, while end users of coal would pay the tax upon receipt. Utilities would pay the tax for nuclear electricity, while imported electricity would be charged at the point of receipt by the importer.[2]

Criticism and Failure of the BTU Tax

The tax faced strong opposition from a number of sources, but its primary opponents were the petroleum companies whose product faced a 133-percent greater tax rate per BTU than other

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[1] One BTU represents the quantity of energy required to raise the temperature of one pound of water by 1 degree Fahrenheit from a base temperature of 39.2 degrees Fahrenheit.

[2] For a description of the proposed BTU tax, see Bredehoeft (1995).

fuel sources. They and other advocates for the domestic oil companies pushed hard for consideration of a broad-based, value-added tax as an alternative to the BTU tax on the grounds that it would be more equitable and less harmful to the economy (API, 1993).

Many of the industries that consume large amounts of petroleum-based fuel, such as trucking, airlines, and agriculture, claimed that they would have a difficult time passing the increased fuel cost along to consumers, leaving their businesses disadvantaged. The airline industry, which was also feeling other economic pressures at this time, estimated that jet-fuel costs for domestic U.S. travel would increase by $0.08–$0.10 per gallon, increasing the average cost of a flight by 2.7 percent (Moore, 1993). Farmers objected to the tax because it would increase their operating costs, which would lead to narrower profit margins and higher food prices (Moore, 1993). Other vocal opponents from industry included chemical, aluminum, and paper manufacturers. Because energy costs make up a sizable portion of their total costs, and their products compete in international markets, it was argued that these industries would have a more difficult time competing internationally (see, e.g., Moore, 1993, and API, 1993).

Industry provided its own estimates of the economic impacts of the BTU tax to bolster their opposition. The American Petroleum Institute (API) suggested that the revenues raised from the tax (nearly $33 billion per year) would be less than the loss in GDP ($35 billion). The API further argued that the tax would put the United States at a competitive disadvantage internationally, lead to the loss of more than 700,000 jobs, and increase inflation (API, 1993). Jerry Jasinowski, president of the National Association of Manufacturers and chair of the American Energy Alliance, said that the BTU tax was

> the worst possible tax we could use to reduce the budget deficit. Not only would this tax mean the loss of between 400,000 and 600,000 jobs and cost the average family over $400 a year, it would also hurt American exports. (McElveen, 1993)

Many opponents referenced analysis by the consulting firm DRI/McGraw-Hill, which indicated that the proposed BTU tax would cause annual inflation to increase by 0.1 to 0.2 percentage points and would reduce real GDP growth by 0.1 percentage point annually through 1998 (McElveen, 1993).

Outside of industry, the BTU tax faced criticism from those who felt that it was regressive, since those with lower incomes tend to spend a larger fraction of their income on electricity, natural gas, and gasoline than do high-income individuals (see Shanahan, 1993). These concerns were at least partially addressed by the Clinton administration's introduction of the Low Income Home Energy Assistance Program and the expansion of the Earned Income Tax Credit.

Others concerned with the social impacts of the tax cited analysis by the Treasury Department that suggested that the BTU tax would create modest disparity among different regions of the country. According to reporting on Treasury's analysis, New Englanders would be paying more than any other region, at approximately $103 per person annually, once the tax was fully phased in. Southern states, such as Kentucky, Tennessee, Mississippi, and Alabama, would fare best, paying about $80 per person annually (Noah, 1993).

Ultimately, the BTU tax was not adopted. Republicans in both the House and Senate opposed the tax, claiming that it would harm the middle class economically. Clinton pushed hard for House Democrats to support the bill, and the tax was reduced at the last minute to win the votes of moderates, allowing it to pass. Some energy-state Democrats voted for the tax—which was part of a larger deficit-reduction bill—because they believed that the tax would be modified in the Senate to rebate the tax for energy-intensive products. In the Senate, Democrats from energy-producing states removed the BTU tax in favor of a $0.43-per-gallon increase in the excise tax on motor fuels, with revenues from the increase allocated toward reducing the deficit ("Deficit-Reduction Bill Narrowly Passes," 1993).

The Clinton administration did not attempt to revitalize the BTU tax in subsequent years. Instead, in 1997, the administration proposed a carbon tax as part of its plan to reduce GHG emissions by 2012 to their 1990 level. The carbon tax would vary across fuel types according to the amount of carbon each contains. The 1997 carbon-tax proposal faced considerable opposition and was never enacted.[3]

CAFE Standards

The most successful program among the three initiatives we consider is the CAFE standards (pronounced "café"). The CAFE standards were originally adopted in 1975 as part of the Energy Policy and Conservation Act (EPCA) (Pub. L. No. 94-163). The standards mandate an average mpg that each automaker is required to meet. Standards for model year (MY) 2007 were 27.5 mpg for cars and 22.2 for light-duty trucks and sport-utility vehicles (SUVs). Fines are levied for noncompliance. The Energy Independence and Security Act (Pub. L. No. 110-140), passed in late 2007, increases fleetwide fuel economy to 35 mpg by MY 2020 and eliminates the disparity between cars and light trucks over time.

History of Adoption

The oil-market disruption of 1973–1974 was a major economic shock in the United States and highlighted the relative fuel inefficiency of American cars.[4] Fuel efficiency was low largely because gasoline was relatively inexpensive.[5] However, emission-control standards were introduced in the early 1970s, and many motorists and auto manufacturers blamed the new emission equipment for worsening gas mileage (Yacobucci and Bamberger, 2007).

EPCA was passed after heated debate and extensive negotiations in Congress regarding potential increases in gasoline prices, gasoline rationing, and price controls. In 1973, there were severe gasoline shortages, and the public mood was attuned to conservation. However, the period was also marked by fairly high inflation, which dampened enthusiasm for raising gasoline taxes, as there were real fears that it would stoke inflation further. Among other measures debated but not passed in Congress were a $0.40 increase in the federal gas tax; a consumer "gas guzzler" tax, to be levied on purchases of fuel-inefficient vehicles; relaxed emission-control regulations to help achieve better mileage; and gas rationing.

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[3] For a critical assessment of Clinton's 1997 energy proposal, see U.S. Senate Republican Policy Committee (1997b).

[4] This section is drawn largely from Yacobucci and Bamberger (2007) and "Ford Ends Stalemate, Signs Energy Bill" (1975).

[5] While other factors, such as consumer preferences for automotive power and speed, contribute to fuel efficiency, the low cost of gasoline to consumers is generally thought to be a major contributor to the low fuel efficiency of early 1970s cars (Dahl, 1986).

As fuel-economy standards began to be discussed both at EPA and in Congress, the automobile manufacturers lobbied for a compromise position, under which they would meet voluntary fuel-economy standards in exchange for delaying by five years the introduction of stricter emission controls. By the end of 1974, the auto industry was suffering from declining sales, and manufacturers claimed that winning this concession would help alleviate the financial hardships the industry was facing. Some in Congress were sympathetic to this argument; debate centered on whether the anticipated shift to smaller cars would further increase imports—creating economic hardship among auto workers—and possibly depress the auto-based domestic tourism industry. However, outside of this opposition from manufacturers, fuel-efficiency standards were not particularly controversial, and many observers doubted that the manufacturers would follow through on a voluntary program.

While the mandatory standards were an improvement over existing fuel-economy levels, they were not particularly ambitious. Japanese and European imports at the time already met much higher fuel-efficiency levels. The standards for cars in the final legislation were 18 mpg by MY 1978, 20 mpg by MY 1980, and 27.5 mpg by MY 1985. EPCA left the establishment of fuel-efficiency standards for light trucks to the National Highway Traffic Safety Administration (NHTSA), the implementing agency. Initially, NHTSA set separate standards for two- and four-wheel-drive light trucks (for MY 1979, 17.2 and 15.8 mpg, respectively); since 1991, there has been a single light-truck standard.

Changes and Debates Since Enactment

While light-truck standards have been steadily increasing since introduction, beginning in MY 1985, standards for cars remained at 27.5 mpg or below and stayed at that level until passage of the 2007 legislation.[6] Table 2.1 provides a summary of changes in CAFE standards over time. Increases to CAFE standards were discussed as part of the 1992 energy bill but were ultimately not incorporated due to a compromise in the Senate that neither fuel-efficiency standards nor Arctic drilling would be included ("Energy Bill Surges Toward Enactment," 1993). From fiscal year (FY) 1996 to FY 2001, Congress prevented NHTSA from increasing the passenger-car standards by including a clause in the DOT appropriation act stating that no expenditure could be made to revise the standards. An effort in the Senate to raise the standards in 2002 was defeated. Opponents of raising the standards contended that the costs of compliance on auto manufacturers would be too great.

A 2006 attempt to modify the light-truck standards also failed. In April of that year, NHTSA issued a final rule that not only increased light-truck standards but also changed the structure of the light-truck program. This structural change would put in place varying standards based on the vehicle "footprint."[7] The standards would begin regulating medium-duty vehicles. However, a court of appeals overturned the rule in November 2007, siding with petitioners that the cost-benefit analysis was inadequate and that no floor fuel economy was established (Yacobucci and Bamberger, 2007).

[6] After the 27.5-mpg goal for 1985 was reached, NHTSA relaxed the standard for three years, MYs 1986 to 1989, based on manufacturer complaints that compliance would pose a financial hardship with the decline of oil prices and consumer purchases trending back toward larger cars.

[7] The vehicle footprint is calculated by multiplying the vehicle's length by its width. This measure does not take vehicle weight or volume into account.

Table 2.1
Current and Future CAFE Program and Vehicle Classes

Vehicle Type	Definition	Current Standard (MY 2007) (mpg)	Standard Signed December 2007 for MY 2020 (mpg)	Program Structure	Authority to Change Program
Car	Passenger cars	27.5	35	Same for all vehicles	NHTSA has limited ability to change standard but no authority to change program structure.
Light truck	Vehicles up to 8,500 lb (SUVs, pickups, vans)	22.2	35	Beginning MY 2008, standard is based on vehicle footprint	NHTSA can change standard and program structure.
Medium-duty passenger vehicle	Vehicles 8,500–10,000 lb designed for passenger transport	Exempt; will be subject to CAFE standards beginning MY 2011	n.a.	Beginning MY 2011, standard will be based on footprint	NHTSA can change standard and program structure.

SOURCE: NHTSA data.

Under the EISA, standards for cars and trucks will continue to be calculated separately until MY 2020. Cars must meet 31.2 mpg in MY 2011, increasing to 35.7 mpg in MY 2015; for light trucks, the comparable figures are 25.0 and 28.6 mpg. In a major change from previous regulations, manufacturers will be able to trade credits not just between those fleet types but also with other manufacturers. The EISA also requires NHTSA to regulate medium- and heavy-duty vehicles and work trucks. The Big Three auto manufacturers have not lobbied as vehemently against increases in CAFE standards as in the past, perhaps because they sense a change in the political climate, in which global-warming issues are taken more seriously. The effort to raise CAFE standards received generally strong public support (Pew Campaign for Automobile Fuel Efficiency, 2007).

Implications of These Examples

Our three examples illustrate several points relevant to policymaking for limiting GHG emissions.

Government programs to encourage specific technological development will have weak results without consistent and predictable support by public- and private-sector actors, marketable results, and appropriate agency coordination. Participating automakers faced uncertainty on a number of fronts. First, the PNGV budget came from a number of separate agencies and was never guaranteed, and the size and inflexibility of the program made it difficult to reallocate funds to more-promising technologies. Second, the project might have ended at any time. Third, many agencies were involved in both funding and decisionmaking, which made the program inherently unwieldy and, to some extent, unpredictable. Fourth, midway through the program, EPA promulgated tier 2 emission standards, which were more stringent than those in place when the program started and would have required "radically better emission control technology" (NRC, 2001, p. 6). These inherent uncertainties may have limited full private-sector participation.

Moreover, the government wanted fuel-efficiency research, while the automobile manufacturers wanted to create a vehicle that would sell. While all three companies were able to develop a concept vehicle, there was no pressure to develop a marketable one. The CAFE standards in place were well below the PNGV targets, and the automakers did not foresee a sufficient market for highly efficient vehicles to merit the full deployment of the technologies.

While economic theory often focuses on what to tax and by how much, political feasibility often comes down to the question of who will pay. Thomas Barthold pointed out that the study of taxes has focused perhaps too heavily on the question of what to tax and by how much.[8] In many cases, and in particular with the BTU tax, the ultimate debate is more focused on who should pay—although another problem with the BTU tax was that it lacked a logical connection to a specific externality, focusing instead on several issues related to energy consumption. Well-crafted environmental policies need to address not only efficiency issues but also equity or distributive issues and appeal generally to the public and industry. In some cases, this may require making certain efficiency concessions to ensure political feasibility.

It can be difficult if not impossible to satisfactorily accomplish multiple, diverse goals with a single policy instrument. The various goals of the proposed BTU tax—debt reduction, energy conservation, energy security, and CO_2 limitation—seemed at odds with one another in some observers' eyes. This may have helped contribute to its ultimate demise. CAFE standards were enacted for one reason—fuel savings—and are now justified using environmental criteria; initially, they were not seen as having multiple goals. Future climate policy will likely need to deliver on multiple levels simultaneously (e.g., emission reduction and revenue generation); to accomplish this, coherent policies with multiple instruments will be more likely to succeed.

A crisis can be a good opportunity to pass legislation that might otherwise fail. In the case of the original CAFE standards, fuel efficiency was in the national spotlight because of a precipitating crisis—the 1973–1974 oil shock—that both politicians and the public perceived to be a serious problem. The same was true, to a somewhat lesser extent, in late 2007, when CAFE standards were raised. In a less charged political climate, the auto manufacturers might have been able to successfully lobby against the introduction of standards. During a crisis, when there is discussion of even more drastic measures, moderate approaches may come to represent compromise positions.

Technological solutions are easier to pass than economic solutions that explicitly raise prices for the public. It is often easier to pass legislation that calls for a technological solution (such as changing vehicle engineering) than a law that explicitly requires the average citizen to pay more money or change behavior. Even though CAFE standards mean that consumers will eventually pay more for new cars, the costs are hidden in the prices of new vehicles, and, because the vehicle fleet turns over slowly, this does not affect all consumers at once the way a gas price hike would. Of course, it is also true that the results of this particular technological solution are realized slowly, because of the fleet turnover issue.

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8 See Barthold (1994) for a discussion of political feasibility and environmental taxes. Also see Keohane, Revesz, and Stavins (1997) and Hahn (2000) for a general discussion of why environmental policy deviates from theoretical ideals; Joskow and Schmalensee (1998) examine the specific case of the sulfur dioxide (SO_2) permits in the Clean Air Act Amendments (Pub. L. No. 101-549).

The greater the number of industries negatively affected, the harder the legislation will be to pass. CAFE standards affect only the automobile industry, while the BTU tax affected a variety of industries: oil, trucking, airlines, agriculture, and chemicals. This put more muscle behind lobbying attempts against the BTU tax, which ultimately succeeded in killing it.

Once initial legislative targets are in place, they can be difficult to change. CAFE standards for cars remained at or below the levels set in the 1975 legislation until late 2007, despite several efforts to raise them. This is largely because the automobile industry was able to successfully lobby against raising the standards, but it is also likely due in part to the lack of subsequent "crises." To help ensure longer-term changes, it may be useful to use mechanisms for ongoing updating of technology performance targets. While this in itself is no guarantee of success, it may help to stimulate incentives for more continuous improvement in the context of technology standards.

Our review of these examples also highlights that research on the economic impacts of energy taxes and their effectiveness relative to regulation does not always yield a clear answer. Even with a nearly 30-year history of implementation, there is a range of analytical opinion on the amount of gasoline tax that would be needed to effect the same reduction in gasoline consumption as an increase in fuel efficiency. This is in part because economic models used to assess policies vary in their assumptions. It is also a reflection of different assumptions about how consumers react to factors other than gas prices in determining the vehicles they prefer and the amount they drive. Similarly, there was a wide range of views regarding the economic impacts of the proposed BTU tax. The challenges in assessing the potential performance of different policy options are an important cautionary note in efforts to resolve policy disputes through analytical investigation.

CHAPTER THREE

Normative Criteria for Evaluating GHG Policy Instruments

In this chapter, we describe four normative criteria for evaluating policies for GHG mitigation. Evaluating policies inherently involves subjective judgments, and there are no universally accepted, standard criteria for environmental policy evaluation. The criteria identified here are similar to those used by two prominent and respected reviews: that of the Intergovernmental Panel on Climate Change (IPCC) for its Fourth Assessment Report and that of the Market Advisory Committee (MAC) on proposed California climate-change policies.[1] Our criteria are also influenced by the lessons gleaned from the three earlier energy-policy examples reviewed in Chapter Two. For example, the CAFE program highlights the value—and difficulty—of making policies adaptable to changing conditions, while the BTU tax emphasizes the role that distributional considerations play in determining the fate of policies.[2]

Cost-Effectiveness

Cost-effectiveness would generally be expressed as a dollar cost per ton of emission reduction. A highly effective but very expensive policy measure could rank low on this criterion, whereas a policy that achieved only minimal GHG reductions—but did so at very low cost—could achieve a high rank.

Cost effectiveness is typically associated with (1) broad and consistent coverage of emission sources, to ensure that the most is accomplished at the least cost; (2) the ease with which a regulation can be implemented; (3) predictable rules and incentives to reduce the uncertainties associated with the implementation of the regulation;[3] and (4) positive synergies with other goals and policies. Examples of such synergy could include energy security and air quality, among others.

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[1] The IPCC (2007, Chapter 13) uses four criteria: environmental effectiveness, cost-effectiveness, distribution considerations, and institutional feasibility. The MAC report (California Environmental Protection Agency, 2007) also uses four, somewhat different criteria: environmental integrity, cost-effectiveness, fairness, and simplicity.

[2] For a discussion of evaluating environmental-policy instruments, see Harrington, Morgenstern, and Sterner (2004) and Sterner (2003).

[3] There could also be uncertainties associated with the evolution of emission targets as the risks associated with climate change and of options for compliance become better understood. However, these risks cannot be so easily reduced, and a regulatory system should not automatically seek to mitigate the emitters' risks if the result is more risks for other members of society. Such "nondiversifiable" risks should be allocated where they can be borne at least cost.

Fairness of Distributional Impacts

This criterion looks at the distribution of impacts—specifically, how the burden of higher energy prices and regulation would be borne across both producers and consumers. Distributional fairness seems especially relevant with respect to the impacts of policy across households and workers whose livelihoods may be affected by GHG-mitigation measures. Distributional fairness considerations can also incorporate concerns about burden-sharing among producers or between consumers and producers, including the impacts of different risks associated with policy impacts (e.g., fluctuations in energy costs).

The distributional impacts of policy packages could be seen as being fairer by including some of the following elements:

- They incorporate or are linked to measures that allocate compliance costs in a way that reflects broader judgments about public burden-sharing based on ability to pay. An example might be a gasoline tax for reducing vehicle-miles traveled and improving vehicle fuel efficiency, combined with income tax rebates scaled to household income.
- They incorporate redistributive compensation to alleviate economic adjustment costs associated with GHG-mitigation policy. For example, a portion of a carbon tax on coal-fired electricity (the most carbon-intensive type) could be returned through transfers to individual workers or communities most adversely affected by reduced coal use.
- They tend to target more of the compliance cost burden toward those who reap the greater benefits from GHG emissions (i.e., the polluter pays principle).
- They have a transparent policy design and implementation, clear rules, and credible assessments of potential impacts during policy design. These may serve to increase confidence that the policy will work as advertised and that there are no hidden cost shifts that unacceptably disadvantage some over others.

Incentives for Innovation

This criterion considers the degree to which a policy package encourages technological innovation, for greater effectiveness in either reducing emissions or lowering the cost. This criterion is especially important for expanding longer-run options for GHG mitigation. A policy package that ranks high on this criterion could offer tangible economic rewards for introducing affordable new technologies that perform well in mitigating GHGs, as would be the case with demands for improved technologies stimulated by market-based GHG-control policies. Various means to more directly channel public funding to innovators are another possible avenue.

Adaptability of Policy Framework

Adaptability refers to how readily a policy framework can change over time, given, in particular, the institutional context in which the framework is established and implemented. Adaptability would facilitate an extension of a policy package to address changes in emission targets and reconfiguration of policies over time as attitudes and response options change, uncertainties are resolved, and new uncertainties arise. Adaptability is important because the impacts of different policies on the rate of GHG emissions and the long-term effects of climate change are uncertain. A policy adopted now may become outmoded in the future due to advances in knowledge about and costs of different measures. It is important that policymakers, as well as producers and consumers subject to regulation, be able to react to such changes in knowledge instead of being locked in to a previously set course of action.

Policy packages that perform well on this criterion may incorporate the following:

- flexibility in the timing of compliance to allow effective responses of investment patterns to adjustment costs and technical innovations without undermining long-term environmental effectiveness
- ability to reset environmental goals periodically as new information becomes available, without needing to totally reconstruct the basic architecture of the policy
- ability to relatively easily replace some policies and implementation details for others within the overall architecture without going back to square one. For example, policymakers might initially decide to address one component of GHG mitigation through a technology-based policy but also want the ability to move toward an incentive-based policy in the future.

Normative Criteria and Political Viability of Policy Packages

The four normative criteria discussed in the preceding sections provide a conceptual basis for evaluating GHG-mitigation policy packages, including potential trade-offs among the criteria. However, it is also important to assess a policy package based on its political viability, as indicated by the willingness of enough stakeholders with enough political power to give assent. The performance of a package in terms of the normative criteria will certainly affect the potential political viability of the package. At the same time, policies that find political support may be inherently weak in one or more of the criteria we have discussed, depending on the relative influence of different stakeholder groups and public perceptions of the policy issue. For example, it may be more effective politically to have energy cost increases occur indirectly through technology standards, even if these lead to greater costs for the economy as a whole.

The need to achieve political support could generate resistance to more-transparent policy designs that would increase distributional fairness. It could also produce movement away from reliable analysis of potential economic impacts that would contribute to cost-effectiveness (Lutter and Shogren, 2004). Certain groups may oppose a policy with consistent regulatory treatment that imposes different burdens across sectors or regions. For example, a carbon tax on energy production would impose greater costs on more-severe climates, such as the Northeast, and emitters in sectors or regions more heavily affected by the regulatory regime will seek lighter standards or requirements (Magat, Krupnick, and Harrington, 1986). This, in turn, could distract attention from more fundamental distributional-equity concerns based on household income and employment patterns.[4] Finally, policies achieve political support or

[4] Another factor that could influence the success of a policy in the political process is the confidence of the public in the information it receives from government and interest groups or in the potential follow-through associated with policy implementation.

meet resistance due to factors beyond the inherent characteristics of a policy, such as a period of crisis.

There are several perspectives on how to incorporate political-viability considerations into policy evaluation. One approach would emphasize identifying first-best policies—even if those policies are politically unpalatable—with the view that the information could help shift stakeholder preferences toward more-efficient GHG instruments. An approach oriented more toward political-economy considerations, as illustrated by the frameworks discussed in Magat, Krupnick, and Harrington (1986), would emphasize the existence of inherent political drivers and constraints and the need for policy options to reflect these, even if the result comes at the expense of economic efficiency. In this paper, we are interested in considering what should be done and what can be done in terms of GHG-mitigation policy. For this reason, we acknowledge the important role of political viability while treating it separately from our normative criteria.

CHAPTER FOUR

Illustrative Comparison of Nominal Policy Packages

In this chapter, we consider three nominal GHG policy packages to illustrate the implications of the normative criteria and aspects of political viability. Each package addresses the instruments used to induce or mandate actions to reduce GHGs. While these packages loosely resemble some actual GHG-mitigation proposals, they are not meant to represent fully developed existing or potential policy options. Instead, we present hypothetical examples that capture important characteristics of the policy landscape and provide the opportunity to demonstrate how to employ our normative criteria. We begin by explaining the three nominal packages, we then apply our normative criteria, and finally we adjust the policy packages to address specific weaknesses, especially by focusing on burden-sharing mechanisms.

The first nominal example is a comprehensive, upstream carbon tax on all fossil energy.[1] This would impose equal taxes per unit of GHG on all types of energy, domestically produced and imported. The tax would be paid initially by producers, but part of the costs would be passed forward to energy users in the form of higher primary energy or fossil electricity prices. Other costs would be borne by workers and shareholders in the fossil-fuel sector. The government would have different ways to use the proceeds of the carbon tax, with implications for overall cost-effectiveness, burden-sharing, and innovation incentives, as described later in this chapter. In the initial example, however, all revenue would be targeted to deficit reduction. A carbon tax is considered the ideal among many economists analyzing different GHG measures (see, for instance, Palmer and Burtraw, 2005; Fischer and Newell, 2008; and Newell and Stavins, 2003).[2]

A second illustrative policy package is a hybrid cap-and-trade program that allocates free allowances to large fossil-energy users (industrial and power plants) and uses upstream allowances allocated to energy suppliers to address fuels and direct residential and commercial use of natural gas.[3] Allowance trading with significant free allocation of allowances downstream,

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1 *Upstream regulation* typically refers to regulating at the point at which carbon-based fuels are introduced into the economy, whereas *downstream regulation* refers to regulating at the point at which fuels are consumed and emissions produced.

2 For our purposes, a very similar mechanism would be a comprehensive cap-and-trade program applied to energy supplies, with all allowances auctioned by the government—though, in practice, there are important differences between price-based and quantity-based approaches.

3 We are abstracting here from the complications that would be required if carbon capture and sequestration became technically and economically viable on a large scale. We are also not addressing the need for exempting energy goods going to noncombustion uses (chemical manufacturing), noncombustion CO_2 sources (cement manufacturing), and emissions from solid-waste burning (or landfill gases).

at least initially, is a prominent feature of many GHG-mitigation bills that are being debated. It is also supported by a number of prominent industry voices.[4]

A third hypothetical package would focus on tighter CAFE standards and other regulatory standards for efficiency of energy end uses (such as appliances and buildings). These would be combined with regulatory standards, such as requirements for utilization of renewable-energy sources, without specifically targeting the carbon intensity of different sources. For example, utilities could be mandated to increase the thermal efficiency of boilers and to satisfy percentage requirements for the use of renewable energy (i.e., a renewable portfolio standard, or RPS).[5] As specified here, the package would incorporate no incentive-based measures and no transfers of funding.[6]

Evaluation of Policy Packages

Here, we qualitatively apply the four evaluation criteria to the three policy packages. Table 4.1 summarizes the evaluation, while the discussion following describes the reasoning behind the scores.

Cost-Effectiveness

The carbon tax and cap-and-trade packages both have high rankings. Levying an upstream tax or creating a permit-trading program for all sources is highly cost-effective, since each covers all uses of energy—transportation, electricity generation, and others—with a common unit of emissions. Taxing or trading upstream for direct end users, based on the carbon content of the

Table 4.1
Qualitative Scoring of Carbon-Mitigation Policy Packages

Package	Cost-Effectiveness	Distributional Fairness	Innovation Incentives	Adaptability	Political Viability
Carbon tax with deficit reduction	[dark]	[white]	[gray]	[gray]	[white]
Cap-and-trade with free allowances	[dark]	[white]	[gray]	[gray]	[gray]
Regulatory standards	[white]	[gray]	[white]	[white]	[gray]

NOTE: Darker shading means higher ranking, gray shading indicates medium ranking, and white means lower ranking.

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[4] For example, the U.S. Climate Action Partnership, a coalition of business and nonprofit leaders, issued *A Call for Action* in January 2007, which provided recommendations to government in line with the group's support for an upstream or hybrid cap-and-trade system. This approach is also supported by the Chicago Climate Exchange, which allows members to trade GHG credits on a voluntary basis.

[5] An RPS is a policy that aims to increase the use of renewable energy by mandating that energy providers produce a certain fraction of their electricity from renewable-energy sources.

[6] We recognize the incentive effects of this policy and acknowledge that it is not as restrictive as, for example, a technology standard. Nevertheless, an RPS is not as flexible as a carbon tax or cap-and-trade policy; thus, we include it as part of a regulatory package.

fuel, is less cumbersome, since there are far fewer producers than consumers of energy.[7] Regulatory standards are less cost-effective, in particular because they typically fail to target firms or consumers that can reduce emissions at the lowest cost.

Fairness of Distributional Impacts

As discussed previously, the general hypothesis is that policy packages are seen to be more fair distributionally to the extent that payments bear some relationship to gains from emitting GHGs (polluter pays) and that compliance burdens are scaled in some way to reflect the ability to absorb them (means testing). By these metrics, allowances allocated for free to emitters are likely to score lowest, since the primary beneficiaries are expected to be the companies receiving free allowances and their shareholders rather than those affected by higher energy costs or transitional job losses. Carbon-tax revenues that support deficit reduction would also receive a relatively low score, since funding would not target adversely affected groups. The distributional fairness of standards-based regulatory approaches in general will depend on how they are designed. However, to the extent that they are seen as targeted more at companies or individuals most able to afford GHG-mitigation investments, they are likely to be perceived as being more distributionally fair than market-based mechanisms.

Incentives for Innovation

As with cost-effectiveness, the two market-based policy packages are ranked higher than the regulatory standards package in terms of providing incentives for innovation. An across-the-board tax on carbon emissions regardless of sector or an equivalent allowance-trading system would foster a variety of cost-reducing innovations spread throughout the economy, not just in targeted sectors.[8] However, many would see relying only on mechanisms that create additional demand (or "pull") for new technologies as not enough "push" for innovation. Finally, since energy-efficiency and renewables requirements are more technologically prescriptive, the incentives for innovation are likely to be more limited in the regulatory package.

Adaptability of Policy Framework

A cap-and-trade program with free allowances is likely to be the most adaptable policy design among our examples. The primary elements to be adjusted are the aggregate allowance ceiling and share of free allowances (100 percent, in our nominal package). The economic and political investments in obtaining and then maintaining a status quo allowance allocation are likely to create resistance to change, however. In principle, the carbon-tax option would also be relatively adaptable; however, experience suggests that changing tax rates legislatively encounters general resistance. Technologically prescriptive regulatory standards are likely to be less adaptable than either of the other two options, as investments to comply with specific regulations may be

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[7] Gasoline taxes are currently implemented this way—paid at the refinery, not by individual stations—and this makes for streamlined collection and fewer possibilities for fraud. In practice, there are cost differences between mechanisms that generate revenue and use it for reducing other economy-distorting taxes and mechanisms that raise no revenue or use it for deficit reduction or lump-sum rebates (Goulder, Parry, and Burtraw, 1997). However, our focus in this paper is on policy packages that are not linked to other, potentially controversial changes in tax policy.

[8] Under a carbon tax, industries would have an incentive to continue innovating to bring costs down, while, under allowance trading with a particular level of emissions mandated, incentives to innovate may be weaker. Moreover, if an emission-trading program targeted only large sources, it would not have the same across-the-board effect as a comprehensive carbon tax. See, for example, Fischer, Parry, and Pizer (2003).

stranded by subsequent changes and beneficiaries will lobby for continuation of tax benefits. We should note, however, that any given technology standard (e.g., appliance standards) may be relatively flexible in terms of updating or tightening the regulatory requirements.

Political Viability

The political viability of a GHG policy package is a subjective issue, but there is a reasonable prospect that our nominal package of regulatory standards would receive a higher ranking on this criterion than the two market-based packages. Regulatory standards are a familiar option to U.S. policymakers and may be viewed favorably by consumers, as is the case with the CAFE program. Cap-and-trade programs also have a regulatory history in the United States, and the numerous actual policy proposals for cap-and-trade suggest that this policy approach would receive some political support. However, the economy-wide cap-and-trade approach in our nominal example, with upstream limits on fossil-fuel supplies, seems likely to receive less support in practice than a more narrowly targeted approach to controlling industrial and power-sector emissions. By similar reasoning, the carbon tax would have the least political viability, given general public and congressional resistance to tax-based approaches limiting energy use. The proposed use of tax revenue in our nominal package would also detract from its political viability, since deficit reduction may be a less popular use of revenue than other options.

Adjusting Policy Design to Enhance Performance and Viability

We now illustrate ways to improve our nominal policy packages' scores on the normative criteria and enhance overall political viability by adapting the packages to more extensively address burden-sharing. The failure of the BTU tax testifies to how difficult it can be to institute a broad, incentive-based policy when at least part of the opposition is based on its impacts on various stakeholders. Thus, while carbon taxes and cap-and-trade programs rank high in terms of cost-effectiveness and provide incentives for innovation, neither option as initially specified is very likely to find broad enough support with the general public and elected officials to be put into effect without some mechanisms to help alleviate initial shocks and the distributional impacts that would result. On the other hand, some of the options for enhancing political viability are likely to reduce the cost-effectiveness or adaptability of the policy framework; some could also compromise broader distributional fairness by concentrating impact mitigation on selected stakeholder groups with greater political power. The challenge then becomes how to add elements to increase political viability without sacrificing too much in terms of other normative characteristics. As noted, this is especially difficult in terms of maintaining the benefits of incentive-based packages.

Carbon Tax with Revenue Reallocation. Although the carbon tax is relatively cost-effective and provides incentives for innovation in the form of price signals, using tax revenue only for deficit reduction ignores other desirable options for revenue allocation. The carbon-tax package can be altered to channel some revenue for technology development and adoption, such as government-sponsored R&D programs or subsidies for automobiles or high-efficiency appliances. Revenue could also be used to help displaced workers or low-income consumers by offsetting payroll or income taxes or targeted tax credits.

Changing the way revenue is used in this fashion can increase the performance of the carbon-tax policy on multiple criteria. In Table 4.2, we represent these changes by

Table 4.2
Ratings After Policy Modifications

Package	Cost-Effectiveness	Distributional Fairness	Innovation Incentives	Adaptability	Political Viability
Carbon tax with revenue reallocation	[dark]	[gray]	[dark]	[gray]	[gray]
Cap and trade with allowance auctioning	[dark]	[gray]	[dark]	[gray]	[gray]
Regulatory standards with targeted financial incentives	[white]	[gray]	[gray]	[white]	[dark]

NOTE: Darker shading means higher ranking, gray shading indicates medium ranking, and white means lower ranking.

adjusting the ratings for distributional fairness and innovation incentives upward. We argue that this also increases the policy's political viability, since revenue is now used to increase the package's appeal to groups most affected by the higher energy costs resulting from imposing a tax on the carbon in fossil fuels. Note that, since there is significant flexibility at least initially in the distribution of revenues, there is considerable scope for customizing the consequences for the aforementioned criteria.

Cap-and-Trade with Allowance Auctioning. A critical component of a cap-and-trade program is how to deal with allowance allocation, and our initial nominal policy package assumes one extreme by providing all allowances for free. An alternative is to auction a share of the allowances initially and increase that share over time. Auctioned allowances would likely reduce political support from sources covered under the trading system, but consumers would likely find the approach more appealing, especially if some auction revenues are rebated to low-income households to counteract the impacts of higher energy costs. Some revenue generated through auctioning could also be allocated to technology research and demonstration programs, thus increasing innovation incentives. Revenue use in this case would look similar to the revised carbon-tax package and have similar flexibility. These changes would increase the package's score on general distributional fairness and innovation incentives. The impacts on political viability are less clear; we assume in Table 4.2 that this measure remains constant to the extent that the competing interests of firms and households balance each other.

Regulatory Standards with Targeted Financial Incentives. Our third initial nominal package assumes voter aversion to directly raising the energy costs of households and other politically influential users, as well as resistance to visibly exacerbating regional differences in energy costs. Sectors that might stand to lose significantly under this regulatory system (e.g., domestic automakers straining to raise fuel efficiency) likely would militate for some form of cost relief. With a focus on technology-based standards, cost relief could come through tax breaks or special standards for the most "vulnerable" sectors. The package could also be changed to subsidize the rapid development of alternative, lower-carbon fuels, acknowledging that subsidies are often difficult to target and thus can have significant economic costs or engender adverse environmental side effects.

Combining incentives with standards seems to have significant interest for some environmental organizations. One rationale is the ability to specifically target vehicle, appliance, and building energy efficiency without increasing the price of fuel.[9] Similarly, incentives for renewable energy, such as the existing production tax credit, could be combined with RPS to promote uptake.

The modified regulatory-standards package would attain even higher political viability while increasing the incentives for innovation. However, neither adaptability nor cost-effectiveness would increase, especially because the updated policy contains as many, if not more, regulatory levers. Moreover, because the costs of compliance are less transparent under this regulatory approach, policymakers and the general public will have greater difficulty weighing the fairness of competing claims for financial incentives. For this reason, the impact on distributional fairness is unclear and would be very sensitive to the extent that financial incentives targeted recipients bearing larger compliance burdens relative to their means. In Table 4.2, we assume no change in this measure.

[9] For example, the Natural Resources Defense Council supports a mixed strategy of a cap on emissions combined with building-code and appliance mandates.

CHAPTER FIVE

Conclusions and Implications

Targeted regulatory standards and financial incentives can exert a strong political pull. Targeted tax credits offer a means for Congress and an administration to "sweeten the pot" for various supporters. In addition, some pertinent regulations (such as CAFE standards) already exist, and tightening regulations already in place is generally easier than passing new regulations. Finally, many of the industries that would face regulatory standards are accustomed to this model, so they might be willing to accept such a familiar model and lobby on the stringency of standards rather than confront the uncertainty engendered by an untested system, such as widespread GHG-allowance trading.

Cap-and-trade with allocated allowances also offers some political as well as economic advantages. Industries that could less easily reduce their emissions would have a relatively straightforward and cost-effective means of compliance, as well as the hope of lobbying for an initial allowance distribution in their favor. In comparison, a comprehensive carbon tax or auctioned-allowance approach would constitute the greatest change from the status quo.

The analysis summarized in Table 4.2 in Chapter Four shows how both incentive-based and standards-based policy packages can be adjusted to increase their perceived distributional fairness, incentives for innovation, and political viability. However, what is also notable in comparing Tables 4.1 and 4.2 is that, in both matrices, the standards-based package performs better than incentive-based packages on political viability, even though the latter do better on cost-effectiveness and innovation incentives. This highlights that evaluation of GHG policy frameworks against multiple criteria does not dispose of conflicts between economic or other normative criteria on the one hand and political viability on the other.

While much rhetorical support has been offered for cap-and-trade, no agreement has emerged on implementing this approach. Debate over various pieces of cap-and-trade legislation reveals the strong continued influence of differing views about economic impacts and burden-sharing (see, e.g., Stavins, 2007). It seems likely that any of the various approaches for national GHG limits that have been advanced in Congress through 2008 will undergo significant further adjustment before a final package is passed and implemented. One question going forward is the trade-off between potential for increases in political viability and negative impacts in one or more of the normative criteria we have considered.

Stakeholder desires for less visible regulatory impacts or for special regulatory treatment are inevitable and understandable. Realistically, a national policy for GHG mitigation will need to find ways to accommodate these desires. It will not be feasible to just resist them in supporting a policy framework that is better in principle but unable to obtain sufficient political support to be enacted. The challenge, as noted previously, is to make the accommodations as low-cost as possible in terms of other desirable characteristics of the resulting policy framework.

To this end, we first suggest that *a GHG-mitigation policy framework should combine reliance on incentive-based emission-limitation mechanisms to improve cost-effectiveness with transparent burden-sharing mechanisms. These mechanisms should be limited in number, means-tested, and, for the most part, limited in duration.* Raising revenues with a carbon tax or auctioning emission allowances provides funds that can be used for mitigating compliance burdens deemed important to address. However, these funds need to be allocated among competing uses, thus providing a mechanism for making more-explicit trade-offs among alternatives. Even if redistributions are made through allocation of allowances, tax preferences, or direct subsidies to affected groups, there is a need to establish clear priorities among different groups of potential beneficiaries and to means-test claims for assistance against estimates of actual burdens.[1] On grounds of fairness, there would seem to be a reasonable argument for some time-limited adjustment assistance to workers and communities most adversely affected by GHG policies (e.g., in coal-mining regions), whereas most industrial sectors have more options for mitigating costs and diversifying risks. Any preferential regulatory treatment offered to a relatively small number of sectors in which higher energy costs could be a major burden on global competitiveness should require periodic reauthorization, based in part on how international participation in GHG mitigation grows over time.[2] The strongest case for ongoing redistribution would come from using a comprehensive carbon tax or auctioned-permit system and then recycling most of the proceeds to individual households with extra measures for mitigating burdens on low-income households.

For good performance, especially over the longer term, a GHG-mitigation policy package needs to be coupled with a comprehensive, strategic policy for GHG-reducing research, development, and demonstration (RD&D). As illustrated by the Senate debate over GHG cap-and-trade policies in 2008, there is a considerable attraction to incorporating in the policy framework a large number of dedicated (i.e., earmarked) revenue streams from allowance auctions for use in advancing various low-carbon technologies. One difficulty with a highly prescriptive approach to R&D funding allocation is that it makes it hard, over time, to target funding toward emerging options with the greatest promise. Locking in funding limits the ability to change allocations as new information is gained about the various options being supported or about entirely new options. In the worst case, the funding shares become entitlements rather than fueling the top-flight innovation opportunities. In addition, this approach makes it difficult to distinguish between technology advances in which government R&D support is more critical and technical advances that the market would accomplish anyway under incentive-based mitigation policies. A strategic approach is also needed for government co-financing of technology deployment whose economic competitiveness is not yet tested.

A strategic energy RD&D policy can help mitigate these challenges. Development of a detailed characterization of such a policy is beyond the scope of this paper. However, drawing in part on our previous review of the PNGV, we argue that key elements would include the following:

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1 This argument is made in support of economic efficiency, not just equity. Increases in tax expenditures will raise the indirect economic costs of distortions from other taxes (Goulder, Parry, and Burtraw, 1997).

2 Morgenstern et al. (2007) summarize the impact of CO_2 pricing policies on U.S. manufacturing competitiveness; for a discussion of mitigation options, see Morgenstern (2007).

- funding over time that is relatively stable (in real terms) but also consistent with anticipated societal benefits (not just with petitions for financial support)
- periodic, independent evaluation of the merits of alternative lines of R&D to expand options for mitigating GHGs more cost-effectively. Other benefits are relevant and should be considered but should be treated as secondary.
- support that is coupled with a merit-based allocation framework based on competitive evaluation of R&D funding proposals (not project-specific earmarks)
- regular exchange of information and coordination with the private sector to limit overlaps, recognizing that public and private R&D initiatives have different functions
- limited, targeted public-sector financial support for technology deployment. In a situation with policy-based incentives for GHG mitigation that can help accomplish this societal goal cost-effectively, public-sector involvement should be limited to initial investments that can provide a high social return in reducing the uncertainty about the commercial-scale costs of new technologies.

While significant compromises among different policy attributes will likely be needed to obtain sufficient political agreement on implementing a GHG-mitigation policy package, it is important to limit irreversible commitments that would constrain the long-term adaptability of the policy framework in the face of uncertain and changing circumstances. A vivid illustration of this point is provided by debates in 2008 over the inclusion of motor fuels in a comprehensive cap-and-trade system. The only practical way in which this can be accomplished at present is through measures that directly raise the price of conventional fuels to consumers. Dramatic fuel-price increases in 2007 and early 2008 illustrated the potential of economic incentives for fuel conservation, though the sharp drop in fuel prices during the latter part of 2008 significantly pared back the incentive. Higher fuel prices create longer-term incentives that are crucial for motivating changes in vehicle choices, alternative fuels, driving patterns, and even land-use decisions in order to cost-effectively reduce a significant share of total GHG emissions. But this approach is likely to be the most contentious element of any potential GHG policy package among individual voters.

Against this backdrop, we note first that fuel-economy standards are already scheduled to rise (along with elimination of the less demanding standard for light trucks and SUVs). Although there continues to be some debate over the relative impacts and cost-effectiveness of fuel price incentives and fuel-economy standards, the latter approach will begin to move the transportation sector toward a lower-GHG future. In the longer term, both public- and private-sector R&D will expand options for cost-effective GHG reductions in the transportation sector.

These observations together suggest that it could be reasonable to consider an initial GHG-control system with an incentive-based approach focusing mainly on large, stationary sources in order to increase political viability, *provided that ample provision is made for incorporating vehicle and other emissions in the medium term*. The incentive-based component could be imposed through carbon taxes (on fuel inputs used by the covered sources or directly on emissions) or by a downstream cap-and-trade system (with some mix of auctioned and allocated allowances subject to the caveats noted previously). Particularly if a significant fraction of allowances are auctioned, the cap-and-trade component would generate revenue to address distributional concerns and RD&D financing. In this approach, motor-fuel taxes still could be elevated to replenish trust funds for transportation infrastructure, to improve energy security by inducing less petroleum consumption per distance traveled, and to help stimulate alternative fuel and vehicle technologies. In the near term, however, expectations for reduced GHG emissions from higher motor-fuel prices would be limited—consistent with the low price-responsiveness of motor-fuel demands in the nearer term, given limited opportunities for substitution.

The key to large and cost-effective GHG-emission reductions over the longer term would be the ability to add in emissions from transportation in the not-too-distant future and the fostering of expectations that this will occur. Adding in transportation fuels could be accomplished simply by expanding the coverage of carbon taxes or by expanding the cap-and-trade program to cover all emissions and fuels (either all upstream or mixed upstream-downstream). However, the political willingness to do so—and thus the credibility of efforts to foster such expectations—would depend on the perceived affordability of lower-carbon options in transportation, the potential availability of funding to promote greater burden-sharing, and general public concern over the threats of climate change. To increase funding for burden-sharing and further advances in RD&D, it would be important in the initial program for large sources to transition fairly rapidly toward auctioning most allowances. At the same time, in order for the incremental cost of GHG mitigation not to differ too greatly between transportation and other sectors (implying a considerable diminution of cost-effectiveness), significantly increasing the stringency of the initial cap on large sources would need to be coordinated with the transition to a more comprehensive policy framework. This would become part of the political calculus in negotiations over broadening and toughening future GHG limits for the country as a whole.[3]

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[3] Most of the cap-and-trade bills that have been proposed contain fairly detailed, long-term paths for aggregate GHG restrictions. These are at best symbolic and at worst counterproductive, since they imply an illusive level of certainty about the desired time path toward sharp cuts in long-term emissions. The timing of emission cuts will be sensitive to the rates of advance in low-carbon technologies as well as the long-term target. Our focus here, in contrast, is on GHG-mitigation policy packages that could be implemented in the near term and adjusted over the medium term.

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