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Introduction

The current Congress has its hands full with many high priority issues, but for the first time, climate change is one of them. Both the Senate and the House are working to develop mandatory federal measures to control U.S. emissions of greenhouse gases (GHGs). As anyone close to the debate knows, the design of these measures is extremely complex and the political, environmental, and economic stakes very high.

This paper has three objectives. First, I provide a broad overview of leading legislative proposals in the Senate, focusing on six important design elements. Second, I review the structure and operation of the European Union Emissions Trading Scheme (EU ETS)—the cornerstone of the European Union’s GHG emissions-reduction policies—and describe some lessons that have bearing on the design of a U.S. system. Third, I discuss some of the challenges and opportunities a carbon-constrained economy holds for the business community and provide some brief closing comments.

Congressional Action

Under active discussion in the U.S. Senate are four bills—Sanders-Boxer, Kerry-Snowe, McCain-Lieberman, and Bingaman-Specter—that set mandatory caps on economywide greenhouse gas emissions. These bills are similar in many respects. They all call for mandatory caps on GHG emissions and either mandate or recommend a market-based cap-and-trade system. In addition, each bill addresses all six GHGs and contains provisions to accelerate research, development, and deployment of climate-friendly technologies.

Although the bills share many similarities, they do differ. When comparing these or any additional bills that will be forthcoming in the Senate or the House, there are at least six important questions to ask:

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1. What is the scope of the regulatory program—that is, how many sources of GHG emissions are regulated by the program?
2. Who gets regulated?
3. What are the emissions-reduction targets?
4. What do we know about the expected cost to reach the target?
5. Do the bills try to limit uncertainty about costs?
6. And if a cap-and-trade program is used, how are the allowances allocated?

What Is the Scope of the Regulation?

While four of the bills mentioned above address emissions throughout the economy, other proposals and approaches regulate only a portion of the emissions. For example, a bill offered by Senators Feinstein and Carper regulates only the electricity industry, which represents approximately one-third of GHG emissions in the United States.

The scope of a regulatory program is important because market-based approaches like cap and trade work by seeking out the cheapest reductions wherever they are in the economy. The larger the program (i.e., the more GHG sources covered by the program), the more opportunities exist to find cheap reductions.

Who Gets Regulated?

The McCain-Lieberman bill regulates electric power generators downstream, where the fossil fuels are combusted and the GHGs emitted, but the bill regulates emissions from the transportation sector upstream at the point of the petroleum importer and refiner. This potentially leaves smaller sources, such as households and agriculture, outside the transportation sector uncovered.

Bingaman-Specter regulates all sources upstream, providing virtually economywide coverage, while Kerry-Snowe and Sanders-Boxer leave the determination of regulated entities to the discretion of the U.S. Environmental Protection Agency (EPA). There is an important link between the scope of the regulation and who gets regulated. Generally, the further downstream you move toward the point of emission, the less coverage (in terms of total emissions) the regulatory program will have. This can be seen clearly in the structure of the EU ETS, which I discuss later in this paper.

What Are the Emissions-Reduction Targets?

Kerry-Snowe and Sanders-Boxer share common long-term emissions-reduction goals, specifically the stabilization of global GHG concentrations at 450 parts per million of carbon dioxide equivalent (CO₂e), slightly more than the current level of 430. To achieve this goal, the bills call for reductions in U.S. GHG emissions of about 60% below business as usual (BAU) by 2030 (although they do not specify the assumed targets for other countries).

The other two bills do not set long-term goals for atmospheric GHG concentrations. Bingaman-Specter requires reductions in GHG emissions intensity, resulting in a reduction in U.S. emissions on the order of 22% below BAU by 2030. And McCain-Lieberman would reduce emissions by almost 60% in 2030.

A table of specified caps in 2020 and 2030 is provided below.

Emissions-Reduction Targets

	2020	2030
Sanders-Boxer	42.0%	63.0%
Kerry-Snowe	42.0%	61.0%
McCain-Lieberman	39.0%	59.0%
Bingaman-Specter	7.6%	21.9%

A key question in many of these bills is whether to meet the target through offsets. While included to some extent in all bills, ambiguity in some about whether there will be a generous or careful approach to such offsets implies considerable uncertainty about the true constraint on regulated emissions and, in turn, costs

What Do We Know about the Cost to Reach the Target?

With the exception of Bingaman-Specter, there is limited analysis to draw upon when attempting to estimate the costs of implementing the various proposals. The recent Energy Information Administration (EIA) analysis of Bingaman-Specter found that the allowance price in 2025 would be about \$11/ton CO₂e, corresponding to an emissions reduction of 10% below BAU. However, to examine more aggressive targets, we must turn to other information.

An earlier 2004 EIA analysis of the McCain-Lieberman bill (S.A. 2028) sheds some light. The 2004 analysis employed different assumptions than one would use in an analysis of the current bill. Keeping these differences in mind, EIA found that a 22% reduction in GHG emissions from BAU in 2025 led to a \$45/per ton CO₂e allowance price. Thus, a doubling in the percent reduction from BAU (10 % to 22%) led to a four-fold increase in the allowance price.

We can combine both EIA studies and examine the impact allowance price has on electricity price. The EIA analysis suggests an \$11/ton CO₂e allowance price in 2025 would cause electricity prices to rise by 6.5%, whereas a \$45/per ton CO₂e allowance price would cause electricity prices to rise by 35%. The McCain-Lieberman, Kerry-Snowe, and Sanders-Boxer bills all call for emissions reductions of around 40% by 2020 and 60% by 2030, so allowance prices under these plans could be considerably higher—so, too, the effects on electricity prices.

Do the Bills Try to Limit Uncertainty about Costs?

Three of the bills allow banking (while Sanders-Boxer is silent on this issue). That is, businesses can hold extra allowances for use in the future, rather than having to use all their current allowances in a given year. This has the effect of creating a floor on the price of allowances determined by expectations about the future. As long as businesses view the future as one with tighter carbon constraints, they will tend to hold onto allowances rather than sell them at a price that is too low.

Both McCain-Lieberman and Bingaman-Specter have features that provide flexibility when prices are unexpectedly high. Bingaman-Specter provides a transparent “safety valve” that literally sets the maximum price for allowances. When allowances reach that price, the government stands ready to sell additional allowances to prevent the price from going higher. McCain-Lieberman instead allows borrowing: if businesses perceive a temporary shortage, they can borrow for up to five years, a total of 25% of their obligation (while paying a 10% annual interest charge). This does not provide guarantees of a maximum cost but does provide flexibility in the face of short-term weather, economic, or other shocks.

How Are Allowances Allocated?

A GHG cap-and-trade allowance system creates and distributes responsibilities to reduce GHG emissions to regulated entities. At the same time, the system creates and distributes wealth in the form of allowances. In the case of the sulfur dioxide (SO₂) trading system set up under the U.S. Clean Air Act, responsibilities and allowances both went to regulated entities, with the allowances allocated gratis (for free). However, other allocation schemes are possible. Under

many of the new bills, responsibilities and allowances flow to different entities, and some allowances are sold at auction rather than freely distributed.

Bingaman-Specter is explicit about the allocation of allowances and calls for an initial auction of 10% of all allowances in 2012, a figure that is to gradually increase to 65%. The remainder of each year's allowances will be distributed gratis to industry and states. The other bills leave the allocation of allowances to the discretion of the EPA administrator (Sanders-Boxer), the president (Kerry-Snowe), or the secretary of commerce jointly with the EPA administrator (McCain-Lieberman).

Other Features of the Bills

The functionality of the proposed cap-and-trade systems also differs across bills. While most contain specific provisions for the banking of allowances, the Sanders-Boxer bill leaves it to the EPA administrator to determine the rules for any system of tradable allowances.

All bills have provisions for offset credits generated from biological sequestration for GHGs (both in plants and soils), while Bingaman-Specter allow for more general offset programs. Furthermore, Bingaman-Specter and McCain-Lieberman have provisions that permit international credits to be used to meet domestic commitments.

As mentioned above, all bills have stipulations for programs designed to accelerate the pace of climate-friendly technology. However, the specificity of the provisions and the range of actions considered vary. On one hand, Kerry-Snowe call for a generic increase in federally funded R&D for low-carbon energy technologies (to be funded with proceeds from a yet-to-be-determined allowance auction) and then turn to very specific tax credits for consumer purchases of hybrid cars and for manufacturer investment in new equipment for the production of such climate-friendly cars (although with no funding source identified). At the other extreme, Bingaman-Specter lists specific technology policies and allocates resources from the allowance auctions to fund these programs.

Finally, Sanders-Boxer and Kerry-Snowe contain multiple additional regulatory provisions that extend beyond a cap-and-trade system. Since EIA has not undertaken any analysis of these bills, it is not possible to state how costly these additional provisions will be.

The European Union Emissions Trading Scheme

Having discussed various U.S. proposals in some detail, we now turn to the EU ETS, both to understand how it operates and derive possible lessons for U.S. stakeholders. The EU ETS is the cornerstone of the European Union's efforts to meet the GHG emissions-reduction goals set forth in the Kyoto Protocol. The EU ETS is an emissions allowance cap-and-trade system, similar in many respects to the current system used to control SO₂ under provisions of the U.S. Clean Air Act. Both the U.S. Senate and House held hearings in March to learn about the structure and performance of the EU ETS with an eye toward lessons that can inform the design of U.S. system.

EU ETS Structure

The EU ETS began in January 2005, includes the 27 countries of the European Union, and is run in two phases. Phase 1 (2005 to 2007) was intended to be a trial period to work the bugs out of the system; however, in all respects, it is a mandatory and binding cap-and-trade system. Phase 2 (2008 to 2012) coincides with the Kyoto commitment period. Specifications regarding future phases have yet to be established, but the program is intended to run indefinitely.

The cap imposed by the EU ETS covers only CO₂, although other greenhouse gases may be added in the future. In contrast to the four Senate bills discussed above, the EU ETS is not an economywide cap-and-trade system. Rather, it regulates downstream about 12,000 emission sources, accounting for half of all EU emissions. As noted above, the downstream point of regulation adopted by the European Union is in part responsible for the fact that the trading scheme captures only 50% of the CO₂ emissions.

Covered sources include iron and steel; cement, glass, and ceramics; pulp and paper; electric power generation; and refineries. Transport is not currently included in the system, although the European Union will include air transport in 2011.

Certainly, the most contentious and politically charged issue the European Union faced in Phase 1 and now in Phase 2 involves allowance allocation—which, in the European Union, also includes setting the cap. Each member country submitted for approval plans for the allocation of allowances under Phase 1. The European Commission is in the process of finalizing National Allocation Plans (NAPs) for Phase 2. NAPs describe three decisions each country must make. First, how much of a country's Kyoto target will the sectors participating in the trading system

be assigned—that is, what is the cap for the ETS? By implication, the remainder of the Kyoto target not allocated by the EU ETS must be met by sectors outside the system—for example, transport or agriculture. Second, how much of the cap will each sector included in the EU ETS (for example, electric power versus iron and steel) be assigned? And third, how will the sector allocation be further subdivided among individual companies?

Phase 1 rules allowed countries to auction an upper limit of 5% of the allowances; only Denmark chose to auction the full 5%, the remainder being allocated gratis. More auctioning is likely to occur in Phase 2, during which the upper limit on auctioning is expanded to 10%.

Emissions sources covered by the EU ETS may satisfy their commitments by surrendering allowances in an amount equal to their emissions or may supplement the EU ETS allowances with credits available under Kyoto Protocol rules. These include Joint Implementation and Clean Development Mechanism credits. As a result, the price and availability of these Kyoto credits will have bearing on the price of EU allowances.

The EU ETS Allowance Market Performance

Early in Phase 1, allowance trades were handled by brokers outside of formal exchanges. Currently about half the trading volume occurs on exchanges and the other half over the counter. In 2005 about \$8 billion of trades took place, and by the end of 2006, this had grown to \$24 billion. Trades in the worldwide carbon market for 2006 may be on the order of \$30 billion—with the lion's share owing to the EU ETS.

The EU ETS allowance market experienced a good deal of volatility in 2006, capped by a very disruptive 70% plunge in the price of allowances in early spring 2006. The slide began during the last three trading days of April. At the time, traders had been projecting a total short per year of something like 80 million allowances. But then the Dutch government released figures detailing its 2005 CO₂ emissions, and the market began to realize that a total short of 80 million was probably too big.

Other governments quickly followed the Dutch and released data on 2005 emissions. The market slid from over €30.00 per metric ton on the morning of Wednesday, April 26, to €13.19 at the close of business on April 28. The European Commission added the crowning touch by accidentally posting emissions data on its web site in early May—data scheduled for release on Monday, May 15. Those figures showed that Germany had beaten its targets by 26.3 million metric tons, leading traders to conclude that the 21 member states who filed data had surpassed their emissions quotas by up to 60 million metric tons, rather than missing them by 60 to 80

million as had been the expected range just three weeks earlier. On the European Climate Exchange, futures prices for allowances expiring in December 2006 and December 2007 dropped to little more than €9.00 on May 15.

Most observers agree that the credibility of the EU ETS was shaken by the volatility last year but that Phase 2, beginning in less than a year, will not suffer the same teething problems as Phase 1. The April 2007 spot price for a Phase 1 allowance is around €1.00, or about \$1.30, while the price for a Phase 2 allowance on the futures market hovers around €6.50, or \$22.

Lessons from the EU Experience

Lessons from the EU experience can be placed in context by considering three features of cap-and-trade systems that are important when evaluating their policy effectiveness. First, cap-and-trade systems establish, alongside a new obligation to limit emissions, a new class of asset—the emissions allowance—and these assets will have immediate value once the system is established; therefore, initial allocation of allowances is an allocation of wealth. Second, cap-and-trade emissions-reduction policies impose a cost on society, and once the initial allocation is made, the distribution of that cost will be determined by the market, not government policy. And third, the spot price is a visible signal regarding the current cost of GHG reductions, while the future price reflects expectations regarding future cost. Importantly, the futures price takes into account expectations regarding government policy decisions and the future cost of abatement—closely linked to available abatement technology.

Lesson 1

The performance of a cap-and-trade market hinges on accurate emissions monitoring data, reporting, and enforcement. For most fuel-related emissions, this requires accurate data on fuel use and emission factors. At the outset of the EU ETS in Phase 1, many nations lacked reliable data reporting systems, which in part contributed to extraordinary price volatility.

- The lesson—inclusion of sectors and sources should be preconditioned by the development of strong emissions monitoring, data collection, and accounting systems. Data on actual emissions should be released in a gradual and orderly fashion, much as economic data releases are currently managed by the Department of Commerce.

Lesson 2

The ability of government to distribute the economic burden a cap-and-trade system will impose on the economy is greatest during the allowance allocation stage. And importantly, the manner in which permits are allocated can alter economic incentives, leading to a variety of unintended consequences.

- The lesson—think very carefully about allocation, and keep the allocation rules as simple and as transparent as possible. Learn your lessons from history and not the law of unintended consequences.

Lesson 3

Allowances are assets that can have significant value. At the same time, a trading program that terminates without banking into the future, such as Phase 1 of the EU ETS, will tend to drive prices to zero or, in the event of a shortage, boundlessly high.

- The lesson—develop effective banking rules.

Lesson 4

Near-term investments in R&D and technology needed to radically lower GHG emissions tend to be large and very long lived. Allowance prices are intended to incentivize these investments and must have as little political uncertainty as possible. At the current time in the European Union, there is considerable uncertainty concerning the level of emissions reductions EU governments will actually require post 2012.

- The lesson—governments need to be as clear as possible about emissions-reduction targets, particularly prices, the commitment periods need to be as long as feasible (certainly longer than current Kyoto periods), and allowance banking is required.

Business Challenges and Opportunities

There is no doubt mandatory GHG emissions-reduction policy will create challenges and opportunities for business—likely challenges for some and opportunities for others. Both the severity of the challenge and the size of the opportunity will depend on the magnitude and pace of the emissions cuts and the economic efficiency of the regulatory structure. It's easy to imagine large, swift cuts giving rise to large challenges for some and great opportunities for others, but poorly designed, overly political, and inefficient policy will only add to the burden of the regulation without an offsetting rise in business opportunities. Politics will likely have a great

deal to say about the emissions-reduction goal, but business should be adamant that the goal is achieved efficiently and at least cost.

The Devil's in the Details: The Design of Federal Legislation Matters

Well-designed federal policy rests on twin foundations—a credible and transparent price on GHG emissions, and a set of complementary policies to accelerate the pace of development and commercialization of climate-friendly technology. Economywide incentive-based approaches like cap and trade (suggested in the four Senate bills) or GHG emissions taxes will be required to set the GHG emissions price. The choice of complementary policies intended to accelerate the deployment of climate-friendly technology is much less clear. However, one should be wary of policies purporting to accelerate climate-friendly technology by mandating particular technology—renewable portfolio standards can fall into this category.

While a GHG emissions tax has many advantages, current U.S. politics seems to favor an allowance-based cap-and-trade system. Given such a system and past EU ETS experience, allowance allocation has emerged as a critical challenge in the policy debate, unquestionably due to the enormity of the financial stakes: tens or perhaps a hundred billion dollars a year will be divided up and possibly given away under an emissions-trading program. While this is first and foremost a distributional question of who gets what, there are a number of key economic concerns—first, the risk of possibly unintended consequences from tying allocations to some change in behavior; and second (to a lesser extent), an interest in the likely distribution of impacts under an emissions-trading program, onto which any allocation approach will be grafted.

The impact on business of alternative methods of allocation will be great, but the precise nature of the impact may not be immediately known. Gratis allocation to regulated firms can reduce the compliance cost burden or, depending on the number of allowances provided to each regulated firm, lead to extra-normal profits (as many suggest was the case for German electric utilities under the EU ETS allocation). Gratis allocation to non-regulated entities—for example, energy-intensive industry or low-income households—can blunt the economic cost burden of the program. And allocation of allowances via an auction can provide government a large revenue stream that can be used for a wide array of purposes, ranging from offsetting distortionary taxes (e.g., FICA taxes) to funding technology R&D.

An important point to remember is that the method by which allowances are allocated can have a very large impact on the distribution of the regulatory burden throughout the economy, thereby creating challenges and opportunities for business. Moreover, allocation methods that act

to alter incentives regarding future economic behavior can alter investment incentives in ways that may not be fully appreciated by legislators crafting the allocation methods. These altered investment incentives will also lead to business challenges and opportunities.

Rising Energy Prices: Winners and Losers

In the near term (the next 10 years), federal GHG policy will cause the price of fossil fuels (petroleum, natural gas, and coal) to rise and, along with it, the prices of electricity and gasoline. These price increases will be felt throughout the county and across households and business but in varying degrees—for example, electricity price rises will generally be greatest where coal-fired generation is dominant. The magnitude of the price increase will be in direct proportion to the severity of the emissions cuts.

Unlike energy price increases in the past associated with unexpected events (e.g., the oil shocks of the 1970s and early 1980s), the passage of sweeping federal GHG policy will cause U.S. households and businesses to alter their expectations regarding the future path of energy prices. Each of the Senate bills discussed above provides credible signals to the U.S. economy that carbon prices are on the rise over the coming decades and, with them, energy prices. Changing household expectations regarding energy prices will change consumers' purchasing behavior regarding all long-lived energy-using durables (cars, homes, and appliances) as well as their acceptance of services designed to enhance their household energy consumption behavior.

While higher energy prices bode well for producers of energy-efficient durables, they represent significant challenges for energy-intensive manufacturers engaged in stiff competition with foreign competitors. Since many of those current and future competitors are located in countries like China and India with low- or zero-carbon prices for the foreseeable future, the effect of U.S. GHG policy on these sectors could be significant. For that reason, targets, allocations, and possibly countervailing measures for these industries need to be considered carefully.

Economywide GHG policies that capture the emissions from the transport sector will disadvantage petroleum as a transport fuel and create market advantages for increased petroleum fuel efficiency, non-petroleum liquid fuels, and new transport energy sources altogether. Markets for increased penetration of advanced diesel technology, plug-in hybrids, and biofuels will likely expand significantly in the next decade and might be the transport technology bridge to the as-yet-unknown zero-carbon transport future.

Higher energy prices will have larger effects on the welfare and spending patterns of low-income groups. Low-income energy assistance policies will likely need to be enhanced, but one can imagine that such programs will unlikely offset the complete economic loss these groups suffer. Thus, one should expect discretionary spending of these groups to be affected, impacting local economies and business firms serving these groups.

Macroeconomic Impacts: Growth, Investment, and Employment

Very aggressive near-term GHG-reduction policies can have macroeconomic implications. Reduction targets that do not match investment cycles can lead to stranded assets, slowed economic growth, and loss of employment. Such aggressive targets are not only economically painful, but also may in the end be counterproductive because they slow the rate of aggregate investment, which is precisely what is needed to transition to a less carbon-intensive economy.

Concluding Remarks

Three issues of relevance to GHG regulation in the United States deserve attention: actions of the states, piecemeal regulation, and adaptation. I touch on each of these briefly below.

As one observes and analyzes the development of federal GHG mitigation policy, one will surely be monitoring the actions currently under way in the states. California has already passed into law a significant statewide cap on GHG emissions and is now in the process of developing policies to meet that cap. Given the political and economic importance of this large state, how California chooses to regulate GHGs can influence federal policy. On the other end of the country, a set of northeastern states operating as the Regional Greenhouse Gas Initiative (RGGI) have not only adopted GHG caps, but have designed a regional cap-and-trade system—one that has attracted the attention of the EU ETS with an eye toward trans-Atlantic linkage.

The speed with which states are taking action raises the specter of patchwork regulation varying across states in terms of stringency and regulatory approach. This very real possibility gives added impetus to Washington to develop a single federal policy with uniform regulations. However, the train may have already left the station—this is surely the case for California and the RGGI states. Given the economic and political clout these states enjoy, one wonders if Congress can impose federal preemption. Add to this the possibility that these states may want to influence the shape and nature of a federal program based on their experience, and one can foresee some difficult state-federal negotiations ahead.

While the four Senate bills discussed in this paper are economywide and attempt to include under a single cap as much of the U.S. GHG emissions as possible, some senators and congressmen believe that a series of targeted bills is the better way to go. Senator Feinstein is in this camp, having already proposed an electric utility only bill followed by a separate transport bill, and other bills are planned. One might be able to craft such bills in a manner that achieves the economic efficiency of a single economywide regulation, but I doubt it.

Moreover, even in some of the economywide bills like Kerry-Snowe and Sanders-Boxer, there is no guarantee of economic efficiency with respect to the manner in which the economywide GHG caps are met. While these bills call for some sort of cap-and-trade program that could in principle lead to efficiency, the bills layer on a variety of other regulatory measures ranging from increased fuel-economy standards for the transport fleet to renewable energy portfolio standards for the electricity-generation sector. Layering on other regulations will likely diminish the efficiency of the cap-and-trade program.

While government policy to regulate GHG emissions in an effort to prevent climate change will pose challenges and opportunities for business, perhaps the greatest impact on the economy over the long haul may be due to necessary adaptation to climate change. The recent April 2007 IPCC (Intergovernmental Panel on Climate Change) report *Climate Change 2007: Impacts, Adaptation and Vulnerability* clearly stated that global warming is happening now, the world's natural systems are being impacted by the change, and humans will have to adapt to these changing natural systems

Recognizing the inevitability of adaptation, recent federal legislative proposals include funding to mitigate the harms caused by climate change, but do so almost as an afterthought, or simply in response to political pressure from coastal states. Moreover, these legislative proposals are wholly silent regarding policies that should guide federal action with respect to adaptation—the same can be said for state level policy development. Given the reality that some amount of climate change is inevitable, and the importance of considering the balance of adaptation and mitigation, it is increasingly critical to develop effective federal, state, and local policy options aimed at adapting to likely impacts of climate change. At the present time, there is relatively little political interest in this issue.