Prepared Statement of
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on
"Auctioning under Cap and Trade: Design, Participation and Distribution of Revenues"
before the
U.S. Senate Committee on Finance
Washington, DC
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Mr. Chairman and Members of the Committee:

Thank you for your invitation to participate in today's hearing. I am Anne E. Smith, a Vice President of CRA International and leader of its Climate and Sustainability Group. Starting with my Ph.D. thesis in economics at Stanford University, I have spent the past thirty years assessing the most cost-effective ways to design policies for managing environmental risks, including cap-and-trade systems. For the past twenty years I have focused my attention on the design of policies to address climate change risks, with a particular interest in the implications of different ways of implementing greenhouse gas (GHG) emissions trading programs. I have analyzed and commented on the merits and issues with all the major climate legislation proposals that the U.S. Congress has proposed and deliberated over that period. I thank you for the opportunity to share my findings and climate policy design insights with you. My written and oral testimonies reflect my own research and opinions, and do not represent any positions of my company, CRA International.

The topic of this hearing is auctioning under a cap-and-trade program. Policy makers are increasingly considering relying on allowance auctions more than on free allocations to distribute the allowances under a carbon cap-and-trade policy. Once the goal of the auction is well-defined, designing an auction to achieve that goal is a technical matter more than a policy matter. In contrast, the question of what to do with the revenues from a carbon auction (the "carbon value") is a very substantial policy matter. As the portion of the carbon value that is collected and redistributed by the government grows under a cap-and-trade program, the differences between cap-and-trade and a carbon fee or tax diminish. In my testimony, I highlight the remaining differences – which are predominantly related to uncertainties – and explain why effective management of that uncertainty is a critical aspect of a long-term, enduring carbon policy.

Distributing Carbon Value under Auctions versus Free Allocations

A cap-and-trade program with 100% auction of allowances would actually function much like any other cap-and-trade program that relies on free allocations. In the absence of any auction, if all the allowances are allocated to parties with compliance requirements, an allowance market forms naturally. Participants in that market include companies buying and selling solely to serve their compliance needs, but also include non-compliance traders (who I refer to as "speculators" but could include traders who are using allowance trading to hedge against energy or other price changes driven by carbon prices). The latter parties are considered helpful, especially during the period of market formation. If allowances are only available through a government auction, there will be no literal allowance transactions until after the first auction, but a secondary market for allowances would form immediately after the first auction. This secondary market will have all the same players as in the primary market that forms in the absence of any auction. Thus, even if participation in the auction were to be limited to compliance buyers only, speculators would still play an active role from the outset of the cap-and-trade policy.

In general, prices in the secondary market and in the auctions will converge, because they are selling identical products. However, this does not mean that there will be any difference in price uncertainty or volatility under an auction-dominated or an allocations-dominated cap. Both approaches to cap-and-trade will be marked by *a priori* uncertainty about fundamental carbon price levels, and *ex post* continual volatility in prices. The main difference between an auctioning approach and an allocations approach would be the technique by which the carbon value is distributed. Under an auction, that value would be distributed in the form of cash (e.g., via subsidies under other government programs, via increased spending by the government, or as direct rebate checks) after the auction is over. In contrast, under an allocations approach, the same amount of value as the auction revenue is distributed in the form of pieces of paper (i.e., “allowances”) in advance of market start-up that the recipients can then convert into cash by selling them.

Theoretically, any distribution of carbon value that can be accomplished under an auction can also be accomplished under free allocations. In practice, there are two key differences that may arise:

1. Free allocations to those with compliance obligations have been treated in the past (e.g., under the Title IV SO_2 cap) as having a zero basis for tax purposes. If used for the recipient’s compliance, there are no tax consequences. However, if the recipient sells any such free allocations, it must pay tax on the full profit from a zero basis. If the recipient needs to buy more allowances in the future, it incurs the full market cost. Thus, there is an incremental incentive for recipients of free allocations who have compliance obligations to hold unused allowances that were originally allocated for free, in order to use them for meeting future compliance obligations for which they would otherwise expect to need to buy more allowances. This tax-related concern can be mitigated in several ways other than simply avoiding free allocations.[1]
2. In practice, it is easier for the government to distribute the value of the allowances broadly to many small entities such as individual households and small businesses, if the government first converts that value into a pool of cash through an auction. Achieving broad allocations of relatively small amounts of value without an auction would entail the government sending out just a few allowance certificates to many different entities. These entities would then have to bear the burden of converting

[1] One way to eliminate the effect could be to change the rule that the tax basis of a free allocation is zero, and assign it a value equal to allowance prices at the time of the allocation.

them to cash, which would impose higher transactions costs, and could lead to scams and swindles of consumers or small businesses with little sophistication about the policy and few options for monetization. Such an allocation scheme could also produce an exceptionally thin market and very high prices in the initial years. Thus, any desire to distribute a portion of the carbon value broadly and in relatively small amounts per recipient will require an auction of that portion of the allowances. (Whether the Federal government should conduct the auction or designate a trustee to do it requires a more extended discussion.)

Benefits of Carbon Price Stability for the Government

If one perceives the above two points are arguments in favor of auctions over free allocations, it is worth considering what can be accomplished under a policy that directly establishes a price on carbon (or even a fairly narrow price collar), instead of relying on the uncertain price outcomes of an auction. The same benefits mentioned above would be maintained: no tax-related disincentives to trading, and greatly enhanced flexibility to distribute the carbon value more widely across many players in the economy. At the same time, an approach that directly establishes a carbon price, or directly narrows its range of variability, offers some additional benefits over an auction under a hard cap. These relate to the inevitable fact that carbon prices under a hard cap are highly uncertain in advance of policy implementation and are volatile long after implementation.

The pronounced degree of *a priori* price level uncertainty is apparent in the wide range of carbon price estimates produced by policy analysts using models of the economy. Figure 1 shows how estimates of carbon prices for the Lieberman-Warner Bill varied by about a factor of eight, even for the first year of the policy. This range does not just reflect alternative modelers' views: the minimum and maximum of the range both came from the EPA's analyses.

A pattern of *ex post* continuation of price instability or price volatility is also the norm in emissions markets. Figure 2 below prices in the EU's Emissions Trading Scheme (ETS) for carbon. Even ignoring the volatility in its learning phase ("Phase I" which ended in 2007), volatility continues to be endemic to this carbon market now that it is in its mature phase (see the "Phase II" prices in Figure 2). For example, many people mistakenly believe that the EU ETS's high price peak near €35/ton (roughly $42/ton) that was followed by a rapid descent to prices below €15/ton (roughly $18/ton) was a phenomenon confined to the learning during Phase I. However, as Figure 1 shows, Phase II prices have been even more volatile since that time. Less than a year ago, Phase II prices again peaked near €35/ton, and only eight months later they hit a low of about €8/ton. This volatility was not a result of "learning," nor of the first release of official emissions data. It was tied to

Figure 1. Range of Carbon Prices Projected for Lieberman-Warner Bill
(Source: T. Wilson, "Understanding Model Estimates of the Economic Costs of Climate Policy," EPRI Modeling Workshop, Washington, DC, May 8, 2008)

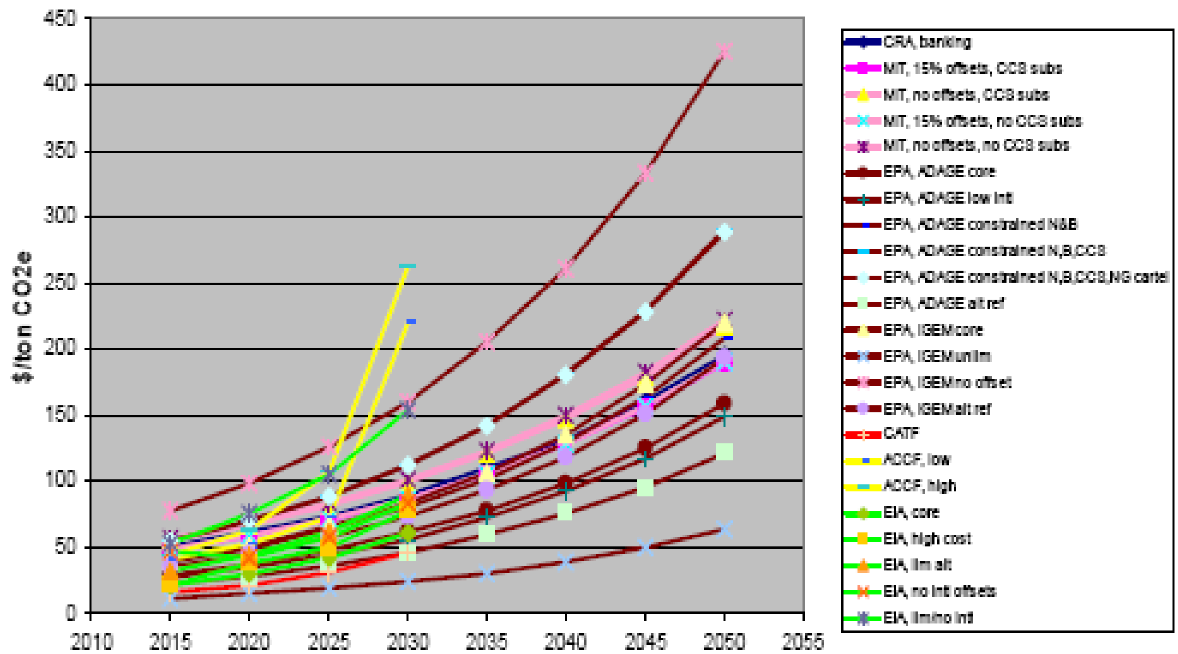
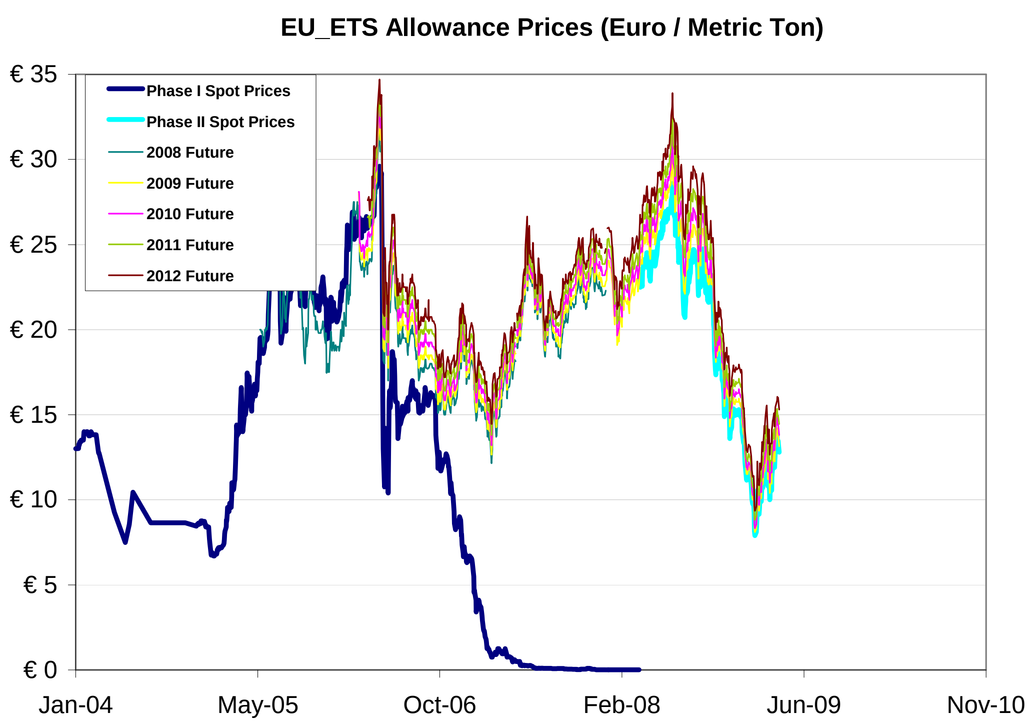


Figure 2. Prices Experienced in the EU ETS's Phase I and II.



macroeconomic outcomes unrelated to the carbon market *per se*. It is an example of what can be expected of any carbon market in the U.S. if firm price ceilings are not enacted with it.[2]

Government auction revenues will fluctuate continually, perhaps dramatically, in the face of such price uncertainty. The future path of revenues will also be very difficult to predict. The government ought to prefer to know what the carbon price level will be in advance of establishing its policies, enabling fairly robust estimates of the revenues that it will be receiving, and how they will change over time. This would enhance the prospects for providing stable funding for whatever rebate, subsidy, research and other programs the government may wish to fund with the carbon revenues. It will help avoid potentially disruptive year to year fluctuations in program funding, and fluctuations in the size of the rebate checks that consumers will come to expect, and perhaps even start to incorporate into their household budgets.

Thus, carbon price stability and *a priori* certainty can only be beneficial from the Federal government's perspective. Further, it is entirely in the government's hands to create such price certainty at the time that it enacts the policy that creates any carbon value at all. This could be done under a carbon cap through provisions to directly and transparently establish allowance price ceilings and price floors (e.g., a price "collar"). An even simpler and more certain approach within the toolkit of market-based measures would be to establish a carbon fee or price rather than through a carbon cap.[3]

Benefits of Carbon Price Stability for the Economy as a Whole

The private sector also will benefit from a carbon policy that offers carbon price certainty. For example, if the carbon price is known in advance – including how it can be expected to

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[2] The EU ETS is not an outlier among emissions markets. Almost all of the U.S. emissions caps have experienced comparable volatility. For example, the SO_2 market under Title IV of the Clean Air Act is widely considered to have been a highly successful cap-and-trade program, but has nevertheless suffered exceptional volatility in the past few years. During 2005, SO_2 permit prices rose from about $600/ton to above $1600/ton, then plummeted to below $400/ton by the beginning of 2007. They dropped below $100/ton in mid-2008 when the court remanded CAIR. Some have argued that banking reduces price volatility. While it may reduce it, it certainly does not eliminate it: this high SO_2 price high volatility occurred even though there was a large bank of allowances in place. Although prices in all previous and existing allowance trading programs have exhibited substantial volatility without causing much macroeconomic consternation, such price volatility is likely to have much greater generalized economic impacts under a CO_2 cap than for caps on SO_2 and $NO_{x.}$ CO_2 is a chemical that is an essential product during the extraction of energy from any fossil fuel. As long as fossil fuels are a key element of our energy system (which they are now, and will remain for many years even under very stringent caps), any change in the price placed on GHG emissions will alter the cost of doing business throughout the economy. This is because all parts of the economy require use of energy to one degree or another.

[3] In fact, a cap-and-trade system with a well-defined, narrow price collar and a full auction will function just like a carbon fee, except that there remains some residual uncertainty about the ability of the market manager to defend the price collar, and there is substantially more complexity to the compliance requirements for covered businesses. While both of these market-based approaches would offer much greater planning certainty and hence potential investment in costly low-carbon technologies, neither would be popular with the financial community, which would face diminished prospects for selling their carbon market management services to the affected businesses.

change many years forward, covered emitters can plan compliance more easily. They will be far more willing to undertake major capital investments in advanced, low-carbon technologies if they have some confidence that the carbon price level will either rise to, or continue to remain at levels that make such investments cost-effective. They may also find it easier to obtain funding for such investments if they are subject to less market risk. These are the predominant benefits of a policy that much more directly establishes a carbon price. An additional benefit is that emitters also can avoid the complex process of developing bidding strategies for auctions and hedging strategies for fine-tuning their needs in the secondary market.

The EU ETS experience has also demonstrated that even very high carbon prices do not necessarily translate into a willingness of the private sector to make investments in new, lower-carbon technologies. Despite the fairly high average prices in the EU ETS, there has been no serious degree of private sector investments in cleaner technologies.[4] The usual explanation for the failure of the EU ETS to motivate investments in clean energy technologies is the uncertainty its carbon price levels, and potential impermanence of the scheme. Even if investments in some clean technologies might be justifiable for the average carbon prices of about €20/ton that have been experienced over the past four years, they have not been forthcoming. Uncertainty on what the carbon price level will be – not just for the next few years but for 10 to 20 years into the future – appears to be inhibiting private sector investments in low-carbon technologies.

The EU's response to this outcome of low investment has been to focus on further government involvement and project subsidization. A simpler approach would be to devise a carbon emissions pricing scheme that would provide much greater certainty for businesses about carbon prices now and in the future.

Another potentially serious concern with volatility in carbon prices should also be mentioned here. When companies need to buy allowances to cover their emissions, as with a full auction, their new cash flow may be large compared to their current net revenue. For example, the cash needed by an electricity generating company that has a diversified mix of coal, gas and zero-carbon generation similar to the US average would face new outlays for allowance purchases of $35/ton allowances that are approximately 20% of its gross revenues, and perhaps 200% of its net revenues. Any delays in the pass-though of such costs to customers could seriously disrupt their financial position. Volatility exacerbates this situation by causing continual variations in the cash flow needs. For example, fluctuation in the allowance price between $15/ton and $50/ton would mean that the cash flow requirements might vary from 85% and 350% of pre-policy cash flows, thus even after price pass-through has occurred, delays in adjustments of the retail rates could translate into see-sawing profitability. Similarly, if a company has any substantial bank of allowances, it could face large swings in its balance sheet situation. Conditions such as these could translate into reduced credit ratings and companies facing more difficulties in raising capital for their investment needs. This possibility has not been studied at all yet, but certainly requires some careful study, including gaining an understanding of whether

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[4] The fairly high rate of investment in renewables such as wind and solar in Germany is traceable to the very high guaranteed returns known as "feed in tariffs" for such generation, and is not attributed to carbon prices.

any potential financial impacts could be exacerbated by the greater use of allocations rather than free allocations of allowances. But the better solution is simply to eliminate the carbon price volatility, which is not in any way essential to the functionality of a market-based carbon reduction policy.

Dissection of Arguments against Providing Carbon Price Certainty

Given both the government and private sector advantages of having well-defined carbon price expectations, one might ask why there is such strong preference among many cap-and-trade advocates to retain price volatility. I believe this comes from two sources: the existence of an influential sector that has a strong vested interest in preserving uncertainty and volatility, and a misconception about what makes a "market-based approach" work.

A) The financial products community would not benefit under a tax like it would under an auction.

Even under a 100% auction there would be a thriving secondary carbon market, and substantial price uncertainty and volatility to manage. These are the phenomena that create demand for new and different services from the financial community (e.g., hedge funds, traders, etc.). It is correct that *if there is to be a cap-and-trade approach*, then such speculators and risk managers have an important role to play which cannot be eliminated by resorting to an auction. A policy approach that offers carbon price stability would effectively eliminate the secondary market and the need for risk management services – and thus eliminate the prospects of a lucrative new area of financial products and services.

The financial sector's loss of potentially large new revenue sources does not mean that this is a loss of wealth in the economy at large. It simply eliminates the ability of the financial community to divert some of that wealth to itself, at the cost of its clients who must also contend with the cost of reducing their emissions.

B) The "market" is not what makes cap-and-trade work, it is the "carbon price".

If the auction is designed well, its clearing price will reveal the marginal cost of control to meet the emissions cap. Compliance bidders will be induced to make additional controls if they can do so more cheaply than the clearing price, and thus the carbon price from an auction will induce the most cost-effective degree of control action. That is, the use of a mechanism that sets a clear, uniform price on emissions helps reduce emissions to a cap in a way that minimizes the deadweight loss, or net cost of the policy. The same occurs if the government simply taxes emissions. The tax rate is the price on emissions, just like the auction clearing price, and it provides the same inducement to control emissions if doing so is cheaper than paying the emissions price. The only difference is that if the tax rate is fixed in advance of the policy, it is not clear what amount of emissions reduction will actually occur – particularly in the first few years of the new policy. The emissions reductions under the tax would still occur in least-cost order, given that a common price signal is being used. However, to get to a specific emissions reduction level – if that were the overriding goal – the government would have to adjust the tax rate multiple times.

Thus, an emissions cap (whether 100% auction or not) works just like an emissions tax, except that the tax rate is unknown in advance.

This also should make it clear that it is not "the market" that enables emissions to be reduced in a least-cost manner: *it is the existence of a price on emissions.* It is a widely held misconception is that "market-based measures" for controlling emissions exist only if there is a mandatory cap, tradable allowances, and active trading. In fact, a reading of the economics literature that gave rise to the concept of market-based measures makes it clear that the critical element for least cost policy designs is that individual emissions control decisions be guided by a common, uniform price on emissions. Both a carbon tax and a cap-and-trade (with or without auctions) are "market-based" measures: both achieve an efficient mix of controls through that price signal. The difference is that under a cap, the carbon price varies because achieving emissions exactly at the cap (no higher and no lower) is presumed to be more critical than the costs that such rigidity about precise amounts of emissions reductions imposes on the economy at large. The consequence of this presumption is not just the dramatic variability in allowance prices that we have observed under all policies with hard caps. In the case of carbon caps, it will also translate into high macroeconomic costs.

In the carbon policy debate, those who are adamantly in favor of a cap over a steady, well-defined price on emissions offer a false choice to policy makers. They say that we must have an active carbon market with constantly varying allowance prices or else we cannot have the cost-minimizing benefits of a "market-based approach." They insist that carbon price uncertainty and volatility are healthy signs that the market is working. Their language is conceals their true assumptions: carbon price volatility is only an inherent part of an efficient carbon policy if one insists that a very specific level of emissions be achieved within the U.S., and during a specific period of years. These advocates are not assigning sanctity to the market, they are assigning sanctity to their specific cap.

There is no scientific basis for such rigid views on the necessity of meeting any specific cap. The precise level of U.S. emissions will not affect climate risks in any quantifiable way if they are on a general track towards near-zero emissions. This is particularly true because global climate outcomes over the next century will be determined by controls on developing country emissions much more so than by a few percentage points of difference in U.S. emissions during the next couple of decades. Expressions of fears that price certainty would take away the certainty of adequate reductions in emissions are misplaced. The certainty needed for emissions is their long-term reduction to nearly zero, not any specific reduction in a specific year. Achieving that goal will require sustained investment in utterly new directions, which is more likely to happen under a policy that establishes a carbon price signal that is predictable and credible for decades to come.

At the same time, the decision to embrace such rigid views in a carbon policy imposes some economic costs of its own that could seriously undercut the theoretical promise of cost-effectiveness associated the cap-and-trade form of market-based regulation. Price uncertainty and price volatility are not costless phenomena for businesses. In the case of a stock pollutant such as greenhouse gases, there is no need to absorb high costs in return for great specificity in achieving each year's emissions cap.[5] Further, if policy costs turn out to be truly excessive, this unnecessary rigidity over caps that are set at inherently arbitrary levels in the first place could undermine the goal of steady progress towards the long-term goal of near-zero emissions.

Misconceptions about the Cost of a Cap-and-Trade Program

Achieving the degree of global greenhouse gas (GHG) emissions control that is necessary to significantly reduce the risks of climate change will be costly, no matter how it is done. Indeed, for cap-and-trade to work, the policy has to drive prices for conventional energy up enough to make people prefer the more costly, low-carbon energy options. To make such changes viable as a political and social matter demands a focus on minimizing the costs of making a transition to a low-carbon economy. Policy practice and theory have demonstrated that market-based approaches offer the best prospects for minimizing cost of achieving regulatory goals. Assurance of a transparent and efficient carbon market therefore should be a central concern in a climate policy. Having minimal price uncertainty is clear a part of the solution. One might ask why so few people appear to be concerned about overall policy costs as well.

There will never be enough value to offset all the costs of a carbon limit of any form.

Some of this lack of concern may be traceable to a belief that the carbon value inherent in the allocations created under a cap-and-trade program is so large that it can actually offset the costs of the carbon reductions that the policy also imposes. It may be helpful to explore the similarities between the cap-and-trade and carbon tax approaches to understand why this cannot happen.

Few people seem to have difficulty understanding that a carbon tax would create net costs on the economy, even as it would generate very large revenues for the government to redistribute. This may be because there is a general understanding among those involved in public finance that when a tax raises revenues, it also always leaves behind a "deadweight loss," which is the cost of the tax policy. The tax payments are one part of costs to taxpayers, and the changes in markets due to the higher price of the taxed goods are a less direct and separate cost. At best, the government can redistribute all of the tax revenues back into the economy, but this revenue recycling will never alter the deadweight loss of the policy.

Under a 100% carbon auction, the phenomenon will be identical: the auction of allowances will create revenues to the government just as if the clearing price of carbon were a carbon tax. The cost of controlling emissions down to the cap will be the equivalent of a tax's deadweight loss. This is the net cost of the policy, and it cannot be reduced by any scheme for recycling the auction revenues. At best, recycling auction revenues can compensate some of the parties for their costs of reducing emissions; but in compensating them,

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[5] Richard G. Newell and William A. Pizer 2003, "Regulating Stock Externalities Under Uncertainty," *Journal of Environmental Economics and Management*, Vol. 45, pp. 416-432.

different losers will be created. Further, if the revenues are recycled to make some parties even better off than they are today, that will only deepen the costs borne by those who would be harmed by the policy. The net cost cannot be "recycled away."

The situation for a cap-and-trade with free allocations is a more complex situation to compare to the tax, but the effect on the economy is the same. Free allocations are just a different way of distributing carbon values in which the distribution occurs without the government first monetizing the carbon value. But there is still a deadweight loss from the act of imposing a price on carbon emissions in order to ration them. No matter what formula the government uses to allocate allowances, there will still be a net cost incurred by the economy as a whole as a result of the policy. That net cost will be the cost of controlling emissions down to the cap, and it is completely separate from the value of the remaining pool of emissions (i.e., the erstwhile auction revenues). The latter is simply a set of transfer payments while the former is a true cost, or loss of economic welfare.

Thus, any carbon-limiting policy will have a net cost. This is true for carbon taxes, caps with price ceilings, and hard caps with 100% auctions or with 100% allocations. In each case, the net cost will be determined primarily by the stringency of the carbon limit, while the distribution of carbon revenues and/or free allocations will determine the pattern of winners and losers across the economy. All of these market-based approaches function much the same as a carbon tax, except that under the hard cap approaches, the effective tax rate is unknown. That carbon price uncertainty, however, allows actual policy costs of the hard cap approaches to rise above the least-cost solution that all market-based approaches are *theoretically* supposed to offer.[6] These extra costs come from mistaken expectations, greater risk aversion, and more risk management activities necessary to manage the price uncertainty uncertainty. These added costs will be incurred for only one reason: an excessive concern about precisely achieving pre-specific but essentially arbitrary emissions caps.

A carbon cap or tax will cause net job reductions for the whole economy, even though "green jobs" will be created.

Another, even more widely held misconception about cap-and-trade policy is the view that it will create new jobs. A corollary to the fact that any carbon-limiting policy will have a net economic cost, is that a carbon-limiting policy cannot produce a net boost to overall employment.

There is no question that a shift to lower-emitting forms of energy will create new jobs in new areas of economic activity involving low-carbon energy supplies and energy efficiency. However, these jobs would be created only because the carbon policy would be forcing out economic activities producing goods and services for consumers and replacing them with activities that support producing more expensive forms of energy. When our economy's productive processes are required to use more costly inputs to produce the same outputs, overall worker productivity will fall, and aggregate payments to workers will also have to fall. This leads to a number of possibilities that reconcile the presence of new types

[6] The theoretical solution being one that occurs under assumptions of perfect certainty.

of jobs with reduced payments to labor across the economy. Some or all of the following would have to occur:

- The new "green jobs" may be lower paying.
- Some of the new "green jobs" may employ people outside of the U.S.
- The new "green jobs" will be fewer in number than losses in jobs elsewhere in the economy.

In general equilibrium analyses I have conducted of the cost of carbon policies, it becomes apparent that the vast majority (about 80%) of the job losses that would accompany such a policy will be reductions in employment opportunities in the services and commercial sectors.[7] These will tend to be "silent" losses of opportunity in the relatively low-wage portions of the economy that are least often associated with either the emitting sectors who will face the direct cost of the policy, or the activities where the most overt examples of new "green jobs" will be found. These net job losses are engendered by the indirect effects on our economy of using higher cost forms of energy.

Carbon Prices Alone Do Not Provide Sufficient Incentives for the Transformational Innovation Needed to Stabilize Atmospheric GHGs

My testimony has been focused on carbon market design options. However, even a highly effective and efficient market-based approach for GHGs will still have a serious limitation that most carbon bills have not attempted to fill. Stabilization of climate change risks will require that global GHGs be reduced to nearly zero levels. Although this goal may be possible to achieve at some point in the later part of this century, it can only be done through truly revolutionary technological progress and the resulting changes in the structure of how our energy systems. By inference, no cap-and-trade system should be placed into law that does not simultaneously incorporate specific provisions that directly support a substantially enhanced focus on transformational energy technology research and development (R&D).

Economic analysis shows that market forces produce a less than socially optimal quantity of R&D, because private entities funding research may not be able to benefit financially from their innovations to the same degree that society as a whole would benefit. Patent protections and other intellectual property rights are intended to minimize this wedge between private and societal benefits from R&D. However, with no large emissions-free energy sources lying just over the technological horizon, successful innovation in this area will require unusually high risks and long lead times. It will require breakthroughs in basic science, placing much of the most essential R&D results beyond the boundaries of patent protection. Market-based policies that place a price on carbon can very effectively stimulate incremental innovation and deployment into the market place of emerging new technologies. However, their ability to motivate major high-risk investments in

[7] Anne E. Smith, "Net Job Impacts of Climate Policy," CRA International presentation at the Policy Forum on Green Jobs, American Enterprise Institute, February 12, 2009 (available at http://www.aei.org/docLib/20090213_Smithpresentation.pdf).

transformational technologies is hampered by concerns with the credibility of the government sustaining very high carbon prices as a matter of policy, once such technologies may become available. This concern undercuts the power of carbon pricing policies to promote riskier forms of private sector R&D directed toward the longer-term, more advanced technological solutions to abatement.[8]

Realistically, then, government must play an important role in creating the correct private sector incentives for climate-related R&D, as well as in providing direct funding to support such activity. This role needs to be built into any carbon-limiting policy. The difficult decisions, which have barely been addressed to date, are how much to spend now, and how to design programs to stimulate R&D that avoid mistakes of the past.[9] The current focus of carbon policy discussions (including today's hearing) has been almost entirely about how to impose near-term controls through cap-and-trade programs. This is encouraging policy makers to neglect much more important, more urgently needed actions for greatly expanded government-funded R&D program, along with concerted efforts to reduce barriers to technology transfer to key developing countries.[10] Neither of these will be easy to accomplish effectively, yet they are receiving too little attention by policy makers.

Summary

To sum up, price uncertainty and price volatility will impose impacts in the case of hard carbon caps that are completely different in scale and scope from those under previous emissions trading programs. The US experience with other emissions caps and the EU ETS experience with carbon caps provide good reason to expect high volatility under a US carbon cap. Their potential to increase variability in overall economic activity thus should be viewed as a core concern in designing a carbon cap-and-trade program. At the same time, the nature of climate change risks associated with GHG emissions is such that it is possible to design price-stability into a carbon cap-and-trade program without undermining its environmental effectiveness. In the case of a stock pollutant such as greenhouse gases, there is no need to absorb high costs in return for great specificity in achieving each year's emissions cap. Thus, the cost to businesses of managing the price uncertainty of a hard cap is not worth the greater certainty on what greenhouse gas emissions will be from year to year. The emissions certainty that is needed is the long-term reduction to a near carbon-

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[8] These points are developed in a more rigorous fashion in W. D. Montgomery and Anne E. Smith "Price, Quantity and Technology Strategies for Climate Change Policy," in M. Schlesinger *et al* (eds.) *Human-Induced Climate Change: An Interdisciplinary Assessment*, Cambridge University Press, 2008.

[9] Arrow, Kenneth J., Linda R. Cohen, Paul A. David, Robert W. Hahn, Charles D. Kolstad, Lee Lane, W. David Montgomery, Richard R. Nelson, Roger G. Noll, Anne E. Smith (2008). "A Statement on the Appropriate Role for Research and Development in Climate Policy." AEI Center for Regulatory and Market Studies, Working Paper 08-12.

[10] Some have argued that the U.S. is losing an long-term business opportunity to become a leader in selling advanced, low-carbon technologies, which will eventually open up markets for those technologies in the developing countries. The current expectation of those countries is more that the U.S. will *pay for* implementing those technologies in their countries. (This view is made quite clear in the Bali Accords.) The expectation that any new, transformational technologies will need to be used in developing countries (whether paid for by them or by the developing countries) lends further concerns with future governments' credibility in maintaining a sufficiently high carbon price level to reward innovators for their research investments (see Smith and Montgomery, *op. cit.*)

free economy. That objective will have greater certainty under a cost-effective, affordable and non-disruptive policy that establishes a carbon price signal that is predictable and credible for decades to come. Once a decision is made to rely primarily on auctions rather than free allocations to define the winners and losers under a carbon policy, carbon price uncertainty becomes the primary differentiator remaining between the hard cap approach and market-based approaches that directly set or manage the carbon price.