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Why Not the Best?
Designing a Greenhouse Cap-and-Auction System for California

Written comments on report of the
Market Advisory Committee of the California Environmental Protection Agency entitled "Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California"

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Selected highlights of these comments:

- We commend the MAC report for recommending that allowances be auctioned, though the benefits are understated and the additional cost of the alternatives underestimated. Action reduces total costs by at least a factor of two, and probably at least a factor of ten. See Section IV., pp 12-3.
- The use of phased-in downstream coverage (Option A) as recommended by the MAC more than doubles the cost of emission reductions achieved in the phase-in period relative to a comprehensive system such as that of Option B. Section II.B, pp. 3-4
- Downstream implementation as recommended by the MAC increases administrative, compliance, and monitoring costs, and the probability of fraud and evasion, by at least a factor of ten. Section III., pp 8-10.
- Leakage and competitive burdens can be completely eliminated while fully preserving the incentive to reduce emissions by extending the consumption-based accounting approach used for electricity to other energy-intensive traded goods such as cement and refined petroleum products. The use of free allocation to offset competitive impacts on employment is completely ineffective. See Section V., pp 23-6.
- Offsets are inherently hard to measure and their use should therefore be limited. Even when offsets can be measured correctly, because improved technology spreads while offset opportunities are used up, emissions offsets should be discounted by a factor of five. Section VII., pp. 34-6.

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I. Executive Summary

The best way to achieve greenhouse gas reduction targets is now fairly well understood, and this understanding can be embodied in a few simple lessons. A well-designed climate policy can strengthen the economy and improve income distribution while reducing emissions, while a poorly designed policy will stunt growth, place a heavy burden on low-and moderate-income households and create windfalls for a few big polluters. If we follow these lessons, California can create a just, efficient and effective climate policy that will be a shining example to the nation and the world. The MAC report adopts some of these lessons, but its recommendations still fall short of the best policy in several key areas. These lessons include:

A comprehensive cap that covers all fossil fuels minimizes the cost of reductions. For example, the exclusion of some sectors during the phase-in period of the MAC report's Option A roughly doubles the cost of emission reductions during that period. See Section II.

The MAC's recommendation of a downstream approach, if adopted, would lead to much higher administrative and compliance costs and greatly increased rates of both litigation and fraud. An upstream approach such as the MAC's Option B should be adopted instead. See Section III.

The MAC recommends a transition to auction, but fails to account for the much greater economic and compliance cost of partial grandfathering or output-based allocation in the early years. Nor is it clear that it will be politically possible to halt such massive giveaways once commenced. See Section IV. The benefits of full auction include:

- The entire burden of a allowance program on the poorest 40 percent of households can be offset with 15 percent of the revenue.
- For reasonable phase-in rates and targets, by investing 20 percent of the revenues from an allowance program in energy efficiency and cost-effective renewables, the average increase in energy bills can be eliminated through efficiency gains.
- Auctioning with revenue recycling can create a "double dividend" of environmental and a non-environmental economic benefits under conditions that accurately describe the real economy.

We can preserve the competitiveness of California's energy-intensive industries, eliminate leakage, and preserve the incentive to reduce emissions, by capping emissions associated with goods consumed in the state rather than emissions associated with in-state production. In the case of electricity, this is the distinction between load-(consumption)-based and generator-(production)-based accounting. This same approach can be applied to other energy intensive products such as cement and refined petroleum products, with equally good effects. Section V.

When revenue recycling is combined with regulatory, incentive and educational programs to promote investments in cost-effective no-regrets technologies, it is nearly always possible to achieve emissions reductions at a net economic benefit. Section VI. A & B.

The key to intelligent integration of technology promotion policies with market incentives for maximum synergy is to identify barriers to adopting cost-effective technologies that can be overcome through education, research, incentives, and regulation. This framework leads directly to certain "rules of thumb" that help those knowledgeable about technology-specific and market-based policies to create consistent integrated analysis and policy. Section VI. C.

Offsets are inherently difficult to measure and, even when measured correctly, should as a matter of principle be discounted by a factor of five. Section VII.

To help the political and regulatory system make the right choices in creating such a system, it is important that policymakers understand the cost of various deviations from a first-best system. We recommend that the CARB staff build on the MAC report by designing a model system based on best practices as described herein, and then attempt to quantify the economic cost of such deviations as may be put forward by the MAC and others, and that that key decisions such as grandfathering versus auction be explicitly modeled by state economists. prior to final decisions being made. Section VIII. Finally, we recommend that for certain decisions such as the allocation of expenditures from the allowance auction revenues that go beyond the core competence of CARB, a second advisory board be created incorporating representation from the legislature and the Governor's office and chaired by a figure with bipartisan respect and broad knowledge of tax, budget, environmental and energy policy.

II. More comprehensive coverage is needed than is provided by the MAC recommendations, and especially Option A, in order to minimize costs and assure that state targets are met.

A. Comprehensive coverage is necessary to assure that California's emission reduction targets will actually be met.

The non-market policy set under the California Global Solutions Act of 2006 ("the Act") now embodies literally hundreds of individual policies and standards. The chance of all of them working as well as projected in the timeframe proposed is near zero. Moreover, few are structured in such a way as to be able to achieve significantly higher than projected reductions. Moreover, few of these policies can be tightened in a quick and relatively painless way. Thus if California is to achieve the reductions mandated by law in 2020, the market mechanism will have to address the shortfall.

This is a very important point, which should shape the entire discussion about the implementation of market mechanisms. Although the language about adoption of a system of allowances is permissive rather than mandatory, it may not be possible to meet other mandates under the act without such a system. For example, the Act requires that the scoping plan and its regulations achieve emission reductions to the lesser of 1990 level or the feasible and cost-effective level by 2020 at the latest, and that this limit be *enforceable*. Section 38562(d)(1). This suggests that the CARB really must adopt a cap and allowance system in order to achieve a scoping report that assures that the targets are hit. The only alternative (besides denial) is to mandate by regulation reductions in emissions well in excess of the statutory target, in order to provide room for some regulations to fail. But this fails another requirement of the statute, that it "minimize costs and maximize the total benefits to California." Section 38562(b)(1).

Although many regulations may be achievable at a net savings, the cost minimization requirement mandates adoption of a market-based allowance system if any of the regulatory provisions impose positive net costs overall. This is because an allowance system with a specified price of allowances will find only reduction opportunities below that price. As a result, if some of the regulations impose net costs, there will be some price of allowances such that the allowance system finds emissions that are of lower cost than the most expensive regulation. As discussed in the next section, this same standard requires that coverage of any allowance system be as comprehensive as feasible.

B. Comprehensive coverage is vital for least-cost emission reductions.

Let us suppose that the cap is binding and some portion of the emission reductions required to hit the state target, say, e.g., ten percent, comes from the allowance system. Because in each covered sector, people will pursue the least expensive options first, the broader the coverage the more low-cost options are available and the lower the total social cost of the reduction is. Also, the more responsive emissions from a sector are to price, the higher the cost from excluding a sector.

Although there has been a great deal of research done on the demand for fuels by sector, in California the allowance system will be implemented on top of an extensive new system of regulations. The price response by sector of the remaining emissions after regulation is not known and can not be reasonably estimated with the data available at this time. The best we can do now is to get a first-order approximation of the cost of exclusion by assuming the price response is the same across sectors. The table below estimates the percentage increase in the total social cost of emission reductions caused by excluding some sectors, sectors relative to the coverage of Program 3 or 4 plus jet fuel plus N_2O from vehicles. This combination would cover 83% (program 3 or 4) + 4.5% (jet fuel) plus 2.5% (mobile sources) = 90% of all emissions. The only assumption required for these estimates is that the elasticity (i.e. price responsiveness) of emission reductions for all sectors.

Col #	(1)	(2)	(3)	(4)	(5)	(6)
Policy Set	Program 1	Program 2	Program 3 & 4	(3) plus mobile N_2O	(3) plus jet fuel	(3) plus both
% Coverage	39.0	72.0	83.0	85.5	87.5	90.0
% cost increase	130.8	25.0	8.4	5.3	2.9	0.0

The table shows that the increase in the total cost from failing to cover some sectors can be substantial. Particularly noteworthy is that achieving a specified reduction under program 1 is more than double the cost of achieving the same reductions under the comprehensive program. The rationales for including jet fuel and N_2O from vehicles is below further discussed below, as is a second reason to believe that these cost estimates understate the cost of partial coverage.

Given that the phase-in of Option A more than doubles the early cost of the program, it is worth examining the arguments against immediately adopting an upstream approach as suggested in option B. I will also briefly discuss a third alternative, sometimes called a "midstream' approach.

C. Comprehensive coverage reduces economically and environmentally costly distortion.

Finally, please observe that the costs of various levels of partial coverage given in the earlier table do not include the costs of distortion that come from the potential for emission-reducing energy flows across the boundary between a covered and an uncovered sector. Most of these involve an emissions reduction in the uncovered sector that is partially offset by a smaller emission increase in the covered sector. This results in the allowance system discouraging innovations that reduce net emissions, as the increase in cost of emissions in the covered sector from the allowances is not offset by any decrease in costs in the uncovered sector. Examples of this abound, and I will provide only a few here:

- If the transportation sector is not included, plug-in hybrids are discouraged because increase in covered electrical emissions is not offset by the uncovered reduction in motor vehicle emissions.

- If electric but not gas utilities are covered in the residential sector, then the use o ground-source heat pumps to replace gas-fired systems is discouraged.
- If the manufacture of biomass fuel involves positive emissions (e.g. from distilling) that are less than those from the conventional fuels they displace, and jet fuel is uncovered then the use of renewable content in jet fuel is discouraged.

The exact cost of such distortion is unknown, but the plug-in hybrid example suggests that it cold in principle be quite large.

D. Jet fuel and N_2O from motor vehicles can easily be accurately measured and should therefore be under the cap.

We assume that the reason jet fuel was excluded was because of the possibility of evading the cost of allowances by choosing to purchase fuels out of the state. It is easy to prevent this sort of evasion by using the method of calculating fuel use that the International Fuel Tax Agreement (IFTA) uses to allocate motor fuel consumption by heavy trucks to states for tax purposes. Total fuel consumption is allocated to the states proportionally to the number of miles traveled in each state for tax purposes, regardless of where the fuel is purchased. Carbon dioxide emissions from burning jet fuel can be allocated the states in exactly the same way. See Appendix B. of my Testimony for additional discussion of this issue.

N_2O from motor vehicles can also be covered, albeit with somewhat more difficult politics. Obviously, this can not be done perfectly, but it can be well-approximated in by a weighted combination of allowance requirements based on motor fuels consumed (administered as an adder to the emissions content of motor fuels) and a one-time requirement that the first seller or importer buy allowances based on the average emissions for the make and model year. It has been shown that this combination provides a good approximation of true emissions. Ooops! I omitted the citation for the claim that you can get a good approximation of a tailpipe emissions charge on N2O with a two-part instrument. There are actually two slightly different approaches, the first of which is slightly more efficient than the second (because of their respective incentives for car ownership). On the possibility of approximating a motor vehicle emissions charge with a motor fuel surcharge and a per vehicle charge on high-emission vehicles based on average emissions from vehicles of that class, see: G.S. Eskeland, "A Presumptive Pigouvian Tax: Complementing Regulation to Mimic an Emissions Fee," *World Bank Economic Review* (1994), 373-394. On the possibility of approximating it with a gasoline surcharge and a subsidy for cleaner vehicles, see: Don Fullerton & Ann Wolverton. "The Case for a Two-Part Instrument: Presumptive Tax and Environmental Subsidy" NBER Working Paper No. 5993 (April 1997); published in: *Environmental and Public Economics: Essays in Honor of Wallace E. Oates*, Panagaria, A., P. Portney and R. Schwab, eds., Cheltenham, UK: Edward Elgar, 1999, pp. 32-57.

III. The upstream approach is superior to the downstream approach by virtually every measure.

A. The reasons for favoring a downstream approach listed in the MAC report are either false or irrelevant.

The MAC report provides six reasons in support of the a phased-in, downstream approach (Option A) over a comprehensive upstream approach (Option B). Claims 1, 2, 3, and 6 are false. Claims 4 and 5 are true, but irrelevant, as they establish no public or private benefit. Let us take them in turn. We quote below each reason given for a system of downstream, phased-in allowances from the MAC report and then assess it briefly.

1. The ability to begin the program in the very near future with implementation of the first step (Program 1)

This would indeed be a significant advantage if CARB were contemplating initiating the market mechanism, say, next year. But as best as I can tell, no one is contemplating implementing the market mechanism any sooner than 2011 or 2012. This is plenty of time to craft regulations for a more comprehensive system, especially given the much smaller number of entities to be regulated.

2. The flexibility associated with a more gradual expansion of the cap-and-trade program's scope

Flexibility to institute a program with higher costs that provides less certainty of emission reductions is a disadvantage, not an advantage.

3. Greater prior experience with the downstream regulatory approach—experience that reduces risk and can help lower administrative costs

Any benefit from greater experience to either risk reduction or administrative cost reduction is surely far more than offset by the fact that under a downstream system one is regulating thousands of highly diverse entities, while under the upstream system one is regulating a few dozen entities, all of which fall into a handful of enterprise types.

4. The fact that downstream entities—the entities that may have the most options for reducing emissions—are the ones required to submit allowances for compliance

It is a truism, one of the first things that one learns in a graduate public finance course, that it makes no economic difference where in a supply chain a tax is levied. However, we agree that markets are not perfect, and that there may be some psychological or informational benefit of measuring emissions downstream, based on the management truism the "people manage what they measure." However, in this case there is already a mandatory measurement system, the registry, being put in place. Thus there is no basis for assuming that placing the requirement for allowance remission on these entities will provide any additional incentive beyond the price and awareness effects under an upstream system.

In a footnote to the point, the MAC recommendations state:

"Many Committee members are convinced that incentives for reducing emissions are strongest when downstream entities must submit allowances. Under Program 4, these entities are not the points of regulation and thus do not submit allowances. Their incentive to reduce emissions stems from the higher fuel prices that result as upstream entities limit fuel supplies subject to the emission constraints established by the cap."

We note that the increase in the fuel cost to a downstream entity from an upstream allowance system is exactly equal to the cost of purchasing allowances by the downstream entity in a downstream system. The economic incentive is precisely equal either way.

5. larger number of regulated entities, which may promote greater liquidity in the allowance market

When allowances are grandfathered, large mismatches between an entity's needed and allocated allowances, increasing with time, are inevitable. Under auction, entities buy only and exactly the allowances they expect to need. Mismatches can easily be met through a combination of banked credits and by allowing shortfalls to be "trued up" by purchase of the shortfall amount in the next auction period. Thus though the larger number f entities may indeed enhance liquidity of the market, this provides no significant public or private benefit.

6. no need for special provisions to reward facilities that engage in carbon capture and sequestration.

The administrative, compliance and enforcement burden required to allow facilities to do capture and sequestration under an upstream approach are exactly identical to the procedures required under a downstream approach. In both cases the capturing entity must separately measure and report the amount of emissions captured and sequestered. The only difference is that in one case the sequestered emissions are subtracted from the allowance purchase requirements, and in the other they result in an allowance rebate.

B. The benefits of using an upstream system instead are large and important.

Now let us turn to the reasons for adopting an upstream system. The report sites three. The first two of these reasons are severely understated. The third, though true, is weak. However, there are also at least six other important reasons for upstream administration. These are listed below as reasons four through nine.

1. Comprehensive coverage is assured.

By controlling carbon as it first enters the economy, upstream coverage assures effective and comprehensive coverage.

As discussed above, such comprehensive coverage is in fact the only way to guarantee that the mandatory targets set by the act are actually reached.

2. Administrative and compliance costs are lower.

Administrative costs are lower under an upstream system because the number of sources to be regulated is smaller by roughly a factor of ten. This is a huge benefit. We strongly urge that CARB make at least some rough-justice estimate of the difference in administrative (i.e. governmental), compliance (i.e. private), and enforcement costs from the upstream and downstream system.

3. Enforcement is more effective.

An upstream system is far easier to enforce and much harder to cheat. There are several reasons for this. First, an upstream system monitors easily flows of carbon-based fuels that are easily detectable by normal human perceptions and are normally traced or easily traceable by financial accounting. In contrast, a downstream system monitors fugitive and invisible CO_2 emissions from combustion using delicate instruments subject to tampering.

Second, as mentioned in the previous point, there is roughly an order of magnitude fewer entities to monitor in an upstream system. Since enforcement resources such as auditing would be spread ten times as thinly under a downstream system, we should anticipate much higher levels of fraud and avoidance under that system.

Finally, under an upstream system, upstream measurement under the allowance program and downstream measurement under the registry allow cross-checks that can aide enforcement and fraud prevention. Allowance systems are administratively similar to excise taxes. One of these similarities is that under both, one can make a great deal of money by evasion. If the manufacturer of a product that uses fossil fuels in its production is able to evade the allowance requirement, they can sell that product into markets where the price is set by honest competitors who have bought allowances, and pocket the difference in cost. For some products this could amount to hundreds of millions of dollars.

Experience with such instruments has taught that a system of cross-checks is essential in order to identify evaders. It appears doubtful that the additional budget for auditors, investigators, and prosecutors will account to much. If there are only a few dozen regulated entities, and reasonable cross-checks, we may be able to make fraud difficult and costly and apprehension for such fraud likely, deterring it before it occurs.

4. Economic efficiency is higher and costs lower during the phase-in.

Because it results in the broadest possible coverage immediately, upstream systems substantially reduce the total economic cost of achieving reductions in the early years. See discussion under "Comprehensive coverage is vital for least-cost emission reductions" above.

5. The incentive for fraud in downstream inventories for litigation over inventory rules and regulations by downstream entities is eliminated.

Unlike the downstream system liability for allowance purchases is directly proportional to emissions reported to the registry. This provides a strong monetary incentive to under-report those emissions. In contrast, an upstream system provides no such incentive for under-reporting to downstream entities because reporting and liability are decoupled. As a result the Registry's inventories will be more reliable.

Similarly, the downstream system provides a strong monetary incentive to litigate and dispute inventory rules, while an upstream system provides no such incentive for downstream entities to litigate Registry rules or procedures.

An upstream system will not only reduce costly litigation and the associated delay, but will also promote a more collegial relationship between the regulatory community and downstream entities, as most interactions with regulators will involve opportunities to achieve profitable energy cost reductions rather than incur costly penalties.

6. Special interest pleading that increases system costs and weakens environmental protection will be prevented.

Under downstream systems, exemptions and other special rules for particular industries, firms, or regions, for specific fuels or in general, are very easy to legislate, design and administer. Under an upstream system, such provisions are difficult to design and administer, requiring special allowance rebate systems that are costly and obvious. The additional costs and public relations risk from such programs reduces a business's incentive to ask for them and legislative and regulatory willingness to grant them.

C. The Midstream approach

The midstream approach recognizes that it does not matter where in the chain from mine mouth or wellhead to ultimate combustion the allowance requirement is placed, so long as it is placed somewhere. It therefore looks for "narrow points" in the distribution cycle or points where monitoring already takes place, to minimize administrative burden and costs. One drawback of the midstream approach is that it often requires additional rules for some class of emissions that is not picked up at the enforcement point. But this may be a good trade for the overall saving in cost.

An example of the midstream approach would be to place an allowance requirement for petroleum products at the terminal rack, where tanker trucks that take fuels to gas stations are filled, and where the flows are already carefully monitored for federal tax purposes. On could include in the carbon content of these fuels the average emissions associated with refining. This would avoid the necessity of monitoring the flow of refined or crude oil through ports or interstate trucking. California refiners with emissions per gallon above the average would be required to purchase allowances for the surplus of emissions over the average emissions times the number of gallons they produce. If less, they would get an allowance rebate in a comparable amount.

Sourcing electric generation and natural gas emissions at utilities can also be considered a midstream approach. Such an approach might need special rules for some non-utility generators not otherwise covered.

We believe that the midstream approach is a viable alternative to the upstream approach that deserves consideration. Most of the arguments in favor of an upstream approach made in this section also apply to a midstream approach.

IV. Permits should be auctioned, rather than allocated based on historical emission levels, output, or any other system.

A. Auctioned permits achieve emissions reductions with the lowest social cost and the greatest social benefit.

1. The economic benefit from the wise allocation of the revenue from permit sales is essential to achieving a stronger economy through market-based climate policy.

There are many possible approaches to allocating permits to use atmosphere's limited capacity to absorb greenhouse gasses without generating dangerous anthropogenic climate change. These include auction, grandfathering (defined as an allocation based on some percentage of historic emissions levels), output-based allocation (a system of providing permits based on generation or sale of electricity, or other good that can be measured in uniform physical units), or population- or household-based allocations such as the Sky Trust proposal.

Any permitting system by its nature reduces the amount of fossil fuels supplied to consumers of that fuel. When you cut the supply, the price goes up. For a given reduction in supply the increase in price, the revenue collected from California consumers, and the economic burden -- all three -- are the same whether the permits are auctioned, grandfathered, or distributed based on population. (Output-based allocation works differently, as described below). This is because using any of the three systems to achieve the same reduction in emissions cuts the supply of fossil fuels by the same amount, and so increase price by the same amount, according to the usual rules of supply and demand. But in auctioned systems, the revenue can be allocated in a way that reduces most, all, or more than all of the economic cost of achieving the emissions reduction. This is worth stressing: the burden of the permit system on the economy is offset by the benefit to the economy of using the revenue, whether to cut other taxes, invest in new clean technology, reduce the deficit or invest in high-value public investments like education, offsets the economic burden of the permit system.

Quantitative analysis has suggested that the welfare cost of a national grandfathered system is four or more times the cost of an auctioned system.[1] Using grandfathered allowances alone it is virtually impossible to get a net economic improvement unless the economic value of the environmental benefit is included. There are, of course, still efficiency benefits from grandfathered permit systems relative to trying to hit the same targets through regulation alone. Although early claims that auctioned allowances or emission charges with revenue recycling will always produce net non-environmental benefits (a claim sometimes called "the strong double-dividend hypothesis" have proved over optimistic, many studies have now shown that such benefits are possible with the right policies and circumstances --- policies that are realistic choices in circumstances that actually apply.

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[1] Lawrence H. Goulder, Ian W.H. Parry and Dallas R. Burtraw "Revenue-Raising vs. Other Approaches to Environmental Protection: The Critical Significance of Pre-Existing Tax Distortions" *RAND Journal of Economics* 28,4 (Winter 1997): 708-731; Goulder, Lawrence H., Ian W. H. Parry, Roberton C. Williams III, and Dallas Burtraw, 1998. "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-best Setting." *Journal of Public Economics* 72(3): 329-360.

For example, at appropriate levels, pollution charges used to cut labor taxes produce a strong double dividend by offsetting inefficiencies caused by the existing state and Federal tax subsidies to housing.[2] Pollution charges levied on fossil fuels produce a strong double dividend because they are born by "Ricardian rents" -- money that flows to owners of coal and oil, not for producing it, but only for holding it in the ground.[3] Appropriate allowance charges that fall on motor fuels -- which account for nearly half of California's greenhouse gasses -- produce a strong double dividend because those fuels are a compliment to labor, thus offsetting the distortion of labor taxes.[4] There can be a strong double dividend if pollution reduces worker health or enterprise productivity.[5] If the economy is at less than full employment and people are not able to perfectly distinguish between price changes and inflation, there is a strong double from pollution charges used to cut labor taxes because they increase workers' labor supply.[6] Existing models that suggest that the benefit from cutting taxes on capital overall are generally not sufficient to offset the distortion caused by pollution taxes when other taxes are present[7] nonetheless suggest that there is likely to be a strong double dividend if more efficient policies to generate investment, such as investment tax credits[8] or direct investment in necessary infrastructure or human capital, are used. No one has even begun to assess the likely benefits of charges on global warming pollution with revenue recycling given that they offset housing tax distortions and are born by Ricardian rents and fall on a compliment to leisure and reduce emissions that cause health and productivity effects and can be used for high-value public investments, but it certainly makes the likelihood of a double dividend more plausible when we realize that these are simultaneous and not competing effects.

For state-level systems, the difference in macroeconomic costs and benefits will be even greater. This is because, under a grandfathered system, the money collected from in-state consumers goes to mainly out-of-state shareholders of big energy companies, transferring dollars out of the state and draining jobs from the state economy. The state then bears both the costs of abatement and the costs of the dollar drain. Under an auctioned system, the same amount of revenue is collected from consumers, but the money is re-spent in the state, creating jobs and strengthening the economy. The value of this benefit, and whether it is larger or smaller than the cost of abatement, depends on how the money is spent.

2. Failure to auction greatly increases the cost of achieving reductions in the regulated utility sector.

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[2] Parry, Ian W.H. and Bento, Antonio M., "Tax Deductions, Environmental Policy, and the "Double Dividend" Hypothesis" *Journal of Environmental Economics and Management*, Vol. 39, pp. 67-96, January 2000.

[3] Antonio M. Bento and Mark Jacobs, "Ricardian rents, environmental policy and the 'double-dividend' hypothesis," *Journal of Environmental Economics and Management*, 2007, vol. 53, issue 1, pages 17-31.

[4] West, Sarah E. and Roberton C. Williams III "Optimal Taxation and Cross-Price Effects on Labor Supply: Estimates of the Optimal Gas Tax," *Journal of Public Economics Journal of Public Economics, 2007, 91:593-617.*

[5] Williams, Roberton C., "Environmental Tax Interactions When Pollution Affects Health or Productivity," *Journal of Environmental Economics and Management*, 2002, 44:261-270.

[6] Arij Lans Bovenberg and Ruud A. de Mooij "Does Money Illusion Rescue the Double Dividend?," German Economic Review, 2005, vol. 6, issue 2, pages 255-257

[7] See, e.g., Goulder, Lawrence, H., Ian W.H. Parry, Roberton C. Williams and Dallas Burtraw, 1999. "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting." Journal of Public Economics 72: 329-360.

[8] Investment tax credit provide a stronger incentive for investment per dollar of public revenue than cuts in capital taxation because the former applies only to to future and current investment, while the latter also applies to the much larger stock of past investments. Attempts to provide current incentives to investments in the past are by their nature futile.

The previous discussion is based on analyses that generally assume that the economy is a competitive one. The utility sector is not competitive, and it does not do pricing in the way that competitive firms do. This exacerbates the defects of giveaways of allowances discussed above. Auction, on the other hand, comes much closer to approximating an efficient market outcome.

To correctly allocate emissions reductions between demand-side and supply-side reductions, the marginal cost of emission reductions should be added to the price, as it would be in a competitive industry. However, regulated utilities are normally assumed to use roughly average cost pricing. To illustrate how important this is, we will make the assumption that the cost of achieving a ton of abatement goes up approximately linearly with the number of tons. This will allow us to use similar triangles to calculate the percentage changes in price of electricity and the cost of abatement under average and marginal pricing regimes.

Under the assumption of linear abatement cost increase, the average cost of abatement for fossil electricity is approximately half the marginal cost. In addition, only roughly 55 percent of the total Watt-hours of electricity consumed in California come from fossil sources. As a result, when the cost of abatement is averaged over all electricity consumed in California only about 27.5 percent of the marginal cost is incorporated into the price. Again assuming linearly increasing abatement cost on the demand side, this implies that only about 27.5 percent of the demand-side reductions that would occur with marginal cost pricing will occur under average-cost pricing with free allocation. The overall efficiency loss from this decision depends on the relative potential for abatement on the demand and the supply side, which we have not attempted to estimate here. Assuming for the sake of illustration, however, that similar abatement opportunities existed on both sides, the total cost of abatement on the demand side would decline to about seven and a half percent (27.5 percent squared) of what it would be under marginal cost pricing, while the total abatement cost on the supply side would nearly triple (172.5 percent squared), and the total social cost would rise by 53 percent.

If we make all the same assumptions but auction the permits, the allowance price will equilibrate at the marginal cost of abatement, and this price will apply to all fossil generation. The effect on electricity prices will still be less than the marginal cost because the price is averaged over non-fossil electricity, but now the average price incorporates 55 percent of the marginal cost, rather than 27.5 percent. Total demand-side abatement cost is 30 percent of what it would be under marginal cost pricing, and total supply side cost increases by about 110 percent rather than nearly tripling, and total social cost increases by only 20 percent. So in this example the total social cost of achieving emissions reductions from the electric sector under free allocation are about two and a half times what they are under auction, and although this is an illustration rather than an estimate, the truth that it illustrates is quite general: using free allocation under average cost pricing results in a much greater social cost of achieving emission reductions, above and beyond the additional cost in competitive sectors.

The problem is even more fundamental for natural gas utilities. If the allowances are grandfathered to those utilities, until such time as biogas becomes available in quantity it is literally impossible for the utility to comply with a declining cap. This is because the utility is required by law to deliver service, and free allocation with average cost pricing implies that there is no market incentive to reduce consumption on the demand side. With no market tools to influence either supply or demand, the utility is helpless to achieve and mandated reduction, at least via market mechanisms. Auctioned permits, on the other hand, create an incentive for demand-side reduction that equilibrates demand with supply. Moreover, it can equalize that incentive with all other covered sectors, resulting in least-cost reductions.

B. Auction provides revenue to offset the burden on low and moderate income households and to finance incentives for efficiency and renewable and other climate-related public investment programs.

1. Auction provides revenue essential to offsetting the burden of emission permitting costs on low- and moderate-income households

We normally expect the cost of greenhouse gas emission permits to be added to the price of the fuels and then passed on to consumers. The burden of such price increases is distributed against annual income in a highly regressive manner,[9] although the regressivity is not as severe against lifetime or multi-year measures of income.[10] In addition, a small number of consumers have disproportionately high energy demands as a result of extremely inefficient housing, special needs, or other factors. African-American and Hispanic-American households have significantly higher energy consumption than white households with the same income level, particularly in the bottom three deciles, because of lower-quality housing stock and higher transportation expenditures, respectively.[11]

The package of household-level energy-efficiency programs that have been proposed in the CAT report, if enacted promptly and implemented effectively, is more than sufficient to offset the average burden on households and turn it into an average savings. However, there is considerable reason to believe that the benefits of such programs may not be taken up by low-income populations fast enough to offset the burden of permit-induced price increases. It is notoriously difficult to get uptake of efficiency programs in rental property, where most low-income households live; low-income families often have used cars and appliances that are older and have not incorporated the newer efficiency standards. Moreover, even when the penetration of new technology is high enough to offset average burdens, it is still not enough to eliminate the burden on the occasional low-income household with very high energy requirements.

These problems require a mix of policies to address them adequately. We suggest that the average burden on households in the bottom deciles be fully offset through changes in tax and transfer policy, primarily by increases in the Earned Income Tax Credit. For low and moderate income households that have unusual energy demands, we suggest increases in

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[9] Casler, S. & Rafiqui, A. "Evaluating Fuel Tax Equity," *National Tax Journal* 46(2)197-205; Howard Chernick and Andrew Reschovsky. "Who Pays the Gasoline Tax?" *National Tax Journal*, 50(2): 233-59 (June 1997); French, Mark. 1990. "Efficiency and equity of a gasoline tax increase." *Energy Systems and Policy* 13 (March): 141-155; Metcalf, Gilbert E., "A Distributional Analysis of an Environmental Tax Shift" (May 1998). NBER Working Paper No. W6546. Hanson, Jean and Margaret Walls. 1999. "Distributional Aspects of an Environmental Tax Shift: The Case of Motor Vehicle Emissions Taxes. *National Tax Journal* 52(1), 53-65; Metcalf, Gilbert E. 1999. "A Distributional Analysis of Green Tax Reforms." *National Tax Journal* 52(4): 655-681.

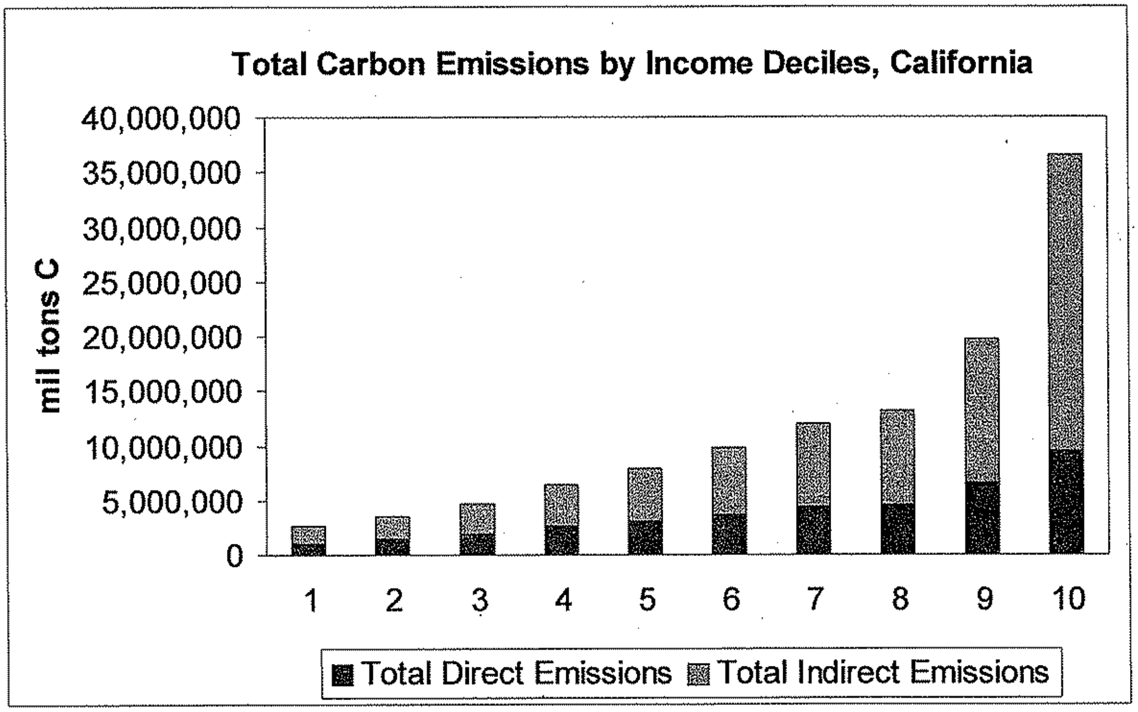
[10] James M. Poterba, "Is the Gasoline Tax Regressive?" NBER Working Papers 3578; (published; D. Bradford, ed., *Tax Policy and the Economy*, Vol. 5, 1991, pp.145-164; Don Fullerton & Diane Lim Rogers, "Distributional Effects on a Lifetime Basis," *NBER Working Papers* 4862, National Bureau of Economic Research, Inc. (1994);

[11] For the results on African Americans, see Andrew Hoerner et al. for Redefining Progress under contract to the Congressional Black Caucus Foundation, *African Americans and Climate Change: An Unequal Burden* (2004). (Executive summary: http://www.rprogress.org/newpubs/2004/CBCF_REPORT_execsum.pdf Full report: http://www.rprogress.org/newpubs/2004/CBCF_REPORT_F.pdf) Hispanic American results from an unpublished analysis of Survey of Consumer Expenditure data by Andrew Hoerner.

Weatherization, in Low-Income Home Energy Assistance Program (LIHEAP)-style payments, and in related programs.

The graph below shows total carbon emissions from the state of California by income decile. The "direct" portion of each bar shows the CO_2 emissions from fuels consumed by households, including the utility emissions from the production of electricity purchased by households. The "indirect" portion of each graph shows the CO_2 emissions associated with the production of non-fuel goods and services consumed by households. The sum of the carbon emissions by decile is carbon emissions for the state.

The graph below shows that the bottom four income deciles are responsible for about 15 percent of CO_2 emissions. Therefore, if greenhouse gas emission permits are auctioned, you can see from the graph that about 15 percent of the revenues would suffice to offset the entire burden for the bottom four deciles, or the direct burden for the bottom eight deciles. This estimate assumes, conservatively but somewhat unrealistically, that 100 percent of the indirect burden of the charge would be passed through to households. If there were only partial pass-through by firms that sell their product in national or global markets, then a smaller percentage of the revenue would be required to offset the indirect burden.



Source: calculations by the author based on the Survey of Consumer Expenditure, the State Energy Data System of the Energy Information Administration, and the BEA input-output accounts data.

2. Auction provides revenue to finance investments in energy efficiency and renewable energy

The burden of a carbon permitting system can be greatly reduced, and in many or most cases become a net benefit, if a portion of the revenues are used to promote low-cost energy efficiency and renewable energy sources. If the percentage reduction in energy use is equal to or greater than the percentage increase in energy price from the permit sales, these measures can reduce the actual energy bills of businesses and consumers.

Preliminary analysis suggests that this can be accomplished through the expenditure of 15 to 25 percent of the revenues from the permit sales.

Examples of instruments that have sometimes been found to be highly efficient ways to promote productivity-enhancing technologies include tax credits, revolving loan funds, grants, investment in fundamental energy research, and other cost-effective measures to reduce energy expenditures.

C. Auctioning is administratively simpler than grandfathering.

1. Auctioning is easy to administer.

The procedures for auctioning in an upstream or midstream markets are particularly simple to administer. Covered entities submit bids, say on a quarterly basis, which consist of a schedule of the quantity of permits that they would like to buy at various prices. The administrator then sums the quantities demanded at each price level, giving the aggregate demand schedule. The price is set at the level where the aggregate demand equals the supply of permits for that quarter. Each entity then receives the number of permits that they requested at that price. The system is simple, foolproof, and virtually ungameable without illegal collusion.

2. No baselines required

Under grandfathering, extensive historical data must be collected in order to establish baselines for the covered entities. This is particularly true under a downstream system, where the covered entities are large emitters. Under such a system good historical data is necessary for many thousands of entities, potentially rising to the tens or even hundreds of thousands if the scale of covered emitters were subsequently reduced so as to expand coverage. This data does not currently exist, implying that the cap can not be put in place until it has been collected, and that it can cover only those entities from whom data is collected. Thus grandfathering implies that coverage will be limited to only the largest emitters, or that a huge and costly additional data collection system will be needed it cover tens of thousands of medium-sized to small emitters. Moreover, as discussed in section III.D.2 below, covered entities have a substantial incentive to exaggerate their emissions during the base period, making the establishment of reliable baselines difficult.

Under an auction, no baseline information is required. Auction relies on the market to allocate permits based on the covered entities' own estimate of their current requirements.

Although a cap must be enforced somewhere along the stream of fuels from mine-mouth or wellhead to ultimate consumer of energy services, this tracking does not necessarily have to occur at the level of the entity doing final combustion, and often should not.

We support the consensus position of the environmental groups that reporting based on Registry protocols should be mandatory for all stationary emitters with annual emissions greater than a specified cutoff level. This information is needed to help establishments understand their emissions profiles and emission reduction opportunities and to help the state establish benchmarks and identify best practices. However, as the consensus position states, it should ***not*** be assumed that this is the level at which a permitting system implementing a cap and trade would take place. The permitting system should be established at a level such that enforcement and compliance can be efficiently monitored by state agencies, that the system can be extended to cover the largest amount of emissions practicable, and that it best facilitates achieving emissions reductions at the least cost.

3. No updating issues

Grandfathered systems face a variety of thorny updating issues that are unique to it. The permit allocation creates an asset that is extremely valuable and well worth fighting over. This is true for all the allocation systems except for auction – under auction, the purchaser pays what the permit is worth, and because there is no windfall, the motive to fight over the allocation is eliminated.

Though the motive for dispute is similar for grandfathering, population-based or output-based allocations, the latter two are sufficiently unambiguous that they would not generate much dispute. For grandfathering, on the other hand, you need to have a system for determining how historic allocations are affected by mergers, divestitures, spin-offs – whole panoply of potential corporate reorganizations. This problem is particularly severe for downstream systems where the number of covered entities is large and the full range of reorganizations possibilities are likely to be observed. Other updating problems that arise under grandfathering include what to do about new entrants (who by definition have zero historic emissions), whether and how to adjust to dramatic changes in firm size, whether growth or shrinkage, and how permits allocations are treated in bankruptcy.

The upshot of all this is that the rules required to administer such a system will be complex, and that the combination of complex rules and having hundreds of millions of dollars worth of permits at stake invites a massive and expensive wave of litigation. These costs should not be underestimated. A major reason why there is such widespread dissatisfaction with the Superfund is that it was demonstrated that for many years firms were spending more money litigating Superfund liability then they were on cleanup. An even closer analogy would be the broadcast industry's ultimate support for the move from administrative allocation of broadcast rights to auction of those rights, because it had found that the cost of litigation was higher than the cost of auction. Finally, and perhaps most tellingly, we are starting to see firms that are under the grandfathered greenhouse gas trading system in Europe come forward to say the allocation system is so opaque, political, and arbitrary that an auctioned system would be preferable.

4. No need for trading

Under an output-based or per capita allocation, trading is essential. These systems will result in very large and immediate cuts in the emissions allowable for some covered entities, and comparably large surpluses for the cleaner entities, which would eliminate all incentive for further emissions reductions. Immediate cuts of the magnitude implied would be catastrophically expensive and probably literally unfeasible.[12] Thus trading is required to cushion these abrupt changes. These trades imply very substantial cross-subsidization of the customers of the cleaner utilities by the customers of the dirtier utilities. We believe that the political and ethical consequences of these income transfers have not been properly considered or understood.

Because the demand for electricity and the generation mix change slowly, a grandfathered system can function without trading, at least in the short run. However, because the demand for electricity is not growing at the same rate for all load-serving entities over time, the disparity between the grandfathered allocation and a covered entity's need for credits will increase steadily over time, with the result that, absent trading, very expensive emissions reductions will be pursued by the faster-growing entities while much less expensive emissions reduction opportunities go begging in the slower-growing entities. This increases the total cost of achieving reduction targets, and the fairness of requiring more expensive and deeper cuts from areas that are growing more rapidly may be

Under an auctioned system, on the other hand, covered entities purchase a quantity of permits based on their anticipated need at the specified price. Emission reduction costs are equalized across utilities, not by trade, but by the initial purchase at a uniform price. Errors by a covered entity in forecasting its permit requirements can be corrected without trading by simply buying more of fewer credits in the next period.

Although we believe that a sufficiently carefully designed and monitored trading system can reduce the total cost of achieving emission reduction goals, there is no question that there have been instances where trading increased the opportunity to "game" market mechanisms with flaws in design or enforcement. Thus it may be regarded as an advantage of an auctioned system that it can be introduced without trading and still allocate reduction costs in a fair and efficient manner.

[12] The CPUC seems to have retreated from an earlier assertion that it would create a system without trading that could be based on grandfathering, output-based allocation or population-based allocation. Such a claim is inaccurate. At least in the short run, the only allocation systems that can function without trading are auction and grandfathering, because other systems create very large mismatches between the need for allowances and their supply. Under grandfathering, the allocations will usually be initially close to need because demand is relatively stable from year to year, but will increasingly diverge as time passes. Moreover, it is our belief that, were they faced squarely with a choice between auction with a sensible allocation of the revenue (based, say, on greenhouse gas reduction opportunities) and grandfathering, a majority of the parties to that proceeding would have preferred auction.

D. Grandfathering is a particularly poor system for allocating permits.

1. Grandfathering is unfair.

Grandfathering – distributing permits based on a percentage of historical emissions -- is unfair. First, it rewards the dirtiest producers and penalizes early actors. It allows dirty producers to remain relatively dirty into the indefinite future, and insists that those who have already devoted considerable efforts to reducing their emissions nonetheless must make further reductions of the same magnitude as dirty producers, or buy credits from those producers. It therefore violates the requirement of the Climate Solutions Act that early actors be rewarded rather than punished.

In addition, grandfathered systems are unfair because they create huge windfall profits for the stockholders of covered entities, profits reaped at the expense of California consumers, both households and businesses. Efforts in the literature to model the size of the windfall suggest that it is between eight and twenty times the actual cost to energy producers of the emissions reduction requirement.[13] Some have suggested that this problem can be neglected for a load-based, electricity-only system, because the regulated or public nature of the industry will preclude passthrough of costs in excess of the true costs. However, in its assessments of various climate policies, the Department of Energy routinely finds that the costs of emissions reductions do in fact translate into higher prices for delivered electricity.[14] Further, an analysis by the Energy Research Centre of the Netherlands (ECN) for the Ministry of Economic Affairs in the Netherlands found that electric utilities were passing 60 percent of the increase in marginal cost through to customers, an amount far in excess of the actual cost of emission reductions to the utilities, concluding that a switch to auction would be much better for European economies.[15] The precise mechanism whereby European utilities, which are, if anything, more heavily regulated than ours, accomplished this passthrough of costs is not known, but is seems foolhardy to assume that Americans are less influenced by market forces, or less ingenious, than their European counterparts.

2. Grandfathering creates perverse incentives.

Grandfathering can create particularly perverse incentives when the use of grandfathering to allocate permits is announced before the baseline period has closed. Under this circumstance, covered entities have an intense incentive to increase their emissions during the baseline period. This is because they are then given a permanent --or at least very long-term –stream of permits, a stream that is will continue to increase in value over time. In addition to the incentive to increase emissions, there is a very strong incentive to exaggerate emissions. This was seen in RECLAIM, where exaggeration of emissions during the baseline period resulted in a glut of permits in the early years. This in turn led to

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[13] Goulder, L.H. & Bovenberg, A.L. "Neutralizing the Adverse Industry Impacts of CO2 Abatement Policies: What Does It Cost?"), in C. Carraro and G. Metcalf, eds., *Behavioral and Distributional Effects of Environmental Policies*, University of Chicago Press, 2001; Smith, A. E. and Ross, M. T. *Allowance Allocation: Who Wins and Loses under a Carbon Dioxide Control Program?* Report prepared by Charles River Associates for Center for Clean Air Policy, Washington, D.C., (February 2002); Burtraw, D., Palmer, K., Bharvirkar, R., and Paul, A. 2002. "The Effect on Asset Values of the Allocation of Carbon Dioxide Emission Allowances." *The Electricity Journal*, June, pp. 51-62.

[14] See most recently, *Impacts of Modeled Recommendations of the National Commission on Energy Policy* Energy Information Administration, Department of Energy. 2005. SR/OIAF/2005-02.

[15] Sijm, J.P.M., Bakker, S.J.A., Harmsen, H.W., Lise, W., and Chen, Y. CO2 Price Dynamics: The Implications of EU emissions Trading for the Price of Electricity, ECN Report ECN-C--05-081, (September 2005).

negligible effort toward emissions reductions in those years – and to a much more severe shock when the glut turned suddenly to a deficit. Thus **it is essential that the report include a strong recommendation against using firm-level mandatory reporting as a basis for grandfathering credits to those firms.** Failure to do this virtually guarantees that any system that allocates permits based on the firm-level baselines so established will fail catastrophically.

This risk is much smaller for an upstream system that sets the permitting requirement where fuels are produced or imported, or a "midstream" system that imposes the requirement at the most administratively efficient point (often at "narrow points" in the fuel distribution chain, such as the terminal rack for motor fuels). The risk is lower because the number of covered entities is much smaller, so auditing can be much more comprehensive; because we have fairly good historic records of aggregate fuel consumption, which can be used as control totals; because we have fairly good historical information about fuel flows through the most important of these enforcement points, and so could set baselines retrospectively rather than prospectively. However, attractiveness of the greater ease of enforcement that upstream or midstream systems offer because of the smaller number of covered entities is substantially offset by fairness concerns, as the smaller number of entities implies that the benefits of the windfall profits discussed above are more highly concentrated.

A less severe but comparably perverse incentive is created under the so-called "rolling" baseline. Under this system, the baseline used for grandfathering is "updated" periodically by replacing the base period with a more recent baseline. Unfortunately, the rolling baseline has an effect similar to that of a prospective baseline. Because firms know that reductions achieved this year will result in a reduced permit allocation in subsequent years, the incentive that the cost of the permit provides to reduce emissions by a ton is cut from the full price of the permit to be only to be only the time value of reduced costs this year as versus a comparable increase in subsequent years.[16] In some cases, this can even turn a incentive to reduce pollution into an incentive to *increase* pollution. Although this has little effect on emissions in the short term, as total emissions remain set by a schedule of targets, updating causes the trading markets to fail, and costs are not equalized across covered entities or minimized for society. Moreover, this system substantially reduces the incentive to develop new technologies, reducing the productivity benefits from the cap and increasing the cost of achieving our long-term reduction goals substantially.

3. Grandfathering here would set a national precedent that would be bad for California.

California is a relatively clean state, from a greenhouse gas point of view. It has the fourth lowest carbon dioxide emissions per capita, and the fifth lowest per dollar of GSP. Because California is not a typical state, different permit allocation mechanisms, if adopted nationally, will affect it quite differently. Auctioning would help California, because our cleaner economy will pay significantly lower rates, as would a population-based allocation. Output-based allocation, which would benefit relatively clean utilities within California, if extended to a national level would not benefit California by as much,

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[16] This was demonstrated with respect to similar rolling baseline provisions in a former version of the research and development tax credit by Bronwyn Hall, "R&D Tax Policy During the Eighties: Success or Failure?" **Tax Policy and the Economy** 7 (1993): 1-36. [NBER Working Paper No. 4240 (December 1992). Berkeley, CA: IBER Working Paper No. 93-208 (January 1993). Stanford, CA: Hoover Institution Working Paper No. E-93-1 (January 1993).]

because the benefit of our lower-than-average greenhouse gas emissions is substantially offset by the cost of our lower-than-average electrical use. (Note that output-based allocation can only be used in the electric sector, as other sectors lack an unambiguous physical measure of output on which to base the allocation). On the other hand, grandfathering would result in a large transfer of assets from the citizens of California to states with coal-based energy systems.

Some have raised the question whether adopting a particular permit allocation mechanism in California implies that the chosen mechanism is substantially more likely to be chosen nationally. There is, of course, a long and proud history of environmental leadership by California, and many of California's climate-related initiatives such as our global warming pollution standards for cars are being actively examined and copied by states across the nation. Moreover, it seem likely that our policies will be adopted by relatively clean states, which constitute most of the states that support aggressive national greenhouse gas reduction goals.

E. Output-based allocation has the highest total social cost

Under grandfathering, when a covered entity sells and additional unit of power, it has to buy emission allowances to cover the associated emissions. The cost of the allocation is therefore added to the cost of the marginal unit of electricity. Under competitive pricing, this would increase the price of electricity by the full amount of the allowances required to offset the emissions associated with the generation of that last unit. Under average cost pricing, the cost of the allowance is spread over all the electricity the utility sells, so only a small portion of the cost is added to each kWh sold. This reduces the distributional justice concerns about windfall profits and regressive burdens, but at a major social cost: expensive reductions on the utility side will be mandated while no incentive is provided for much cheaper emissions reductions on the consumer side (e.g. turning off the lights when you leave a room). Thus the total social cost of achieving reductions is greatly increased.

Under average cost pricing, output-based allocation and grandfathering have similar distributional and total social costs when summed over all utilities. However, output-based allocation has peculiar implications for horizontal equity: customers of low-emissions utilities have their electric rates subsidized by customers of high-emissions utilities, as the latter will have to buy allowances from the former, and each will pass their respective costs and savings on to their customers.
It is under competitive (marginal cost) pricing, however, the inefficiency of output-based allocation becomes truly striking. Whereas when the grandfathered utility had to buy an allocation when it produces an additional unit of power, under output-based allocation the utility is given a valuable additional allocation, which it could in principle sell. Thus, instead of the price of the permit being added to the price of electricity, it is subtracted from that price.
In a truly competitive market this is an unstable condition because marginal cost will be below average cost, which means the firm is losing money. This will result in firms folding or otherwise leaving the market until the price rises to the average level again. What would happen to such firms if they have marginal cost pricing, or a hybrid of marginal and average cost pricing, as most utilities probably actually do, if they are not allowed legally to exit is unclear. But it seems safe to say that they will be similar to grandfathered utilities under average cost pricing – socially inefficient but not distributionally regressive – only a little more of each.

F. Auctioned permits are not taxes.

Although auctioned emissions permits raise revenue, they are not taxes, economically, legally, or politically.

Auctioned permits are not taxes economically because they increase rather than decreasing economic efficiency. All (or nearly all) taxes are charges applied to a base of production consisting of some valuable activity or product – making sales, working for wages, earning profits, holding property for use, etc. These charges discourage the taxed activity, resulting in an additional burden beyond that of the tax revenue, referred to by economists as a *deadweight loss*. This burden arises from the lost value of the economic activity that the tax discourages. Unlike taxes, auctioned permits (and other charges and fees against pollution or depletion of natural resources, such as the public goods charge proposed in the CAT report) discourage "bads" rather than goods. Thus there is no deadweight loss, and in fact there is an efficiency gain from such charges, provided that they are no grater than the (marginal) social costs imposed by the activity covered by the permits. This has been known at least since the since the 1920 publication of The Economics of Welfare by Pigou. Although some kinds of pollution charges have occasionally been referred to as "pollution taxes," this label is deceptive, because it can mislead people into believing that they reduce efficiency, when in fact they increase it.

Auctioned permits are not taxes legally because their primary purpose is to reduce emissions of greenhouse gasses that cause costly and dangerous climate change at the lowest net social cost, rather than to raise revenue. As discussed above, auctioned permits with efficient revenue recycling have a lower total social cost than other permit allocation mechanisms, and can produce a net social benefit.

Auctioned permits are not taxes politically because they are rightly seen primarily as an environmental measure rather than primarily as a revenue measure. They are closely analogous to two other classes of revenue measures that are often not regarded as taxes: user fees, which can constitute a charge for the use of a public asset in limited supply, like a park, road, or, in the case global warming pollution permits, the absorbtive capacity of the atmosphere; and "sin" taxes on activities that are self-destructive and impose costs on others, like smoking, drinking, or polluting.

V. A well-designed cap on emissions will enhance the competitiveness of emissions-intensive industries in the state while encouraging continued emissions reductions.

A. Emissions associated with the production of energy-intensive goods should be treated as made where the goods are consumed (consumption-based) rather than where they are produced (production-based).

By designing the permit system so that it covers emissions associated with California's consumption of energy-intensive products, rather than California's production of those products, we can enhance the competitiveness of even our most energy-intensive industries.

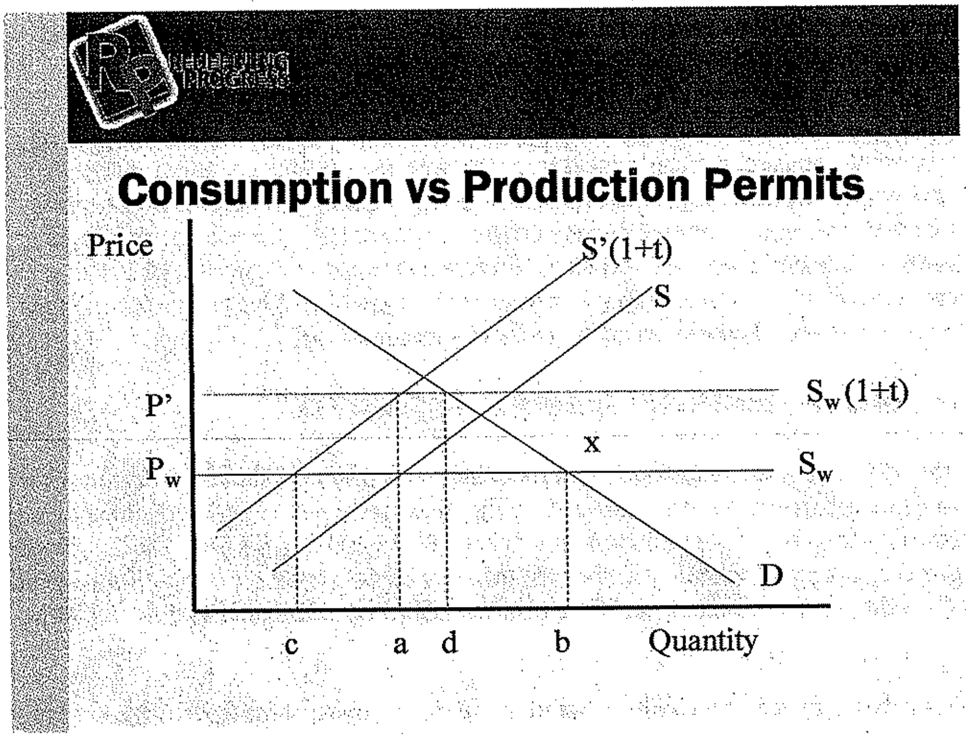
In electric sector, a consumption system is referred to as "load-based." Under a load-based system, those who sell electricity (load) to in-state consumers need permits for greenhouse gas emissions produced in generating that electricity. This is true whether the generation takes place in-state or out-of-state. Load-serving entities must buy permits for electricity they import. No permits are needed for electricity sold to out-of-state consumers, again, whether generation is in or out of state. Exactly the same system can be used on other energy-intensive products besides electricity, such as oil refining and cement production.

This approach levels the playing field between domestic out-of state producers. It completely eliminates all competitive burden of the permitting system for the products that it covers. It also eliminates the problem of "leakage." This problem is that policies to reduce domestic emissions can be rendered ineffective if they result in displacement of energy-intensive production out of the jurisdiction. This occurs when domestic policies increase the cost of producing goods domestically, thus encourage consumers to substitute imported goods. The increase in foreign production of goods causes a corresponding increase in foreign emissions. From a global environmental perspective, there is no benefit from driving production to unregulated jurisdictions where it is likely to be produced less efficiently with higher emissions (plus the additional emissions from transport). Instead, the environmental goal is to retain those industries and help them become cleaner. (The term "foreign" here refers to other states as well as other nations).

It is easy to see why a load- or consumption-based system reduces the negative impact of a an emissions permitting program, but it is less obvious, but true, that it eliminates that burden entirely and, in conjunction with other policies, can actually increase the competitiveness of emissions-intensive activities. We can easily illustrate this using the graph below, which is actually far simpler than it at first appears. Think of this as the market for some product the consumption of which causes pollution, such as gasoline, which emits a fixed amount of CO_2 per gallon consumed.

The lines labeled **S** and **D** are our usual supply an demand curves. One would think that a normal market would settle down at the point of intersection where supply equals demand without surplus or shortage – where the market clears. But actually, that would be a rather unusual market. The reason for this is that most markets are open to trade, to a world supply curve $\mathbf{S_w}$ that lets you buy as much of the good as one wants at the world price $\mathbf{P_w}$. The world price sets the price in the domestic market, which does *not* clear –at the world price firms supply only amount a, while consumers demand amount **b**. The difference, **b-a**, is imports.

Now suppose one required an allowance purchase or emission fee on domestic *production* (i.e. supply) of oil in the amount t. This is added to the price of production, so that we have a new supply curve **S'** for which the price has been shifted upwards by amount t. However, the price in this market is still set by the world price $\mathbf{P_w}$. As a result, domestic production falls from **a** to **c**; the difference is made up by imports, so leakage is 100 percent, and domestic consumption is unchanged. We just lost a lot of jobs with no environmental benefit.



Suppose that we now want to apply that permitting fee to domestic *consumption*. Recalling that consumption equals production plus imports minus exports as an accounting identity, we apply the same charge that we previously applied to production to imports as well. (I have shown a nation that is a net importer, but all of these arguments would apply just as well if world supply was above the intersection of supply and demand so that our country would be a net importer). This lifts the world's supply curve up by the same amount, **t**, that we lifted the domestic supply curve. World supply still sets the price in the domestic market. But now, instead of imports being larger that the original amount, they have shrunk to only **d-a**, an amount smaller than the original amount. Consumption has fallen from **b** to **d**, so we have real emissions reductions, with no corresponding increase in imports, i.e. no leakage. And the amount supplied – the point where the new world price intersects the new domestic supply curve – is **a**, *exactly the supply with which we started.* If you look carefully you will see that this is inevitable, not accidental. Moreover, the price received by the domestic producers is the new world price, **P'**. After the producer pays the permitting fee t, the payment that s/he takes home is just equal to $\mathbf{P_w}$ – again, exactly the payment received in the no-policy case. The position of the domestic producer is entirely unchanged by a consumption-based permitting system.

This analysis is equally valid for international or interstate trade. It demonstrates why California's climate policy, however stringent, will not harm California's oil refining industry.

A load- or consumption-based system is a relatively new idea in environmental policy, but well understood and has been extensively analyzed in the public finance literature, where the legal and administrative procedures that are required to turn a charge levied on domestic production into a charge levied on domestic consumption are referred to as border adjustment.[17] Virtually all consumption taxes are border-adjusted, e.g. the taxes on gasoline,

[17] This is also sometimes known as the "destination system," because products that move in international trade are taxed in their destination state rather then their state of origin.

alcoholic beverages, Ozone-Depleting Chemicals (ODCs), sporting goods, Superfund Toxic chemicals, and the value-added taxes popular in Europe.

Border adjustments fully offset the cost of the permitting system, but do not offset benefits of efficiency programs, or tax cuts financed with recycled revenue. So under a consumption-based system, even -- or rather, especially -- the most energy-intensive industries becomes more competitive. This improvement in competitiveness takes place without watering down the incentive to reduce emissions. As a result, California's product is produced with lower emissions per unit of output than the foreign product it displaces (through decreased imports or increased exports), so world emissions go down for this reason as well.

B. Consumption-based accounting is administratively feasible.

Industries that require consumption-based treatment are those that have significant increases in their output price relative to the baseline, after policy-induced efficiency improvements and revenue-recycling have been taken into account. When efficiency improvements are combined with revenue recycling, the result is that the vast majority of industry, in excess of 95 percent measured by value of gross output, or 98 percent measured by employment, have net price savings.[18]

This analysis is based on a $50/ton carbon permit price. In our view, permit prices are unlikely to exceed $30/ton in the forecast period, and will reach that level only if an implausibly high level of the technology promotion programs suggested by the CAT report and subsequently fail to be implemented or are ineffective. So the true figure for share of industries requiring consumption-based accounting is even small than those listed above.

This implies that only a very small percentage of industries need consumption-based accounting to preserve their competitiveness. The most important of these by far are the energy industries themselves: oil, coal, gas, and electricity. We believe that it is probable that the only industries that would need consumption-based accounting are the energy industries and cement. We suggest that other industries be allowed to apply for consumption-based treatment if the net impact of climate policy increases their cost of production by more than a specified amount, say one percent. Although we believe that there are unlikely to be any qualifying industries under this test, its existence could be a source of reassurance to energy-intensive industries that are unsure of the magnitude of efficiency savings that will prove feasible and economic.

See Appendix A. for a discussion of workable rules for attributing emissions to out-of-state electric generation; Appendix B. for further discussion of how the price impact of the climate actions plan should be measured and how consumption-based accounting could be implemented for industries other than electricity; Appendix C. for a discussion of the proper accounting system for emissions from interstate and international air travel; and Appendix D. on the validity of a consumption-bases system under the federal Commerce Clause and under GATT/WTO rules.

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[18] Hoerner, J.A. & Mutl, J. *Good Business: A Market Analysis of Energy Efficiency Policy*, Redefining Progress (2001). Executive summary: http://www.rprogress.org/newprograms/sustEcon/gb-execsumm.htm Full report: http://www.rprogress.org/newprograms/sustEcon/goodbusiness.pdf

VI. Market-based approaches to emissions reduction should be combined with intelligent technology promotion programs.

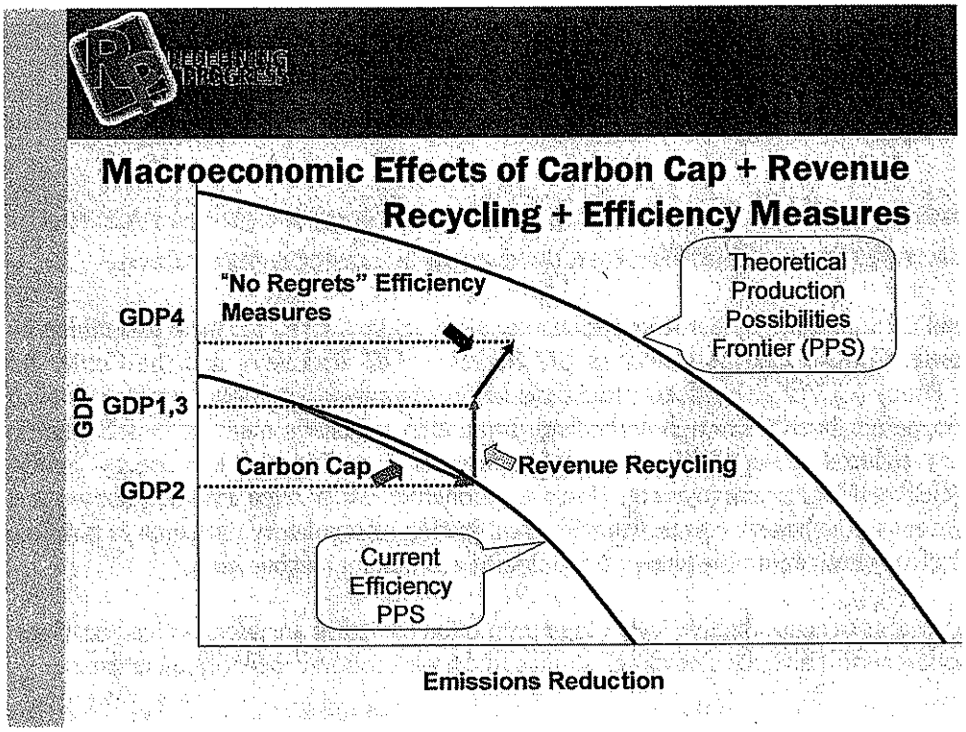
A. The combination of market mechanisms with technology programs reduces the costs and increases the benefits from achieving emissions reductions.

As has been demonstrated by the recent economic analyses by CEPA, the team assembled by the California Climate Change Center at UC Berkeley (UC Berkeley), and the Center for Clean Air Policy (CCAP), significant reductions in global warming pollution can be achieved at a net economic benefit through technology-promotion measures alone, a benefit that is reflected in reduced energy bills, increased consumer spending for non-energy goods, increased GSP and higher employment. However, modeling results have generally shown that the greatest economic benefit comes from the combination of regulatory measures to promote energy-efficiency and renewable energy technologies and market mechanisms.

When the benefits of cost-effective technology promotion measures are added to the benefits from recycling permit revenues, nearly all studies find a net economic benefit, rather than a cost.

One way of understanding this is by a simple graphical analysis. The curves in the graph below represents the conventional tradeoff between emission reductions and GDP, i.e. the highest level of GDP the economy can achieve with a given level of emissions and a specified stock of technical knowledge.[19] The lower curve shows this tradeoff under current technology. The higher curve represents the tradeoff under a better, future technology.

[19] Krause, F, DeCanio, S, Hoerner, J.A., and Baer, P (2003) "Cutting Carbon Emissions at a Profit (Part I): Opportunities for the United States," *Contemporary Economic Policy*, 20(4) 339-65.



This shows that with technological improvement, you can get more GDP **and** lower emissions.

The brown arrow labeled "carbon cap" represents the result of a cap and trade system, either auctioned or grandfathered. It does not improve technology, but it does induce efficient selection of reduction options, so it moves you from a point with higher GDP and more emissions to another point on the production possibilities frontier with lower GDP and less emissions.

This second, light blue arrow, labeled "revenue recycling," represents the benefits from investing the revenue from auctioned allowances (or from other revenue-raising approaches such as emission fees). This graph assumes the revenue goes to non-environmental investments, so you get an increase in GDP without any change in the environmental outcome, though of course it would also be possible to invest in new clean technology. You can see that the investment of revenue just about offsets the GDP cost of the cap. That's a good reflection of the literature. Depending on exactly how you spend the money, some studies find the economic benefit from investing the revenue is a little more than the cost, some a little less, but virtually everyone agrees that the two are nearly comparable, within twenty or thirty percent of one another, whether this is based on theory[20] or on surveys of modeling results.[21] Most

[20] Goulder, L. H. 1995. Effects of Carbon Taxes in an Economy with Prior Tax Distortions. *Journal of Environmental Economics and Management* **29**: 3 (September); Parry, I.W.H., and A. M. Bento 2000. Tax Deductible Spending, Environmental Policy and the Double Dividend Hypothesis. *Journal of Environmental Economics and Management* **39**:1 January; Parry, I. W. H., Roberson, R. C. and Goulder, L. H. (1999). When Can Carbon Abatement Policies improve Welfare? The Fundamental Role of Distorted Factor Markets," *Journal of Environmental Economics and Management* **37**: 1 (January) pp. 52-84; Mabey, N and Nixon 1997. Are Environmental Taxes a Free Lunch? Issues in Modeling the Macroeconomic Effects of Carbon Taxes. *Energy Economics* **19**:1 (March).

[21] Repetto, R. and D. Austin 1997. The Costs of Climate Protection: a Guide for the Perplexed. Washington, DC, World Resource Institute; Mabey, N., S. Hall, C. Smith, and S. Gupta 1997. *Argument in the Greenhouse*. (London: Routledge); Shackleton, R., M. Shelby, A. Cristofaro, R. Brinner, J. Yanchar, L. Goulder, D. Jorgenson, P. Wilcoxen, P. Pauly, and R. Kaufmann. 1996. The Efficiency Value of Carbon Tax Revenues. In D. Gaskins and J. Weyant, Editors, *Reducing Global Carbon Emissions: Costs and PolicyOptions*, Energy Modeling Forum, Stanford University, Stanford, CA; Zhang, Z. X. and H. Folmer 1998. Economic Modeling Approaches to Cost Estimates for the Control of Carbon Dioxide Emissions. *Energy Economics* **20**: 101-120; Hoerner, J. A. and B.

models find that the economic benefits are greatest if the revenues are recycled to cut the more distorting taxes or to encourage high-value investments. These could be in energy efficiency and renewable energy, human capital (education), physical and financial capital, essential infrastructure such as roads and schools, or in research and development. General labor tax cuts can also perform quite well, particularly in Keynsian models when the economy is not initially at full employment.

Finally, we add the arrow labeled "no-regrets efficiency measures." Those are policies that cause emission reductions at a net economic savings. Many of the measures and most of the proposed savings in the Climate Action Team's report are of this type. These technology improvements **both** improve GDP and reduce emissions, and so the arrow moves toward the higher efficiency curve.

When you look at these three arrows together, you see that the net result is both a stronger economy and a cleaner environment. Again, this is an accurate reflection of the literature for this sort of combination policy. Hoerner and Bosquet surveyed 103 studies of market-based approaches to reducing greenhouse gas emissions in Europe, and found that the combination of "no-regrets" technology policies and market mechanisms produce better GDP and employment outcome than market mechanisms alone.[22] Indeed, the integration of technology policies was more strongly associated with positive outcomes for both GDP and employment than the choice of recycling option (i.e. between cutting taxes on labor, capital, consumption, income, etc.). One explanation of this finding can be found in the following section.[23]

If you grandfather, of course, the second arrow is missing, so you are likely to have a comparable environmental improvement, but much less likely to see an improvement in the economy overall.

Why does the third arrow exist? Why aren't all cost-effective technologies adopted instantly? Market mechanisms achieve emissions reductions at lowest total cost, provided the relevant markets function adequately. This is not always the case, especially in information/technology markets and in the presence of externalities. Market mechanisms can internalize the externalities, but additional technology policies are necessary to effectively deal with the problems of imperfect information and informational public goods like scientific knowledge.

Another useful perspective is supplied by imagining trying to reach the targets of the Global Warming Solutions Act with only market incentives. The demand for fossil fuels is not very sensitive to price, with most estimates for long-term price response falling around half a percent decrease in the amount of fuel demanded for each one percent increase in price. So the 25 percent reduction in emissions from business as usual that the Global Warming Solutions Act mandates by 2020 would require roughly a fifty percent increase in current, already high energy prices, if those reductions were achieved by market mechanisms alone. This is a price increase that would be difficult for a state acting alone to sustain. If, however, most of the reduction is achieved through cost-effective technology promotion programs, the market mechanism need only achieve reductions equal to the shortfall from those desired. This increase is likely to be more politically and economically sustainable.

Bosquet (2000). *Environmental Tax Reform: The European Experience*. Center for a Sustainable Economy Report; Available from Redefining Progress at http://www.rprogress.org/programs/sustainableeconomy/eurosurvey.pdf (Oakland CA: Redefining Progress).

[22] Hoerner, J. A. and B. Bosquet (2000). *Environmental Tax Reform: The European Experience*. Center for a Sustainable Economy Report; Available from Redefining Progress at http://www.rprogress.org/programs/sustainableeconomy/eurosurvey.pdf (Oakland CA: Redefining Progress).

[23] See especially Krause, DeCanio, Hoerner & Baer at footnote 19.

B. Market mechanisms promote technological development.

Improved energy-efficiency and renewable-energy technologies allow us to produce energy services (such as passenger-miles, rooms heated, goods manufactured, kWh, etc.) with a lower total cost. This must be distinguished from mere substitution effects, where capital, labor or materials are substituted for energy (say, by installing insulation), but the total cost of the service including the cost of the additional purchase of capital, labor and materials does not go down, and indeed goes up. Technological improvement has an unambiguously positive effect on the economy by increasing productivity, so that the same input of labor, capital, energy and materials produces a greater output. Technological improvement, both directly and through increases in the quality of inputs (more sophisticated machinery and equipment, workers educated or trained with more advanced knowledge, high-tech materials, etc.) is in fact the primary engine of growth, accounting for more than half of the total GDP growth in the US.

There is now considerable evidence that flexible, market-based approaches to emissions reduction stimulate the development of new technologies.[24] Regulatory approaches can also help to accelerate the introduction of new technologies, but typically work by accelerating the diffusion of existing technologies.

Moreover, research into how managers make environmental decisions shows that a cap increases effectiveness of a wide range of technology promotion policies, including voluntary measures, public-private partnerships, research consortia, DSM programs, etc. One example of this is provided by our study of US Ozone-Depleting chemicals policy.[25] The U.S. ODC policy, which included a cap and trade system, was extremely successful. It succeeded in phasing out ODCs ahead of schedule and at less then half of the cost originally projected by the EPA. We interviewed dozens of managers about their decision-making process. What those managers told us was that the cap gave them certainty that change was coming. Manager after manager told us that the existence of the cap encouraged them to seek out opportunities for reduction that were not yet mandated by law, and to participate in programs that would help them cut their emissions. Under a cap, such programs look like help. Without it, they are sometimes seen as costly impositions that should be fought or avoided.

The phase-down of the cap also provides predictability that reduces costs by stimulating technological development. Efforts to model the process by which new commercial technologies are developed have generally found that technical knowledge is produced by some combination of time with economic resources such a labor and capital. As applied to a single technological problem for a fixed amount of time, the marginal productivity of the economic factors falls rapidly, so that budgetary increases produce less and less return. Despite this, many economic analyses of the cost of reducing emissions have used the "manna" model of technological improvement, in which technology "falls from the sky" rather than resulting from investment. More realistic technology models imply that steady effort yields a larger amount of technological progress than a crash program with the same budget. Quantitative estimates suggest that the benefits of improved energy technology from continuous but moderate research effort can result in a net economic benefit relative to inaction.[26]

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[24] Jaffe, A., and R. Stavins (1995). "Dynamic Incentives of Environmental Regulations: The Effects of Alternative Policy Instruments on Technology Diffusion." *Journal of Environmental Economics and Management* 29: S-43-S-63.

[25] Some of these results were reported in Elizabeth Cook, ed., Ozone Protection in the United States: Elements of Success, Washington DC: World Resources Institute (1996).

[26] Dowlatabadi H. (1998), 'Sensitivity of Climate Change Mitigation Estimates to Assumptions about Technical Change', *Energy Economics*, 20(5-6), 473-493.

C. Market and non-market emissions reduction policies must be intelligently integrated.

1. Recognize that no-regrets options exist and are caused by market barriers.

Many thousands of case studies have demonstrated that there are new efficiency and renewable energy technologies that are cost-effective at current prices, and the continued existence of such opportunities in California has been well documented by the Tellus Institute, the Center for Clean Air Policy, the University of California Energy Institute, the Climate Action Team and its member agencies, and many others.. Models and analyses that refuse to recognize this should be rejected out of hand. Yet this knowledge is difficult to integrate with the usual economic assumption that all agents optimize all the time. This is a reasonable simplifying assumption for many purposes, but it is clear that the real world is messier than this, that there are many barriers to instant adoption of new technologies by potential users. These include:

- that the technology is not yet known or invented,
- that knowledge of the technology has not diffused to users,
- that potential adopters lack good knowledge of the technology's reliability or other important performance features,
- that the unit cost of production is high due to low production experience or volume, and
- that use of the technology is more expensive or less convenient because others are not using it yet.

2. Follow sensible rules of thumb on regulation

Regulators are not yet used to working in an environment where there are also market mechanisms in place. Conversely, many economists have not thought through how to deal with the existence of no regrets regulatory policies with any clarity. In this setting, it is desirable to have some interim rules of thumb for regulators on deciding when to regulate, thus determining what emissions reductions should be expected from the market mechanism. Only in this way will business people and economists know what level of emission reductions will need to be achieved through the market mechanism, and be able to make reasonable forecasts about allowance prices. These forecasts in turn will need to be reintegrated into the calculations required by the rules of thumb in an iterative manner.

a. First identify the barrier.

In determining whether a particular regulatory initiative is desirable it should be recognized first that government and business are both fallible. Businesses usually have the best information about current and near-term production costs and small changes in production technology. However, where reductions in cost can only be achieved through large changes from current business approaches or through coordination of many businesses, businesses loose their forecasting advantage.

Given a fallible government and fallible business, the government's first response on identifying what appears to be a cost-effective new technology is to identify the barrier to the market adopting the technology. If a technology appears to be cost-effective now but is not being adopted, and yet there is no obvious barrier to adoption, this is a sign that the government estimate of costs may be mistaken.

b. Tailor the regulatory response to the barrier.

Once the barrier to market adoption has been identified, the government should appropriately tailor its action to promote a new technology to the nature of the barrier. Failure to invent new technologies should be met by research. Unfamiliar technologies should be promoted through education. Imperfect knowledge of product characteristics should be met with labeling requirements. And so forth.

Regulation is the appropriate reaction where the primary barrier to adoption is a high price caused by small production volume or limited production experience. For investments with a long life-span, it may also be appropriate to mandate if the allowance system is not expected to fully integrate the external cost of greenhouse gasses in the early years because of the rate of phase-in. In this circumstance present value calculations by business are unlikely to embody the full or true cost of emissions despite the existence of the allowance system.

c. Don't mandate technologies that are not cost-effective.

In general, the regulators should not mandate a technology unless it is cost effective, in the sense that the net present value of the forecast energy savings, including the price of the allowances, less the net present value of the cost of achieving those savings, is positive. If a technology fails this test, then it is cheaper to achieve those reductions through the market mechanism, and that is what should be done. Of course, this analysis should also include the value of any non-market social or environmental co-benefits or costs.

d. Include that value to California of emissions reductions induced by technological spillovers as a co-benefit.

Technical knowledge, whether created by formal research or through manufacturing experience, is by its nature a quasi-public good, in the sense that, once created, it can be replicated and disseminated almost costlessly. Emissions-reducing technologies created in California can be exported to the rest of the nation and the world, reducing the cost of emissions reductions and increasing the likely level of such reductions. These reductions in turn provide positive environmental benefits from reduced climate change.

The change in in-state emissions from a change in technology relating to a particular industry or good is equal to (the gross state product time the industry share of gdp) times (the industry emissions per dollar of output) times (the percent change in emissions/ per dollar of output from the new technology). The equivalent global spillover figure is the global equivalent, using global production levels and emission efficiencies, where the domestic technology improvement percentage from the technology is reduced by a "spillover percentage" that represents global adoption rates or partial copying. These spillover percentages can be based on market penetration estimates using normal global market estimation tool, or can be econometrically estimated.[27]

[27] See, e.g. Coe, David T, Elhanan Helpman, and Alexander W Hoffmaister, 1997, "North-South R&D Spillovers," *Economic Journal*, 107, 134-149; Crespo, Jorge, Carmela Martín and Francisco J Velázquez, 2004, "The Role of International Technology Spillovers in the Economic Growth of the OECD Countries," *Global Economy Journal*, 4, Article 3, 1-18; Engelbrecht, Hans-Jürgen, 1997, "International R&D Spillovers, Human Capital and Productivity in the OECD

Because this analysis is potentially complex and costly, it should be limited to areas where the technology can be widely replicated and the sectoral emissions are large. The most likely examples would initially appear to be technologies associated with motor vehicles and electric generation, though a review of major technologies should be conducted to see if such an analysis should be extended to additional technologies. Technological improvements in renewable electric generation and transportation technologies offer potential reductions from technology spillovers which are comparable in scale with the entire reductions of the rest of California's climate program.

Although the emission reductions induced by such spillovers provide value to the state and so constitute a basis for justifying regulation, if included in a trading system they would result in double-counting as multiple nations claim credit for the same emissions. Instead of incorporating these emission reductions in the market mechanism, the state should look for opportunities to promote non-environmental economic benefits from such technology forcing regulations through tools such as the development of export industries and revenues from technology licensing.

Inclusion of all spillover-induced emissions reduction in cost-benefit analysis at the forecast allowance price could result in adoption of regulations that would be extremely costly within California. We suggest that instead these spillover benefits should be valued based on the climate benefits they provide to California plus the direct benefits from export and licensing opportunities, i.e. balance local cost against the local benefits of the technology plus the local benefit from global emissions reductions from spillovers.

e. Don't exclude regulated technologies from capped sectors

The cap should be regarded as covering the entire economy including sectors that are subject to technology regulations. It is true that this means that technology regulations will not produce additional emissions reductions. In an efficient system with both market and non-market measures, the primary purpose of technology measures is not to reduce emissions, but to reduce the cost of achieving emissions by promoting technological development.

One important reason for including regulated sectors under the cap is that technologic regulations are by their nature unable to achieve a large portion a of the available low-cost emission reduction opportunities. Demand-side reductions fall into three categories: behavioral, in which consumers reduce demand by changes in behavior without changing the underlying products or technologies (e.g. by turning out the lights when you leave a room, or wearing a sweater and keeping the thermostat cooler); structural, by replacing more energy-intensive products and services with those of lower energy-intensity; and technological, in which the same products and services are produced with a more efficient technology (including home production of services such as hot water and heated living

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Economies: An Empirical Investigation," *European Economic Review*, 41, 1479-1488; Frantzen, Dirk, 2000, "R&D, Human Capital and International Technology Spillovers: A Cross-Country Analysis," *Scandinavian Journal of Economics*, 102, 57-75; Kao, Chihwa, Min-Hsien Cheng and Bangtial Chen, 1999, "International R&D Spillovers: An Application of Estimation and Inference in Panel Cointegration," *Oxford Bulletin of Economics and Statistics*, 61, 693-711; Keller, Wolfgang, 1998, "Are International R&D Spillovers Trade-Related? Analysing Spillovers Among Randomly Matched Trade Partners," *European Economic Review*, 42, 1469-1481; Xu, Bin and Jianmao Wang, 1999, "Capital Goods Trade and R&D Spillovers in the OECD," *Canadian Journal of Economics*, 32, 1258-1274.

space). (I am including capital-energy substitution such as increased insulation in the technological category).

Most of the reduction in energy use per dollar of GDP that we have seen over the last several decades has been behavioral or structural.[28] Because regulatory programs focus almost entirely on technological changes, excluding regulated sectors from the cap will increase the total social cost of achieving reductions in those sectors significantly. For example, technology regulations may affect what kind of car we drive, but price signals can also affect how we drive, whether we use mass transit, bicycles and other alternatives rather than cars, whether we choose to drive at all, as versus, say, spending more time at home with our families, and ultimately where we live, how we build our cities and plan land use, and so forth.

VII. Offsets are hard to measure and when measured correctly should be discounted by a factor of five.

A. Offsets should be discounted by a factor of five.

How should we set the allowable level of offsets? Is there a ***principled basis*** for the level of offsets that we should allow? In this section we show that, for offsets that do not push the envelop of technology, in addition to the usual requirement that the offset be real, verifiable, additional, permanent, etc., they should also be discounted by a factor of five, i.e. it should take five tons of offsets to balance an avoided ton of domestic emissions.

One argument that has often been made is that in principle there should be no limit on offsets, provided one can assure that offsets are real, additional, verifiable, permanent, etc. This is the position taken in the MAC report. The arguments for this position are clear and compelling: that one should cut the total cost of achieving emission reductions by seeking least-cost reductions wherever they are found. We understand the appeal of this argument. However, we believe it to be fallacious, because it does not recognize the fundamentally different natures of emission reductions achieved through technological improvement and emission reductions achieved through low-cost offsets, primarily biological sinks and bringing inefficient facilities up to developed-world standards.

Technology is not rival, i.e. improvement in technology by one nation not only does not deplete the stock of technology for other nations, but actually increases the generally available supply of technical knowledge. Most offsets, on the other hand, are part of an exhaustible stock of low-cost emission reduction alternatives. When a nation purchases an offset, it increases the cost of offsets to all other nations by depleting the stock.

Thus it is reasonable to adopt a "Golden Rule" assumption for technology improvements: that the developed nations will achieve percentage emission reductions comparable to those that we achieve. This is reasonable both under an "equality of effort" standard and because the developed nations largely share a common technology.

[28] See, e.g., Stephen Casler and Adam Rose, "Carbon Dioxide Emissions in the U.S. Economy: A Structural Decomposition Analysis" *Environmental & Resource Economics*, 1998, vol. 11, issue 3, pages 349-363; Rutger Hoekstra & Jeroen C.J.M. van den Bergh, "Structural Decomposition Analysis of Physical Flows in the Economy," *Journal Environmental and Resource Economics* Vol. 23, No. 3 pp. 357-378 (November 2002).

With respect to the developing nations, the situation for technology is less clear. Developing nations have emissions per dollar of gross national income (GNI) that are about 3.7 times those of the developed nations. See table below. This is due to a mix of technological lag and the compositional effect, in which developing nations first strive to increase their production of food, housing, and export goods, all relatively high-energy, and then beginning at about $10,000/capita transition toward the developed-nation GDI composition that consists primarily (in value terms) of low-energy services. As the table below shows, the World Bank's "middle-income" category, though it has nearly three times the income per capita (measured in purchasing power parity (PPP)) of the low-income nations, has nearly the same emissions per dollar of income.

	Population mill.	GNI ($ Bill. PPP)	GNI ($PPP/ capita)	GDI Growth rate	CO2 Tonnes/ capita	CO2 Tonnes (Mill)	CO2 Tonnes/$1000 GNI
Low income	2,343	5,291	2,258	6.5	0.8	1874.4	1.58
Middle income	3,018	20,051	6,644	7.2	3.3	9959.4	1.45
High income	1,004	31,138	31,009	3.4	12.8	12851.2	0.40

Source: Calculated from World Bank, *World Development Indicators 2006*, http://devdata.worldbank.org/wdi2006/contents/Section1.htm

Anticipated growth over the next 43 years will leave much of the develop world still in the income range where the composition of GDI will remain relatively energy-intensive. However, it is worth noting that the ratio between the developed-world's emissions per dollar of income and the developing world's emissions per dollar has remained nearly constant since at least the 70s, while in both emissions per dollar has improved significantly. Thus is appears that, though the developing world has a generally lower level of technical efficiency, that their growth in technology moves roughly evenly with the developed world. This makes sense in a model in which most technologies start on the developed world and diffuse to the developing world. Thus we can reasonably assume that technological progress alone will not cause a convergence of developed-world and developing world emissions per dollar, but that technological improvements will be reflected as comparable improvements in the emissions per dollar ratio in both developed and developing nations (though perhaps with a modest lag).

Currently the developing world has about twice the growth rate in income of the developed world, about a 35% higher population growth rate (the latter based on a World Bank 20 year projection). If this difference continues, by 2050 the aggregate GDI of the developing world will move from its current level of about 80 percent of the developed world's, to being 3.8 times ours. If emissions were also to continue at their current level of 3.7 times ours, developing world emissions will be almost 14 times ours. The IPCC business as usual scenarios show a lower ratio, roughly four to one, because they assume that the poorest part of the developing nations will grow at a much lower rate, and the richer part will grow at a sufficiently high rate that they will get into the region where the compositional effect will slow their emissions growth significantly.

Taking the IPCC's conclusions as correct, combined with our previous conclusions about technology, we find that a percentage of emission reductions achieved by developed nations through technological improvements will then result in roughly four times the emission reductions from those same technological improvements by developing nations. Thus each ton of emissions reduced through technological advance will result in five tons of emission reductions world wide.

Although we may reasonably assume that the share of our emission reductions that we achieve through low-cost offsets will be comparable to that of other developed nations, developing nations will presumably sell their low-cost emission reductions to developed nations. Thus there is no developing-world multiplier effect for emission reductions through offsets.

We concluded that; viewed through the lens of our long-term emission reduction goals, reductions achieved through domestic technological improvements in developed nations result in five times the global emission reductions as reductions achieved through offsets. Thus California should adopt a standard that, in addition to assuring that such reductions are real, additional, verifiable, permanent, etc., five tons of offsets (of the sort that do not push the edge of new technologies) should be required to offset a ton of direct emission reductions. This standard should apply whether the offsets are foreign or domestic.

So far this argument has been framed primarily in terms of the efficiency conditions for a sound climate policy. Offsets do not enjoy the large positive technological externalities that efficiency improvements and renewable technology improvements do. But it can also be framed in terms of a feasibility constraint. Investing in reduction opportunities with large technological spillovers is necessary to achieving a sustainable global emissions level. This is true because, in the absence of technological improvement *and spillovers*, in 2050 emissions from the developing world alone will be *three to five times the sustainable level*. No plausible offset program will be adequate to cope with emission overages of this magnitude.

B. Many apparently valid offsets actually result in no emission reductions.

In this section we show that the requirement that offsets be real, verifiable and permanent is often quite difficult to assure, giving several examples of apparently real but actually fictitious offsets.

Many commonly proposed offset types have little or no effect on global emissions, or can not be verified in any determinate manner. For example:

- Emissions from the permanent preservation of logged forests results in no emission reductions unless parallel steps are taken to reduce the global demand for wood by and amount equal to the foregone cutting. This is because the same trees will simply be cut down elsewhere. It is less obvious but also true that tree planting in reserved land has no effect if the land so reserved would otherwise have been used for some non-forest activity. This is because the activity that did not take place on the planted land is likely to take place elsewhere, resulting in deforestation that may offset, or in some cases exceed, the emissions sequestered by planting.

- Emission reductions from re-powering of existing facilities, or the replacement of existing equipment with more efficient equipment, on a project basis, is inherently unverifiable. There are two reasons for this. First, it is never clear that the equipment in question would not have otherwise been junked. Facilities that are good candidates for replacement are nearly always also among the facilities most likely to be shut down as uneconomical. Second, it is never demonstrable to what extent the achieved improvement would or would not have been achieved in any event through domestic action. The only case where such domestic action can be clearly shown to be unlikely is when the improvement itself is uneconomical, as when sequestration capacity is added to an existing facility. But these uneconomical additions are rarely low-cost relative to emission reduction opportunities available domestically.

- Emission reductions from replacing new facilities with higher-quality facilities than would otherwise be built are likewise unverifiable because there is rarely any assurance that the new facility would have been built at all in the absence of foreign financing.

These examples could be multiplied, but they suggest at a minimum that offsets should be allowed only from sectors that either do not produce traded goods, or produce such goods under comprehensive national caps with emissions embodied in imports and exports being covered under the cap.

VIII. Next steps – Recommendations on the developing a system of market allowances.

A. Develop a CARB staff proposal built on the MAC report

The MAK has made its recommendations, and the next step must be a CARB staff proposal that builds on the MAC report, retaining its strengths, eliminating its weaknesses, and addressing more fully the nitty-gritty details of implementation.

B. Avoid premature political compromise in the staff report.

While political considerations will ultimately play a part in the design of a market mechanism as finally implemented, it is vital to realize that no one is going to compromise the system cleaner, or more efficient. No special interest provisions are going to require the auction of a higher share of allowances. No back-room deal will make the extent of coverage higher, or more uniform. The CARB staff report is likely to be the high-water mark of the entire regulatory process.

This tells us something important about what the people of California need from this report. We need a plan is clean, simple, and comprehensive; a plan that reflects the best economic thinking. We need you to recommend design decisions that make it harder to implement special exceptions, not easier. We need a clear statement of what should be common knowledge: that the plan that serves the public best is one that is comprehensive form the beginning, implemented upstream to make it harder to muck up (with downstream reporting through the registry to promote widespread managerial attention to emissions), and auctioned 100 percent, so that the money that is collected from California consumers, business and family alike, can be returned to them.

The compromising that the MAC produced on the scope of coverage and point of implementation is *premature*. This is true, first, because preemptive capitulation is never a sound bargaining strategy. We need a plan good enough that people can compromise from it and still have something good. And second, because *every specific deviation from the public-interest ideal has powerful natural enemies*. It is the job of the advocacy community to mobilize those enemies in support of good policy; and this is proceeding apace if not always in the public view. But we need your help. We need an uncompromised proposal to fight for. And we need clear statements of the costs that accompany each kind of compromise, that we can wield as weapons for the truth.

In 1984, President Ronald Reagan charged a small group of senior economists and lawyers at the Department of the Treasury to produce an overall simplification and improvement of the tax code, without substantially changing the revenue raised or the progressivity of the distribution of burden. After ten months of study, this group produced the document now known as Treasury I.

Treasury I was devised with no attention to politics, but only to policy. No reasonable person should have expected that it could be adopted unaltered, and it wasn't. But it did a miraculous thing. First, it was endorsed by both Citizens for Tax Justice and The Tax Foundation, at opposite ends of the political spectrum. Next, it led to the most engaged discussions between Democrats and Republicans on tax policy to occur in our lifetimes. And third, it was the basis for the Tax Reform Act of 1986, the most important and fundamental reform of our nation's tax policy ever to occur in peacetime.

It is universally acknowledged that this reform would never have happened if it were not for Treasury I. And people laboring in the bowels of the Treasury bureaucracy like Gene Steuerle and Charlie McLure have earned a permanent place in the history of American tax policy because they *thought clearly* and *spoke the truth*. If they had tried to craft a politically acceptable proposal, they would already have been forgotten.

This is California's hour. California can be a shining example, setting the mold for national, and ultimately global policy. We can choose that, when the history books are written, they will say the pivotal event in moving from worsening the climate problem to solving it was accomplished here and by us. Recognizing that this work is likely to be the most momentous thing that most of us, it is time to put aside compromise and set the bar as high as we can manage, aiming California climate policy for the treetops by aiming the staff report for the stars.

Let us translate this into a few concrete suggestions:

B. Emphasize the optimal policy.

By now there should be little disagreement about what the best climate policy looks like. It is as comprehensive as can be managed with accurate measurement and reasonable compliance, administration, and enforcement costs. It is administered upstream, to assure that it can be enforced and make it harder to carve out special exemptions and exceptions; but with downstream reporting requirements to focus management attention on emission reduction opportunities. It addresses both leakage and competitiveness concerns with load-based emission accounting (or a close analog) for electricity, and analogous policies for other emission-intensive manufactured goods such as refined petroleum products and cement that focus on emissions associated with California consumption rather than California production. It integrates market and non-market policies in a wise and careful way.

The MAC report goes far in this direction. When compared to RGGI or the European Trading System, it shines. But it still falls short in several important ways that should be fixed in the staff report: recommending Option A over the clearly superior Option B; suggesting a mix of free allocation and auction rather than 100 percent auction; and containing an inadequate discussion of competitiveness/leakage problems outside of the electric sector.

In the discussion of competitiveness/leakage problems the MAC report keeps open alternatives that the staff report should clearly and firmly close, such as output-based allocation. Output-based allocation, like free allocation to regulated sectors with average-cost pricing such as utilities, roughly doubles the total social cost of achieving emission reductions by eliminating the incentive to reduce consumption of the most pollution-intensive products; and then doubles it again by forgoing the benefits of revenue recycling. If you think these are exaggerations, speak to the economists on the MAC, who were outvoted on these questions. It would be more accurate to say that the quadrupling of social costs is a lower-bound estimate for the losses from output-based allocation relative to auction.

C. Describe alternatives as deviations from the optimum.

The staff report should not hesitate to describe deviations from optimum policies as such, e.g., partial free allocation or partial coverage of emissions, should be described as such. The report should estimate and state clearly the cost of each deviation from the optimum, such as the cost of full or partial free allocation or of coverage limitations under the Option A phase-in approach. ***It is vital that the report include some rough statement of the magnitude of these costs. This is our strongest single recommendation.*** Without a sense whether you are talking about increases in public costs by ten percent, 100 percent, or 1000 percent, these costs can not effectively be balanced against the political support that the beneficiaries of certain bad policies will surely offer, and all of the careful economic analysis will be vitiated in the public debate. Silence on these questions is effectively a zero estimate, and as such often far worse than even the crudest approximation.

This is not to say that such deviations may not have compelling arguments in their support, nor to urge you to stint on such arguments. Some deviations from optimal policy will surely be required by real-world issues such as administrability and political feasibility. But policy makers and the public need to know what they are paying for such compromises so that they can intelligently ask if they are worth the price.

The MAC stated clearly that it did not have the time to do new research to quantify such costs. This must be remedied at the staff report stage. Order of magnitude estimates such as we suggest can be accomplished based on the common wisdom and a solid literature review, or by proper use of analytic capabilities and models already in the state's passion.

D. Recommend expenditure of allowance revenues on energy-efficiency and to offset burdens on low- and moderate-income households.

Lower bounds on such expenditures are essential in maintaining the progressivity and positive economic benefits of thee integrated climate plan, and as such required by the Global Warming Solutions Act. We discuss the magnitude of such lower bounds in our original MAC testimony. See especially section IV.B.1 & 2 of that testimony.

We would also suggest that the MAC recommend the creation of a few key administrative instruments, such as a carbon fund to contain the revenue from allowance auctions, and perhaps a revolving loan fund to assist utilities and others businesses to make the transition to new cleaner technologies.

E. Build appropriate deference to democratic processes into the regulatory plan.

A number of the most important recommendations of the MAC are beyond the core competency of the Air Resources Board.

This is especially true of auction and of any recommendations on how auction revenues be spent. Full auction of allowances (in contrast to the much more modest carbon fee revenues authorized by CGWSA Section 38597) could raise upwards of two billion dollars per year, and some of the most promising possible approaches to returning the revenue to the economy or to consumers, such as offsetting regressivity through the earned income tax credit, or returning the revenue to business by a cut in the sales tax on manufacturing equipment, involve decisions that one would not ordinarily pick CARB to make. Further, there is a risk that in recognition of this problem, CARB will either decide not to auction to avoid the embarrassment of having to assign the revenue, or allocate it all to pollution-control-equipment-like expenditures, whether or not this is really the best use of the revenue.

CARB should convene an advisory group chaired by a person with budgetary experience and wide knowledge of energy, environmental, tax and budgetary policy and bipartisan respect, such as Tom Campbell or Leon Panetta, and including representatives of both the Department of Finance and the Legislature, to prepare a study outlining several sensible options for revenue recycling.

Appendix A. Attributing emissions content to imported electricity

There are, broadly speaking, two methods of accounting for the emissions from electricity or other emissions-intensive products. These systems can be applied whether one is creating a cap-and-trade system, a system of emission fees or taxes, or simply an accounting system. The first of these systems is generation-based which measures or controls emissions associated with the *production* of power within the state. The second system is load-based which measures or controls emissions associated with *consumption* of power in the state. In the tax setting, the generation- or production-based system is known as the origin system, because the tax is imposed in the state where the taxed product originates, while the load- or consumption-based system is known as the destination system.

Note that, as an accounting identity, consumption equals production plus imports minus exports. A load- or consumption-based system need not, and probably should not, be administered at the consumer level – it is adequate to monitor producers, importers, and exporters. In some cases, a load- or consumption-based system might be most easily administered at an intermediate level. For example, a cap on emissions from motor fuels might be best administered at the terminal rack, the facility where tanker trucks are filled for distribution to gas stations. Because federal motor fuels taxes are collected at this point, much of the administrative apparatus for monitoring the sale of fuels is already in place.

Some have suggested that, because electricity is a uniform commodity bearing no trace of its origin, it is not currently possible to make a reasonable attribution of the emissions content of imported power. To assess if this is true, we must first ask what such a tracing system need do to be adequate for purposes of climate policy. Such a system should create the right incentives on the margin to construct cleaner new plants and discourage dirtier ones. It should provide an approximately correct result when perfect tracking of power to its generating plant is not available. It should not be possible to game the system through "bookkeeping" changes that attribute relatively clean power to exports to California without making actual changes in the corresponding emissions from the generating state. It should be administrable at a reasonable cost using currently available information. And it should not place a disproportionate or discriminatory burden on interstate commerce within the meaning of the Commerce Clause of the U.S. Constitution.

Although it is probably true that it is not currently possible to make a perfect estimate of the emissions associated with specified imports, it is fairly easy to produce sensible, non-discriminatory accounting rules that create the proper marginal incentives, generate reasonable results, are fairly "game-proof" and can be applied easily and immediately. One such set of rules is demonstrated below.

Before turning to the details of such a system, note first that electric power facilities fall into two broad categories that require separate treatment: plants built in the past and plants built in the future. For plants built in the past and currently operating, changes in ownership or in the terms of long-term contracts that do not result in shutting the plant down have no effect on the total emissions from the electric generating system. Thus, no transactions of this type should have any impact on the carbon content attributed to imports, which should be permanently fixed based on historic ownership or contracting arrangements. The only exception to this rule that should occur is when there really is a full tracking system that can determine precisely what emissions are associated with the generation of power that is imported, one that covers the entire power-pool from which imports are drawn so that "cherry picking" – using the tracking system only for power from cleaner plants – can be prevented.

For plants built in the future, on the other hand, the task is to assure that the benefits of clean power and the costs of dirty power are fully incorporated into the decision-making around the plant's construction. Thus, the attribution of emissions content to imports should be fully responsive to changes brought about by these decisions.

Finally, we shall need a fall-back rule for the residual of power which is neither fixed based on past contracts or ownership nor generated pursuant to ownership share or long-term contracts from plants built after the regulation goes into effect.

One way to achieve these various goals is to attribute greenhouse gas emissions to imported power according to the following four-tiered system:

First tier: Power from new facilities. For any out-of-state generating facilities built subsequently to the enactment of this program with financing in whole or part from a California entity subject to the cap, or based on a long-term contracts with such a California entity, the "allocated emissions" shall be equal to the annual emissions from that plant in CO2-equivilent tons times the ownership share. "Allocated power" shall be equal to the annual kWhs of generation from that plant times the ownership share, less average line losses in transmitting that electricity to the California border. Imports by the California entity up to the amount of allocated power shall be treated as having a carbon content per kWh equal to the allocated emissions divided by the allocated power. This rule creates the proper incentives on the margin with respect to investment in new generating facilities by California entities.

Second tier: Traceable power. A California entity's imports in excess of the allocated amount from Tier 1 shall be treated as having an emissions content equal to the share of annual emissions from facilities contributing power to the relevant power grid attributable to the production of those imports, divided by the amount of those imports. This section shall apply if and only if a reliable system for tracking the contribution of various plants to the production of imported power exists.

Third Tier: Power from pre-existing units. At the moment that the regulations are put into place a determination shall be made of the average quantity of electricity purchased from existing plants pursuant to ownership shares or long-term contracts, and of the average level of emissions from those plants times the share of their output being sold to California purchasers under those shares or contracts. Emissions intensity for this power shall be based on the ratio of these two quantities. Imports that have not had emissions allocated under the first or second tier shall be treated as having this level of emissions intensity up to the limit of the average quantity as specified above.

Fourth tier: Residual power. Remaining imports shall be treated as having an emissions content equal to the average emissions content of electricity generated in the state or power pool (emissions over generation less line losses) in the most recent year for which reliable emissions data are available. This average will be calculated after subtracting the output and emissions tracked under the higher tiers. The Secretary may issue regulations that provide a finer categorization of imported power under this subsection where there are identifiable categories of power with distinct market characteristics for which reliable emissions and power output estimates exist, subject to the requirements that (1) the emissions for the categories sum to the state emissions and the generation in the categories sum to the state generation, and (2) in the view of the Secretary, the resulting categorization more accurately reflects the variation in emissions from the exporting state properly attributable to the variation in export sales from that state.

Some have argued that the creation of a tracking system such as that described in the second tier would be a daunting task, and that we should forgo attributing emissions content to imports for this reason. However it should be observed that much of the required administrative mechanisms are already in place to assure that the correct generators are paid for the power they generate. Even if this were not true, it would be technically easy to track the relative contribution of power from various generation facilities by imposing very small "signature" variations of the power output of each plant, and then measuring the strength of various signatures at the point of import. The larger barrier is likely to be industry or governmental resistance in the exporting state. But in any event, the tracking system can operate just fine with only tiers one, three, and four until such time as the tier two tracking system is created.

Tier four's use of the state average to attribute emissions content to traded power is a fallback rule for power that cannot be attributed by the tier one and two rules. In its simplest form it can be easily calculated using published data from the U.S. Energy Information Administration.

Various refinements from this simplest approach are available. For example, we might divide imports into baseload capacity purchased under long-term contract and other purchases, where emissions content is estimated separately for baseload and non-baseload generation. Alternatively, it might be possible to identify baseload plants that would always be run regardless of export sales, and subtract their emissions and generation from the state totals in calculating a state average. Other refinements can no-doubt be developed, and considerable work along these lines has already been done by the Registry and the LBNL. See, e.g. Estimating Carbon Dioxide Emissions Factors for the California Electric Power Sector, C. Marnay, et al., Environmental Energy Technologies Division, LBNL (August 2002). However, it is important to note again that we need not wait on the development of such refinements to put the system into place. Any inaccuracies in the tier four emissions attribution will apply to only a small portion of emitted power, and will not affect decision-making about the construction of new plants. Thus the system can be implemented immediately, and then refined as time and resources permit.

Finally, we should observe that the sole purpose of this regulation is to allow California's load-bearing entities to properly measure the emissions content of the power they sell in the state. Provided that the system does not require the importer to purchase a larger number of emissions credits than would have been required if the same power were generated in the state, it does not impose any economic or legal burden that would violate the dormant Commerce Clause by discriminating against interstate commerce, and so passes the four-prong test of *Complete Auto Transit Inc. v. Brady*, 430 U.S. 274 (1977), and its progeny. (Congress has the power to regulate interstate commerce under the Commerce Clause. The courts have held that, in the absence of such regulation, the "dormant" commerce clause forbids states from placing undue or discriminatory burden on interstate commerce.)

Appendix B. Proper measurement of emissions from international and interstate air travel

The problem: Airlines are often able to choose whether to refuel their planes in California or at their previous port of call. As a result, the purchase of fuel in California is not a good measure of greenhouse gas emissions relating to California air travel, as total emissions from the flight are the same regardless of where refueling takes place. Indeed, if the effort to avoid the cap induces airplanes to load up with surplus fuel to cover the next leg of a flight, this will actually increase greenhouse emissions because of the additional fuel required to carry the increased load.

The solution: To avoid this problem, we propose that, for purposes of determining emissions under a cap, fee, or permitting system, emissions shall be measured by the plane's average emissions per mile times the number of covered miles. For flights between California ports of call, "covered miles" are defines as miles in California air space. For Interstate and international routes, "covered miles" are defined as one-half of the total distance between ports of call. Distance in every case shall be measured along the great circle routes between ports of call.

Average emissions shall initially be based on the fleet average for planes of the specified model type. The Secretary shall conduct a study to determine whether the variation in efficiency between planes of the same model type is sufficient to justify the additional administrative burden of determining plane-specific average emissions levels, or to otherwise vary the average emissions rate estimate based on age, equipment, load, or other factors, including hearings allowing a full opportunity public comment.

Background: This approach to measuring the emissions from air transport is similar to, and based on, the approach used by the International Fuel Tax Agreement (IFTA) to allocate fuel consumption from heavy trucks by state. IFTA was mandated by Congress in 1991 to assure that of motor fuel use taxation laws with respect to motor carrier vehicles that operate across state lines are uniformly administered. All the states, with the exception of Alaska and Hawaii, participate in the IFTA. Under the agreement, states are able to act cooperatively in the administration and collection of motor fuel use taxes. This essentially allows motor freight carriers to base their operations in one state and report their taxable activities on one fuel tax report in that state, rather than file separate reports in each state in which they operate. Fuel tax collections are allocated to states proportionally to miles traveled in each state times their respective tax rates.

Appendix C. Administrability of a consumption-based system on emissions-intensive products

Non-fuel industries that might require consumption-based treatment are aluminum, cement (especially if non-fossil emissions are included), liquefied gasses, electroplating, chlor-alkali, nitrogenous fertilizer, asphaltic blocks and tile, and a few bulk industrial chemical like ethylene.

We suggest that other industries be allowed to apply for consumption-based treatment if the cost of permits associated with the energy they consume, less, first, the estimated value of industry-average net policy-induced efficiency savings and, second, the value of benefits to that industry of tax breaks or other services financed through the credit, exceed 1% of sales value. Note that estimated emissions and savings by industry are likely to be calculated as part of the state's planning process once mandatory firm-level emissions accounting is in place.

Consumption-based treatment for non-energy industries, should it prove necessary, could be implemented as follows: In-state producers would attribute a share of their actual emissions to exports based on the firms out-of-state sales as a share of total sales. Note that for companies with operations in more than one state, this number is already calculated in order to allocate corporate income across states, and the rules and procedures for doing so are well-established, well-known, and adequately audited. For out-of-state producers emissions content could be imputed an a per-dollar or per-physical unit basis based on national industry averages. Importers would be required to purchase permits based on the imputed value. In order to survive commerce clause challenges by out-of-state producers with emissions rates below the national average, a procedure should be established by which they could demonstrate their lower emissions rate, which should then be used for imputation for imports that firm.

Appendix D. Consumption-based accounting under auction does not violate the federal Commerce Clause or GATT/WTO trade rules.

When permits are allocated by auction, load-based accounting for electric emissions, and similar consumption-based accounting for other energy-intensive products, is allowed under the interstate commerce clause of the U.S. Constitution, nor is it barred by trade rules under the GATT/WTO.

The distinction between a load-based and a generation-based permitting system is closely analogous to the distinction between a production and a consumption base for excise taxes. In the later context the issue has been thoroughly litigated and thoroughly analyzed, primarily under the four-prong test of *Complete Auto Transit v. Brady*, 430 U.S. 274 (1977), and its progeny: that an economic instrument imposing a charge will be sustained "when the tax is applied to an activity with a substantial nexus with the taxing State, is fairly apportioned, does not discriminate against interstate commerce, and is fairly related to the services provided by the State." Compete Auto does impose one substantive constraint on the design of a permitting system: that it may not, if applied by both of two adjacent states, impose a heavier burden on interstate than on in-state commerce. This means, for example, that if you require permits for the emissions associated with electricity imports, you must then exempt exports, and visa versa. It is permissible for two states to operate two different systems in such a way that double taxation occurs. For example, if state A uses a generation-based system and state B uses a load-based system sales from A to B are covered twice and sales from B to A are not covered at all. This is permissible.

There might be a colorable argument under in Quill *Corp. v. North Dakota ex rel. Heitkamp*, 504 U.S. 298, 306-08 (1992), – the case that held that sending mail into a state did not, alone, constitute sufficient nexus to allow taxation of the sale -- that out-of-state electric generators with no property or personnel in California do not have adequate nexus to be covered. However, such an argument is unlikely to prevail, for two reasons. First, Quill is widely regarded as an aberration, based on the court's unwillingness to override a clear precedent, but inconsistent with the bulk of recent case law. The court has really bent over backwards to find some basis for economic nexus, such as the hiring of an independent contractor in the state, 1017 Tyler Pipe Industries v. Dept. of Revenue, 483 U.S. 232, 249–251 (1987), or upholding a use tax on fuels temporarily stored in the state prior to being loaded on a plane, 1018 United Air Lines v. Mahin, 410 U.S. 623 (1973).

Second, the requirement that in-state load-bearing entities purchase credits based on the estimated emissions per kWh times the number of kWhs sold, can probably not be successfully characterized as either discriminatory or as imposing an economic burden on out-of-state generators. On its face, the legal requirement is imposed on in-state load-bearing entities, not on out-of-state generators. Economically, the costs of the permits will be born primarily by California consumers, as explained in section V.A above. Even if the out-of-state generator could establish that the regulation burdens them, it would not appear to be a heavier burden than is imposed on similar in-state generators.

The Constitutionality of a load- or consumption-based system is less clear than under grandfathering, though we believe the weight of the law still supports it. Under grandfathering one would argue as above that the system does not impose any economic burden on the out-of-state generator. However, if the generator were to somehow establish burden, the case that the system is non-discriminatory is weaker then under auction, because whatever burden is imposed on in-state generators is much more than offset by the value of the permits allocated to those generators, while out-of-state generators bet no permit allocation.

This system of border adjustments described in the text is similar to that used under the ozone-depleting chemical cap-and-trade and tax systems and under the Superfund toxic chemicals tax to impute the content of ozone-depleting chemicals and toxic chemicals, respectively, in traded goods. It has withstood challenge under GATT/WTO rules.[29]

Some question has been raised about doing border adjustments for manufacturing inputs that are not physically incorporated into the traded good, such as process energy. Although these arguments continued to be made, the weight of the law supports the view that they are allowed when they do not impose a burden on foreign goods in excess of the burden on domestic goods or constitute a disguised form of subsidy,[30] and the European Parliament has recently adopted a resolution "adopt border adjustment measures on trade in order to offset any competitive producers in industrialized countries without carbon constraints might have."[31] Moreover, even if they were found to violate the terms of the GATT/WTO agreement, such measures clearly fall within the scope of the environmental exemption to the agreement under GATT Article 20.

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[29] GATT Panel Report United States - Taxes on Petroleum and Certain Imported Substances, L/6175, BISD 34S/136, 154 ff., adopted on 17 June 1987.

[30] Demaret, Paul and Stewardson, Raoul. "Border Tax Adjustments under GATT and EC Law and General Implications for Environmental Taxes," *J. World Trade* 28:4, p. 5 – 65 (1994); Hoerner, J. Andrew, and Frank Muller. 1996. *Carbon Taxes for Climate Protection in a Competitive World.* Swiss Federal Office for Foreign Economic Affairs (June 1996): Hoerner, J. Andrew. Available from http://www.redefiningprogress.org/programs/sustainableeconomy/swiss.pdf; *The Role of Border Tax Adjustment in Environmental Taxation: Theory and U.S. Experience.* Working Paper. Center for a Sustainable Economy, Washington, DC. Presented at the International Workshop on Market Based Instruments and International Trade, Institute of Environmental Studies, Amsterdam, (19 March 1998). Available from http://www.rprogress.org/newprograms/sustEcon/BTA.pdf; R. Ismer & K. Neuhoff. *Border Tax Adjustments: A feasible way to address nonparticipation in Emission Trading,"* Cambridge Working Papers in Economics 0409, Department of Applied Economics, University of Cambridge (2004); Frank Biermann and Rainer Brohm, 2003. *Implementing the Kyoto Protocol Without the United States: The Strategic Role of Energy Tax Adjustments at the Border.* Global Governance Working Paper No 5. Potsdam, Berlin, Oldenburg: The Global Governance Project.

[31] European Parliament Resolution on the Seminar of Governmental Experts on Climate Change, 12 May 2005, B6-0278/2005