CARBON TAX CENTER

Design of Economic Instruments for Reducing U.S. Carbon Emissions

Addressed to the U.S. Senate Finance Committee
Pursuant to the Committee Staff's solicitation for comments on its December 18, 2013 Discussion Draft, "Energy Tax Reform"

Prepared and submitted by the Carbon Tax Center
on behalf of Citizens Climate Lobby and Citizens Climate Education Corp.

January 31, 2014

The **Carbon Tax Center** was founded in 2007 to support enactment of a U.S. carbon pollution tax at the earliest possible date, in the most transparent and equitable form possible, rising briskly enough to eliminate at least 80% of U.S. emissions of carbon dioxide from fossil fuel combustion by 2050.

CTC works to educate and mobilize advocates, stakeholders, public officials and other concerned citizens on the need for, benefits from and mechanics of such a carbon tax. Fundamental to these activities is CTC's Web site (www.carbontax.org), which distills and links to authoritative sources on the theory and practice of carbon taxing and to reports on politics, progress and obstacles to enacting carbon taxes worldwide, particularly in the U.S.

CTC also develops, maintains and disseminates a carbon tax spreadsheet — a non-proprietary and uniquely accessible economic model for gauging how effectively carbon tax proposals will reduce carbon emissions, generate tax revenues and affect energy prices. A link to the version of the spreadsheet used to develop the quantitative findings in these comments is available in the sidebar on page 11.

Through its Web site, blog posts, papers, economic modeling and networking, CTC informs and tutors citizens and public officials to help them advocate for taxes on carbon pollution at both the federal and state levels. CTC also reviews and digests academic and institutional papers and analyses by government agencies, NGO's and think-tanks, providing links and cross-references to the growing body of policy information on carbon taxes.

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The **Citizens Climate Education Corp.** is the not-for-profit arm of the **Citizens Climate Lobby**. CCEC and CCL work to create the political will for a stable climate. CCL advocates for U.S. carbon tax legislation to Members of Congress, while CCEC works to educate citizens and Members of Congress on issues regarding carbon pricing. http://citizensclimatelobby.org/

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Introduction and Summary

These comments were prepared by the Carbon Tax Center (CTC) in collaboration with the Citizens Climate Lobby (CCL) and its affiliate, the Citizens Climate Education Corp. (CCEC).

We congratulate the Senate Finance Committee Chair and staff for their "Energy Tax Reform Discussion Draft" (dated Dec. 18, 2013), including its solicitation of comments. It is high time that Congress formally sought input on streamlining or eliminating subsidies for domestic energy production. This committee has done so — and boldly by also seeking comments on economic incentives for reducing carbon emissions, such as carbon taxes. We applaud the Draft's main premise that clearer price signals are urgently needed to efficiently encourage climate sustainability while enhancing U.S. prosperity.

Although CTC and CCL/CCEC operate separately and independently, we are committed to the same central policy instrument for achieving the rapid and large-scale reductions in CO2 releases that are required to address and resolve the onrushing global climate crisis: a robust, transparent and briskly rising fee or tax on carbon emissions.

To be sure, we do not regard even an optimally designed carbon tax as the sole measure necessary to safeguard Earth's climate; complementary policies such as energy-efficiency standards are needed as well. Nevertheless, both CTC and CCL/CCEC are focused on achieving such a tax in the United States as soon as possible and in a way that incentivizes other countries to follow suit.

It's axiomatic that raising the price to emit carbon pollution will be more effective than lowering prices of selected means of not emitting it (i.e., subsidies).

Our rationale is simple and straightforward. The U.S. energy system is so diverse, our economic system so decentralized, and our species so varied and innovating that no subsidies regime, no matter how enlightened, and no system of rules and regulations, no matter how well-intentioned, can elicit the billions of carbon-reducing decisions and behaviors that a swift full-scale transition from carbon fuels requires. At the same time, nearly all of those decisions and behaviors share a common, crucial element: they are affected, and even shaped, by the relative prices of available or emerging energy sources, systems and choices. Yet those decisions cannot bend fully toward decarbonizing our economic system until the underlying prices reflect more of the climate damage that carbon fuels impose on our environment and society.

These three facts — the inability of carbon subsidies or rules and regulations to make a big enough dent in carbon emissions, the centrality of price in energy-related decisions that determine the magnitude of those emissions, and the chronic "externalization" of climate damage from the price of energy — are what have led CTC and CCL/CCEC to advocate carbon taxing as the central element of U.S. climate policy.

WHY A CARBON FEE/TAX WORKS BETTER THAN LOW-CARBON CREDITS/SUBSIDIES

When weighing the efficacy of competing policy instruments for reducing carbon emissions, it's axiomatic that raising the price to emit carbon pollution will be more effective than lowering prices of selected means of not emitting it (i.e., subsidies).

Raising the price to emit carbon through a carbon emissions tax will create the broad incentives to induce decision-makers at all levels of society to reduce emissions through conservation, substitution and innovation. Currently, the prices of gasoline, electricity and fossil fuels in general include little or none of the long-term costs associated with climate change, and only part of the near-term health costs of burning fossil fuels. This omission puts a heavy "thumb on the scale" in the ongoing competition between continued use of fossil fuels and deployment of alternatives.

Our society's exclusion of climate-damage costs from the prices of coal, oil and gas weakens incentives to reduce the use of these fuels at every turn. Currently, every category and type of alternative — be it implementing carbon-reducing energy efficiency measures (e.g., high-mileage cars, high-efficiency appliances and lighting, zero-energy building designs); constructing and maintaining zero-carbon energy facilities that displace fossil-fuel generation (e.g., wind farms, solar arrays, nuclear power plants); developing low-carbon fuels (e.g., biofuels from high-cellulose plants); or practicing conservation-based behavior such as bicycling, recycling and overall mindfulness toward energy consumption — is deployed at less than the climate-optimum level because the dollar savings from the associated fossil-fuel reductions are artificially shrunken. In this light, a tax on carbon pollution should be seen not as an alien ingredient injected into our market system but as an overdue and essential correction — a way to permit markets to finally tell the truth about what fossil-fuel burning is doing to our climate.

Taxing fuels in proportion to their carbon-polluting effects will elevate incentives to reduce their overuse at every link in the chain of decision and action — from individuals' choices and uses of vehicles, appliances, and housing, to businesses' choices of new product design, capital investment and facilities location; from governments' standard-setting, land use and procurement choices, to entrepreneurs' and inventors' exertions in garages and at workbenches in countless cities and towns.

A tax on carbon pollution should be seen not as an alien ingredient injected into our market system but as an overdue and essential correction.

We commend the committee staff for proposing to rationalize the convoluted and anachronistic web of energy subsidies by replacing it with two new clean-energy credits, both designed to evoke new large-scale supplies of low- and zero-carbon electricity and fuels. The intention is worthy. But no pair or even array of subsidies, no matter how thoughtfully devised, can bring forth nearly the amount of carbon reductions that a carbon tax of comparable magnitude would elicit.

The main reason, noted above, is that subsidies that reward low-carbon production cannot course through the economy as broadly and deeply as a carbon tax that rewards low-carbon end-use consumption as well as low-carbon production . A subsidiary but still notable reason is that lowering energy prices through energy subsidies stimulates additional energy use which then undercuts the carbon reductions sought through the subsidies.

We have quantified these factors for both the proposed clean-electricity and clean-fuels subsidies, and for an economy-wide carbon tax that would be set at the levels of those subsidies. Here's what we have found:

- The proposed clean-energy credits would reduce U.S. CO2 emissions from burning fossil fuels in 2024 (the year we have chosen for analysis) by 399 million tonnes. (A tonne is a metric ton, i.e., 1,000 kilograms or 2,205 pounds.) This estimate is the net of a "gross" reduction of 466 million tonnes and a "rebound effect" from increased energy use due to the lowering of energy prices, of 67 million tonnes.
- An economy-wide carbon tax set at the same dollar levels as the clean-energy credits would reduce U.S. CO2 emissions from burning fossil fuels in 2024 by 959 million tonnes. That is nearly two-and-a-half times as great a reduction as the net from the clean-energy credits.
- For the clean-energy credits, roughly 80% of their CO2 reductions would be realized in the electricity sector. The comparable percentage for the carbon tax is 65%.
- Outside the electricity sector, the carbon tax would eliminate over four times as much CO2 as the clean-energy credits.

- For comparison purposes, U.S. CO2 emissions from burning fossil fuels totaled 5,221 million tonnes in 2012. Our (CTC's) modeling projects that absent both the clean-energy credits and a carbon tax, emissions will reach 5,533 million tonnes in 2024.

These figures, which are compiled in Table 1 on page 10, indicate that in reducing U.S. CO2 emissions, a carbon tax far outperforms the clean-energy subsidies outlined in the Discussion Draft.

The two approaches also differ strikingly in their fiscal and distributional impacts:

- The clean-energy subsidies proposed for consideration would cost taxpayers as much as $39 billion annually in 2024 (or $33 billion in 2013 dollars).
- The carbon tax would raise roughly $450 billion annually in 2024 (or roughly $375 billion in 2013 dollars).

Importantly, some or all of the carbon tax revenue could be "recycled" through either "green checks" ("dividends") or "tax shifts" or a combination to "make whole" a majority of lower- and middle-income households, leaving a neutral or even "progressive" net distributional impact. In contrast, the monetary benefits of the credits/subsidy approach would flow overwhelmingly to high-income, high-energy use households. Thus, the subsidy approach would have a net regressive effect and would be without a revenue stream or other mechanism to compensate.

Finally, a carbon tax can be designed to protect energy-intensive, trade-exposed American industries from unfair competition while incentivizing other nations to adopt effective carbon-pricing policies. A subsidy-based climate and energy policy has no potential to do either.

The Proposed Clean-Energy Credits Are Preferable to the Current Mix of Federal Energy Subsidies, but Are Not Nearly as Effective as an Equivalent Carbon Tax

INTRODUCTION

The Discussion Draft proposes replacing a hodgepodge of 42 current subsidies pertaining to energy production and conservation, with just two production-related tax credits: one for electricity whose generation produces at least 25% less CO2 than the national average, and another for motor fuels that emit approximately 25% less CO2 than conventionally produced gasoline.[1]

This approach has much to recommend it:

1. It offers a single, uniform credit for reducing CO2 in the electricity-generating process, and a single, uniform credit for transportation fuels that reduce CO2 emissions.
2. The credits are substantial. We estimate them to be worth approximately $61 per metric ton (tonne) of CO2 eliminated in making electricity, and $113 per tonne of CO2 eliminated in the composition of transportation fuels.
3. The clean-electricity credit would almost certainly lead to a substantial reduction in CO2 emitted by the electricity sector; we estimate that the sectoral reduction could be as much as 380 million tonnes of CO2 — a drop of almost 19% from the 2012 level of 2,035 tonnes.[2]
4. Both incentives would create a more stable and certain investment climate for developing and adopting clean technologies and fuels, compared to current subsidies, some of which must be renewed almost continuously (e.g., the primary clean-electricity subsidy, the Production Tax Credit, historically has required biennial or even annual renewals).
5. Replacing 42 separate tax credits and subsidies with two will improve the transparency of both the tax code and U.S. energy and climate policy.
6. The proposed revision will almost certainly cost taxpayers less per ton of CO2 eliminated than the current 42-subsidies regime. This is because the proposed credits are aimed only at measures that would reduce CO2 emissions, whereas the current basket of subsidies has a host of objectives, many of them competing and only some directly aligned with reducing CO2.

It's clear from these considerations that replacing the current assortment of tax credits with the two outlined in the Discussion Draft would be a marked improvement in terms of transparency, efficiency and impact.

Nevertheless, the draft proposal has major shortcomings, some of which are inherent in the nature of subsidies. The drawbacks are particularly glaring when the proposed subsidies are compared to an equivalent (equal-price) carbon tax.

[1] The Discussion Draft limits the clean-fuel credit to "Any fuel that is about 25 percent cleaner than conventional gasoline." To keep our analysis manageable, we ignored this threshold in our calculations, thus expanding eligibility for the tax credit and increasing somewhat both the magnitude of the subsidy and the estimated CO2 eliminated.

[2] We say "as much as" because our 380 million tonne figure includes CO2 reductions from a number of incremental supply-side measures, such as grid operators' replacing economic dispatch by carbon dispatch, that would appear to fail two criteria for the clean-electricity credit: it must be facility-based, and must be at least 25% cleaner (in terms of CO2 per kWh) than the U.S. average. It also does not reflect a potential "rebound" effect, estimated further below.

The most critical drawbacks of the draft proposal are these:

1. The draft proposal rewards low- or zero-carbon ***production*** but not carbon-reducing ***consumption*** (conservation and efficiency).
2. By keeping energy prices artificially low, the new subsidies in the draft proposal would stimulate energy consumption, leading to a give-back of some of the CO2 reductions.
3. The proposed credits will produce no revenue for the Treasury; instead, they will create a considerable drain on the taxpayer.

Other drawbacks to the proposed clean-energy subsidies are these:

4. The draft proposal does not address sectors accounting for an estimated 25% of U.S. CO2 emissions.
5. The different incentives between the respective clean-energy credits offered by the draft proposal will lead to economic inefficiencies.

We estimate that the CO2 emissions reductions under the draft proposal would be only around 40 percent as great as the reductions expected under an equivalent carbon tax.

6. The proposed credits won't spur other nations to implement similar policies.
7. The proposed credits may not be durable (long-lasting) enough.
8. Formulation and administration of the clean-fuel credit are likely to be complex and entail administration that could be both costly and subject to undue influence.

We estimate that, as formulated in the Discussion Draft, the Committee's proposal would reduce CO2 by less than half as much as across-the-board carbon taxes set at the same levels as the proposed subsidies.[3] Indeed, taking account of factors 1, 2 and 4, above, we estimate that the CO2 emissions reductions under the draft proposal would be only around 40 percent as great as the reductions expected under an equivalent carbon tax.

DETAILS

Following is a fuller discussion of what we perceive to be the drawbacks of the proposal:

1. *The draft proposal rewards low- or zero-carbon production but not carbon-reducing consumption (conservation and efficiency).*

   The clean-electricity and clean-fuel tax credits apply only to energy production. No credits, and hence no incentives, would adhere to the myriad of activities by which CO2 emissions can be reduced at every level of society and in every part of our economy by employing more-efficient technologies (for vehicles, appliances, building designs, industrial processes, lighting, etc.) and through behavioral changes that are sometimes referred to as conservation (examples include shorter trips, less motorized recreation, greater local sourcing, smaller houses, turning off equipment, etc.).

[3] The hypothetical carbon tax in this comparison would be set at approximately $61/tonne for the electricity sector (the same rate as the clean-electricity credit), $113/tonne for the passenger vehicle, freight and aviation sectors (the same rate as the clean-fuels credit) and $87/tonne (the mean of the two rates) for the remaining fuel-consuming sectors.

ESTIMATING THE CLEAN-ENERGY CREDITS

The Discussion Draft envisions a tax credit for "any facility producing electricity that is about 25 percent cleaner than the average for all electricity production facilities… The maximum production tax credit for a zero emissions facility is $0.023 per kilowatt[-hour] of generation, indexed for inflation."

U.S. electricity production in 2012 was 4,054.5 TWh, with associated CO2 emissions of 2,035.5 million metric tons (CTC estimate), resulting in a sectoral average of 502 g/kWh. Eligible facilities may not exceed 75% of that, or 377 g/kWh. The ratio of that figure to $0.023, times one million, or $61.08, corresponds to the tax credit for each tonne of CO2 eliminated by a qualifying facility.

For transportation fuels, the benchmark is CO2 emissions and energy content of a gallon of gasoline, which we estimate to be 8.88 kg and 125,071 Btu, respectively. The Discussion Draft states that "The maximum production tax credit for a fuel with the same energy content as gasoline and with zero lifecycle emissions is $1 per gallon." Dividing $1.00 by 8.88 and multiplying by 1,000 yields a tax credit of $112.65 per tonne of CO2 eliminated by a qualifying fuel.

This omission has a certain logic, rooted in the difficulty of tailoring tax credits to the billions of actions by households, firms and society that can reduce CO2 emissions. Indeed, the very notion of one tax credit rewarding drivers for, say, "gentler" (and hence more fuel-efficient) accelerating and braking, and another credit for families that fly only to Disney World rather than to, say, Tahiti, and a third compensating households that keep the thermostat at 73 degrees rather than 72 in July, and a fourth paying families to live in smaller houses, is patently absurd.

Yet those examples correspond to precisely the kinds of conserving actions and decisions that a "conservation" tax credit would bring about, at the margin, if it could somehow be instituted; and the CO2 reductions from such actions are no less real and critical for protecting our climate than are reductions from substituting wind energy for coal-fired electricity that the proposed tax credits would target.

The same can be said of investments by firms to install building systems or manufacturing equipment that reduce fuel use (not to mention managing them optimally over their lifetimes) and thus carbon emissions; or of efforts by airlines to alter flight paths to boost fuel efficiency and, over the long term, pay their suppliers more for fuel-efficient aircraft; or of public decisions to invest in transit or to create urban amenities that families may access without having to drive long distances. Rewarding some CO2-reducing actions and not others is unfair and inefficient. Yet the draft proposal would do precisely that by providing credits to supply-side measures but not for demand-side actions.

Rewarding some CO2-reducing actions and not others is unfair and inefficient.

Granted, this deficiency is an inherent limitation of subsidies (credits) as a tool to reduce carbon emissions. It's simply not practicable to write and administer the tens of thousands of subsidy provisions that would be required to encompass most of the CO2 reductions that result from efficiency and conservation but need to be incentivized in order to be fully realized. But it's important to point out that in the aggregate, those efficiency and conservation actions would be as potent (if not more so than) as the clean electricity technologies and clean fuels that would be eligible for the tax credits outlined in the Discussion Draft.

Based on our modeling, we believe that the inability of the proposed clean-energy credits to incentivize efficiency investments and conservation behaviors would "strand" (leave unharvested) at least as much CO2 reduction as the credits would elicit. Using our carbon tax model, we estimate that economy-wide taxes applying the Discussion Draft's proposed tax-credit levels to all fossil fuels would, in their tenth year, lead to U.S. CO2 emissions

SUBSIDY REBOUND EFFECT

We estimate that the clean-electricity credit will cause elimination of 380 million tonnes of CO2 (Table 1). At a unit subsidy cost of $73/tonne (inflated to 2024, our calculation year, from $61 in 2013), the total value of the subsidy is $27.7 billion.

With our model, we also estimate year-2024 electricity consumption (w/o subsidies) of 4,579 TWh, at a unit price of $0.115/kWh and resulting sector revenue of $526 billion. The subsidy, if entirely flowed through to consumers, would reduce electricity rates by 5.3%, leading to a 3.9% increase in consumption (assuming-0.7 price-elasticity). Factored by our projected 2024 per-kWh CO2 emissions average of 0.74 lb/kWh, the associated CO2 increase is 59.5 million tonnes.

Analogous calculations for transportation fuels yield a far smaller rebound totaling 7.5 million tonnes.

at levels roughly 960 million metric tons less than current (2012) levels. (See Table 1.) By comparison, the projected reductions due to the clean-electricity and clean-fuel credits would total just 466 million tonnes. While that is a considerable amount, it is less than half as great as the reductions projected for the carbon tax.

Most of the difference between the two approaches, which is just short of 500 million tonnes, is stranded demand-side reductions that cannot be captured through subsidies (tax credits). It corresponds to more than 9 percent of total U.S. CO2 emissions from fossil fuel combustion in 2012. Moreover, the difference between the two approaches is almost certain to be greater than even 500 million tonnes, due to a "rebound" effect inherent in the subsidies approach, which we now discuss.

2. *By keeping energy prices artificially low, the new subsidies in the draft proposal would stimulate energy consumption, leading to a give-back of some of their CO2 reductions.*

"Subsidies tend to induce excessive output," Oates and Baumol pointed out nearly 40 years ago in their classic article, "The Instruments for Environmental Policy."[4] This is because "subsidies (relative to fees) … result in a larger number of firms, a larger output for the industry, and a lower price for the commodity whose production generates pollution."

We have ventured a rough estimate of this "rebound effect" using our carbon tax spreadsheet model. (See sidebar for methodology.) The result is sobering. As much as one-seventh (14%) of the CO2 reductions that our modeling attributes to the two clean-energy credits would be lost as a result of increased energy consumption stimulated by the lower prices brought about by the subsidies. In numerical terms, the projected "gross" reduction in CO2 emissions of 466 million tonnes would shrink by 67 million tonnes, mostly because of the rebound in electricity consumption. (Notwithstanding the greater per-unit subsidy to be offered to clean fuels, the subsidies would stimulate an eight-fold greater rebound in electricity use than in transportation fuels because of the far greater dollar magnitude of electricity subsidies and the higher price-elasticity of electricity consumption.)

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[4] Wallace Oates & William Baumol, "The Instruments for Environmental Policy," in Edwin S. Mills, ed., Economic Analysis of Environmental Problems, NBER, 1975 (p. 105). Their chapter, which is available at http://www.nber.org/chapters/c2834, predated their definitive volume, ***The Theory of Environmental Policy*** (Baumol and Oates, Cambridge University Press, 1988).

Table 1: U.S. CO2 Emissions from Fossil Fuel Combustion (figures in millions of metric tons)

	Electricity	Transport Fuels	Other	Total
2012 Base	2,035	1,859	1,326	5,221
Committee Draft Reductions (gross)	380	86	0	466
Rebound	(59)	(7)	(0)	(67)
Reductions w/ Clean-Energy Credits (net)	**321**	**78**	**0**	**399**
Reductions w/ Carbon Tax	**625**	**230**	**104**	**959**

Source: Carbon Tax Center calculations with CTC model. 2012 figures are for context only. Reductions shown are for 2024 and are calculated against CTC projections for emissions in that year absent both clean-energy credits and a carbon tax. Carbon tax reductions assume tax is set at levels in Committee Discussion Draft.

Netting the rebound effect shrinks the proposed subsidy program's reduction in CO2 emissions to 399 million tonnes a year. This is 58% less than the 959 million tonnes of CO2 we estimate would be eliminated through a carbon tax set at the same rates as the subsidies.[5]

3. *The proposed credits will produce no revenue for the Treasury; instead, they will create a considerable drain on the taxpayer.*

Like any subsidy, the proposed credits will take money from taxpayers. Whether the taking assumes the form of increased taxes (while government services are unchanged) or reduced government services (while taxes remain unchanged) or a combination, depends upon other fiscal policies. What is beyond dispute is that the clean-energy credits will constitute a transfer payment from taxpayers to producers of low- or zero-carbon energy. While some of and perhaps most of this windfall would be passed on to end-users, the overall effect would be regressive, given that the distribution of U.S. energy consumption is more skewed toward the wealthy than the distribution of government services.

A rough estimate of the magnitude of this money transfer is $39 billion per year. Most of that amount, $28 billion, would be paid as subsidies to clean-electricity producers, with the other $11 billion paid to clean-fuels producers. While the new credits are almost certainly a more efficient way to incentivize a given level of CO2 reduction than the current basket of energy subsidies, the fact remains that the credits will run up a considerable tab for government and/or the taxpayer (or a combination of the two).

For comparison purposes, the $39 billion bill for the subsidies — equivalent to $33 billion in today's (2014) dollar terms — would fund the entire combined budget for the U.S. Departments of Justice and Interior as well as the Army Corps of Engineers. Alternatively, it would pay for a 15-month extension of unemployment benefits for the long-term unemployed.[6] The agencies

[5] Our rebound calculations assume that the entire value of the subsidies flows through to end-use consumers. In reality, some would be captured by energy producers. Our estimates of the rebound in CO2 emissions should thus be considered an upper bound.

[6] CTC's estimated $39.3 billion subsidy cost in 2024 equates to $33.4 billion in 2014 (applying the 1.6% annual GDP price index implied in U.S. Energy Information Administration's "AEO2013 Early Release Overview"). Proposed 2014 budgets for Justice, Interior and the Army Corps, respectively, $16.3 billion, $11.7 billion and $4.7 billion, are in Budget of the United States Government, Fiscal Year 2014, Summary Tables, Table S-11, p. 222. A $6.4 billion cost to extend unemployment benefits for three months was reported in New York Times, "Unemployment Extension Is Stalled, With 2 Proposals Defeated in the Senate," Jan. 14, 2014, http://nyti.ms/1esBXxN.

CTC CARBON-TAX MODEL

The Carbon Tax Center has developed and maintains a six-sector model (electricity, passenger vehicles, freight, aviation, "other" petroleum, and non-electric uses of natural gas) to estimate the impacts of different-size carbon taxes on CO2 emissions, along with revenue generation.

In the model, energy usage is dictated by changes in real GDP and price, which are factored through sector-specific income-elasticities and price-elasticities that capture the rates at which changes in income and price affect usage. Supply-side elasticities reflect the substitutability of lower-carbon fuels in each sector.

The model runs in Excel and may be downloaded via this link: http://www.carbontax.org/wp-content/uploads/2014/01/CTC_Carbon_Tax_Model_Tailored_to_Baucus_Proposal.xlsx. This version of the model applies the value of the clean-electricity credit ($61.08/tonne) to the electricity sector; the clean-fuels credit ($112.65/tonne) to the transport sectors, and the mean of the two ($86.87/tonne) to the remaining sectors.

mentioned provide substantial services, including administering the federal court system and the National Parks, and the benefits extension was hotly contested, not just because of ideological considerations but because of concerns over paying for it. This suggests that Congress will (and should) think hard before creating a new subsidies program whose recurring (annual) cost could rise to the amounts indicated.

4. *The draft proposal does not address sectors accounting for an estimated 25% of U.S. CO2 emissions, thus constricting its potential reach at the starting gate.*

As Table 1 shows, electricity generation and transportation fuels together account for the lion's share of U.S. emissions of CO2 from fossil fuel combustion. Thus it is fitting that a two-sector subsidy should address those two activities. Nevertheless, other activities in our society also contribute to emissions. These include manufacturing aside from factories' use of electricity (which is subsumed under power generation); non-electric provision of heat and hot water, which is dominated by natural gas; and oil refining. By our estimates, these activities are responsible for approximately 25% of U.S. emissions of CO2.

Designing subsidies to reward efficiencies and other activities that could reduce carbon emissions in these sectors runs up against the same problems discussed in Item #1 above: fuel use in industry and heating is so decentralized and diverse that it's simply not amenable to being incentivized by credits. The effect is to put 25% of U.S. emissions out of reach. This exclusion, like that for efficiency measures and conservation actions, is an inherent weakness of a subsidy approach to carbon reduction.

5. *The different incentives between the respective clean-energy credits offered by the draft proposal will lead to economic inefficiencies.*

It is axiomatic that policies that employ financial incentives to elicit changes in the amounts of selected economic activities should offer the same-size incentives across all of the arenas to which they apply. In the economics literature, this is informally called "the law of one price." Price differences for the same commodity across times or regions give rise to economic distortions and inefficiencies caused by misallocation of resources. A secondary effect is arbitrage and speculation.

The proposed credits fail this criterion, and not by a little. As noted, transportation-fuels producers are offered a value of nearly $113 per tonne of CO2 eliminated, whereas electricity-producers are offered only $61 per tonne of CO2 eliminated. The import of this difference is that some fuel producers will make investments in clean-fuel production that would not be cost-effective if they were receiving only the credit offered to electricity producers, and that electricity producers will fail to make some investments in clean-electricity production that would be cost-effective if they were receiving the credit offered to fuel producers.

This mismatch between the two sectors is not nearly as serious a drawback as the withholding of credits from efficiency and conservation actions in both of the sectors. Moreover, it has a certain logic, derived from the far greater substitutability of low-carbon fuels in the electricity sector than in transportation. (That difference drives the apparent incongruity in the greater CO2 reductions shown in Table 1 for the clean-electricity credit despite its lesser value vis-à-vis the clean-fuels credit.) But it is substantial nonetheless and does not appear warranted. The cost of the mismatch will be borne by the Treasury (i.e., taxpayers) as higher payouts for a given amount of CO2 reduction than would be required if the credits were uniform, and by the climate, in the form of lesser reductions in CO2.

6. *The proposed credits won't spur other nations to implement similar policies.*

With an estimated 80% of world emissions of CO2 now emanating from other countries, U.S. policies to reduce CO2 must not only be effective at slashing domestic emissions, they must also provide a template and incentives for the rest of the world to institute their own effective measures.

A subsidies-based policy fails the test of global replicability and would undermine the effort to harmonize the world's nations in moving to lower emissions.

Unfortunately, subsidizing clean-energy production is a costly approach that is beyond the means of other countries, particularly still-developing nations such as China, India, Brazil and Indonesia. For example, because China burns at least three times as much coal as the U.S., it would take on triple the substantial fiscal burden estimated earlier for the proposed clean-electricity credit if it were to offer the per-unit tax credits envisioned in the Discussion Draft.

A subsidies-based policy thus fails the test of global replicability and would therefore undermine the effort to harmonize the world's nations in moving to lower emissions.

7. *The proposed credit for clean electricity may not be durable (long-lasting) enough.*

Both credits would expire once the CO2 "intensity" of the respective sectors fell below 75% of specified baseline levels. The baseline level for electricity in the committee draft proposal is the carbon intensity of U.S. electricity generation (i.e., CO2 emitted per kWh produced) in 2013. Based on trends that appear to be well-established, that time may not be far off. Already in 2012, the carbon intensity of the U.S. electricity sector was 15% less than in 2005 — largely because of substitution of fracked natural gas for coal (the upsurge in wind-generated electricity also played a part). Both phenomena are expected to continue and to be joined by rapidly rising use of solar-generated electricity.

Indeed, the clean-electricity tax credit itself will solidify these trends. Our modeling suggests that, leaving aside lead times, the $61/tonne credit for zero-carbon electricity generation will accomplish the targeted 25% reduction in sectoral carbon intensity, and thus trigger its expiration, all by itself.[7] While that result is somewhat theoretical, it nonetheless suggests that the clean-electricity credit needs to be made more durable to attract the investments needed to hasten decarbonization of the U.S. electricity sector.

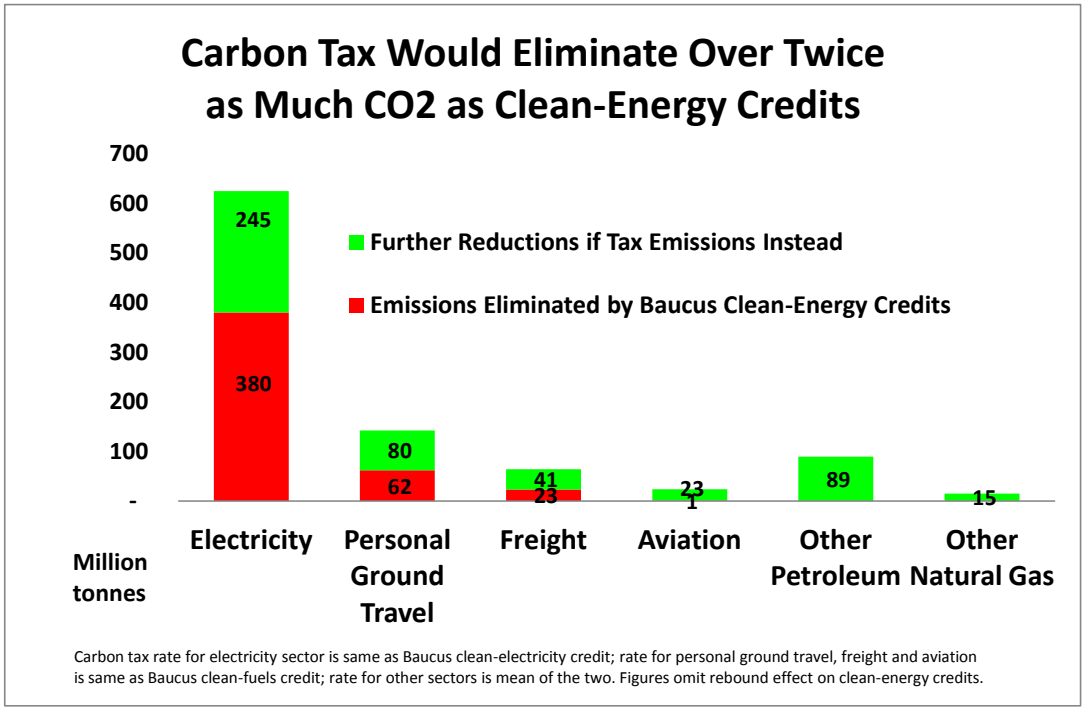
For transportation fuels, the baseline level specified in the Discussion Draft is 25% less than the CO2 released from combusting a gallon of gasoline. Because the technical potential for reducing

[7] Our model suggests that the $61/tonne credit for removing CO2 from electricity production will reduce the average U.S. CO2/kWh ratio, now (in 2012) 502g, to 383g. The subsidy is withdrawn when the ratio falls to 377g.

the carbon content of liquid fuels is limited, supply-side reductions in transportation will have to be accomplished largely by substituting natural gas and/or electricity for gasoline, diesel and jet fuels; while this process has thus far been gradual at best, it may be subject to tipping points based on network effects in providing electric and methane fueling infrastructure. As with electricity, the clean-fuel credit itself might greatly accelerate the advent of this infrastructure — thus hastening the time when the threshold specified in the proposal would be crossed and the credit withdrawn.

These considerations suggest that, at the least, it might be advisable to replace the "sudden-death" nature of the threshold with one employing a more gradual phase-out.

Fig. 1



Carbon tax rate for electricity sector is same as Baucus clean-electricity credit; rate for personal ground travel, freight and aviation is same as Baucus clean-fuels credit; rate for other sectors is mean of the two. Figures omit rebound effect on clean-energy credits.

8. *Formulation and administration of the clean-fuel credit are likely to be complex and require administration that could be both costly and subject to undue influence.*

The language in the Discussion Draft pertaining to the clean-fuel credit is straightforward enough:

> Energy efficiency is defined as the energy density of a fuel compared to conventional gasoline. The credit per gallon of fuel is calculated by multiplying its cleanliness by its energy efficiency … The credit phases out over four years once the greenhouse gas intensity of all transportation fuels has declined to a level that is 25 percent cleaner than conventional gasoline.

Left unasked, however, are important but thorny questions such as: Will the calculation of greenhouse gas intensity of transportation fuels include electricity and natural gas to the extent that they are used in vehicles? How exactly will "upstream" impacts be calculated for such fuels? Will the higher carbon intensity of tar sands and other heavy oils be reflected in the calculation of their greenhouse gas intensities as part of figuring the sectoral average?

While methodologies for these calculations are reasonably well developed, all of them are subject to varying assumptions, which means that political considerations will probably be brought to bear. This in turn would open up the matter to rulemaking, with attendant potential for delay and complexity.

In short, while reducing 42 subsidies to just two will invariably simplify the tax code and make energy and climate policy more predictable, not all of the complexity and opacity will necessarily disappear.

Protecting Trade-Exposed Industries From a Carbon Tax

The Discussion Draft requested "comments … on how to design … a tax or fee [on carbon pollution] so that it would not harm trade-exposed and energy-intensive industries..." The accepted best approach is "harmonizing" domestic excise taxes via "border tax adjustments."

Border Tax Adjustments (or Border Tax Assessments, BTAs) are import fees levied by carbon-taxing countries on goods manufactured in non-carbon-taxing countries. Their primary purpose is to ensure a level playing field in international trade while internalizing the costs of climate damage into prices of goods and services. Another impetus is to help bring into being the broader global system of carbon pricing needed to rein in the world's CO2 emissions. BTAs accomplish this by giving non-carbon-taxing nations a stark choice: if you won't tax your carbon pollution, our BTAs will do it for you.

Here's how former U.S. trade official Jennifer Hillman articulated the BTA idea in a recent paper for the American Action Forum et al.:

> Policymakers have sufficient latitude with this [World Trade Organization] framework to design and implement a carbon tax system that represents a good faith effort to reduce carbon emissions while encouraging all other countries to cut their emissions too, all while preserving the competitive position of U.S. companies. Policymakers can be bold; the WTO will recognize genuine climate change measures for what they are and is unlikely to find fault with such measures, provided they do not unfairly discriminate in favor of U.S. companies.[8]

Does the World Trade Organization (WTO) treaty sanction "harmonization" of domestic excise taxes via border tax adjustments?[9] Hillman and others[10] are emphatic that it does. They point to Articles II.2 and III.3 of the General Agreement on Tariffs and Trade (GATT) — the de facto "constitution" of the

OUTPUT-BASED REBATES OF CARBON TAXES

Under a carbon tax with output-based rebates, domestic manufacturers pay the carbon price imposed on their fuel and energy inputs but are rebated a portion of those payments based on the assumed carbon intensity of the product. This approach recognizes the inherent carbon intensity of the product (under present technology) while maintaining manufacturers' incentive to minimize the carbon intensity of their inputs.

Unfortunately, output-based rebates provide no incentive for other nations to enact their own carbon taxes. Nor do they incentivize consumers to reduce purchase of the energy-incentive product via substitution or conservation. However, they would ensure that U.S. producers aren't disadvantaged by other nations' failure to tax their own manufacturers.

For further discussion, see Carolyn Fischer and Alan K. Fox, "Comparing Policies to Combat Emissions Leakage: Border Tax Adjustments versus Rebates," Resources for the Future (2009), RFF DP 09-02.

[8] Jennifer Hillman, "Changing Climate for Carbon Taxes, Who's Afraid of the WTO?," published by the German Marshall fund of the United States, the American Action Forum and Climate Advisers (July 2013), at p. 16. Hillman, a German Marshall Fund transatlantic fellow, served as counsel to the WTO Appellate Body, the final adjudicator of international trade disputes, during 2007-2011. She previously served a nine-year term as a U.S. International Trade Commissioner. As General Counsel to the Office of United States Trade Representative (1995-1997), Hillman oversaw U.S. government submissions in dispute settlement cases before both WTO and NAFTA.

[9] WTO was built around the EU's system of Value Added Taxes, which are routinely border-adjusted. For example, an American purchasing goods in Europe is entitled to have the VAT rebated. U.S. carbon taxes could be similarly harmonized.

[10] Perhaps the most authoritative paper on this subject is, Joost Pauwelyn, "Carbon Leakage Measures and Border Tax Adjustments under WTO Law," Graduate Institute of International and Development Studies, Geneva (2012).

World Trade Organization — which empower countries to impose taxes on imports, provided they don't exceed the taxes imposed on "like" domestically-produced goods.

Historically, tax systems that have run afoul of GATT and WTO have been discriminatory attempts to favor domestically-produced goods by imposing higher tariffs on foreign-produced goods. In contrast, GATT allows taxes based on the production process — its "carbon intensity," in the case of a carbon tax. Calibrating those taxes requires data on production processes abroad, though that may be hard to obtain. Absent such data, Hillman suggests that WTO would accept an assumption that an imported product's carbon intensity is similar to that of its domestically-produced counterpart. Companies producing goods less carbon-intensively than U.S.-produced equivalents could petition for reductions in their border tax adjustment.[11]

The U.S. could impose non-discriminatory tariffs on carbon-intensive imports, attaching to them the same carbon price as domestically made goods.

Under WTO rules, then, the U.S. could impose non-discriminatory tariffs on carbon-intensive imports, attaching to them the same carbon price as domestically made goods. Conversely, WTO also sanctions exemption or rebate of domestic excise taxes on exports. Thus, carbon-intensive goods and services exported to non-carbon taxing nations would not be disadvantaged versus goods produced in countries lacking carbon taxes.

In contrast, unilateral subsidies, even the consolidated and simplified subsidies outlined in the Discussion Draft, do not offer the potential to catalyze globalization of efficient climate policy. The same is true of regulatory approaches based on U.S. EPA's Clean Air Act authority, which we discuss below. Only carbon taxes with Border Tax Adjustments appear capable of incentivizing other nations to adopt comparable measures while protecting U.S. energy-intensive, trade-exposed industries.

[11] In "The Design of a Carbon Tax" (Harvard Environmental Law Review, 2009), Gilbert Metcalf and David Weisbach articulate a structure in which a default carbon intensity of traded goods is based on the "content" of five energy-intensive commodities. Imports are assumed to have similar "carbon content" as comparable domestic goods unless one of the trading entities petitions for an adjustment based on actual production practices that differ from those assumed. See pp. 541-551.

Protecting Low-Income Households Under a Carbon Tax

The Discussion Draft requested comments on "how to design [a carbon tax so that] it would not … disproportionately harm low-income households." Motivating this question is the fact that, like most consumption taxes, carbon taxes tend to increase living costs for low-income households by a larger fraction of their annual income than for those at the top income levels.

The revenue stream from a carbon tax allows policy-makers to mitigate or even eliminate its ostensible regressive effects.

This is because disparities among Americans' household incomes tend to be even more stark than differences in their use of fossil fuels and carbon-intensive products (see sidebar at left). Nevertheless, the revenue stream from a carbon tax allows policy-makers to mitigate or even eliminate its ostensible regressive effects.

There are three general approaches to addressing regressive effects of carbon taxes. One, providing direct assistance to low-income households, is treated in the sidebar on page 18. The others, which have more popular and political appeal as well as greater economic efficacy, are dividends and tax-shifting.

1. *Dividends ("Green Checks")*

   This approach returns carbon tax revenue directly to households through equal per-capita or per-household payments. Since these "dividends," sometimes called "green checks," represent a pro-rata share of the carbon tax paid, any household with below-average energy use will receive a larger dividend payment than it will bear as increased energy costs from the carbon tax.

   Because most low- and moderate-income families use less energy (actually, fossil fuels) than the U.S. average, a policy of "dividending" 100% of carbon tax revenues to households would cause a net progressive (downward-shifting) redistribution of income and wealth. According to our calculations at the Carbon Tax Center, even if only 70% of carbon tax revenue were returned in this fashion, half of all households, including most whose incomes are at or below the U.S. mean, would be made whole for their carbon tax expenses, both direct and indirect. (See Fig. 2, below.)

   Note that the dividend is not a "rebate," since its dollar size doesn't depend on the household's energy expenditures; nor does it undermine the energy-saving incentive from a carbon tax, since each household maximizes its net "after-dividend income" by fully pursuing efficiency and conservation measures.

INCOME, ENERGY & CARBON

According to the Congressional Budget Office, the top income quintile uses roughly 4 times the fossil fuels of the lowest-income quintile but has roughly 12 times the after-tax income. (See U.S. Congressional budget Office, "Offsetting a Carbon Tax's Costs on Low-Income Households" (2012), Working Paper 2012-16, http://www.cbo.gov/sites/default/files/cbofiles/attachments/11-13LowIncomeOptions.pdf. Figs 1 & 2.)

Nevertheless, taken by itself, this stark finding overstates the regressivity of carbon taxes, due to differences between household ***incomes*** and ***expenditures***. Factoring in indexed transfer payments to low-income households attenuates somewhat the disproportionate burden of a carbon tax or other consumption tax. (See Joshua Blonz, Dallas Burtraw and Margaret Walls, "Social Safety Nets and U.S. Climate Policy Costs," ***Climate Policy***, 12(4) (2012), 474-490.)

DIRECT ASSISTANCE TO LOW-INCOME HOUSEHOLDS

This third approach to mitigating disproportionate burdens provides assistance directly to low-income individuals or households, for example by increasing payments for heating costs, or other benefits. CBO has estimated that fully offsetting the additional cost that a carbon tax would impose on households in the lowest income quintile would require only 12% of the gross revenue collected by a carbon tax, while offsetting the cost for the second quintile would take just 15% more. (See CBO citation in previous sidebar.)

Compensating the bottom 40% of households would thus require only 27% of carbon tax revenue, leaving the large majority of the carbon tax revenue stream available for other purposes. To compensate low- and moderate-income households, CBO and others suggest a range of direct disbursement methods such as increased SNAP (Supplemental Nutrition Assistance Program) payments, increased and broadened assistance with fuel bills, or direct electronic funds transfers.

Note that we at CTC estimate that a carbon tax starting at $15/ton CO2 and rising each year by $12.50/ton, along the lines of the Larson bill mentioned here, would continue to produce increasing revenue well into its third decade, at which point the decline in fossil fuel use begins to overcome the aggressive upward price trajectory. Although some cast this eventual decline as a mark against a carbon tax as a revenue source, its cause, a pronounced shift away from fossil fuels, is the tax's raison d'etre.

2. *Tax Shifting*

This approach uses the carbon tax revenue to reduce other, distortionary[12] taxes. If the tax being reduced is more regressive than the carbon tax, the net distributional effect of the tax is progressive.

The most regressive tax paid by most U.S. households is the payroll tax on wages. One leading authority on carbon taxation and distribution, Tufts University economics professor Gilbert Metcalf, has analyzed the net incidence from pairing an income tax credit for payroll taxes with a carbon tax in a "pure" (revenue-neutral) "tax swap" or "shift."[13] Metcalf found that such a tax swap would be distributionally-neutral, i.e., it would leave unchanged the distribution of after-tax incomes among income groupings. In 2009, Rep. John Larson (D-CT) incorporated Metcalf's framework into legislation[14] proposing a steadily-rising carbon tax, with the carbon revenue used to rebate a portion of wage taxes.

In recent years, a number of economists have analyzed a variety of other possible carbon tax "shifts," including cuts to individual and corporate income tax rates.[15] While none appear to address regressive impacts as effectively as the Metcalf-Larson framework, some offer the possibility of counteracting much or even all of the economic drag a carbon tax might engender.[16] The political, economic and environmental success

[12] In this context, "distortionary" denotes taxes that discourage desirable activity such as work, saving or investment. In contrast, "Pigouvian" taxes on undesirable activity such as CO2 pollution correct a pre-existing distortion. Payroll taxes are both distortionary and regressive. Thus, use of revenue from a carbon tax to reduce payroll taxes offers an opportunity to improve economic efficiency while also counteracting regressive effects.

[13] Gilbert E, Metcalf, "A Proposal for a U.S. Carbon Tax Swap — An Equitable Tax Reform to Address Global Climate Change" (Brookings Hamilton Project, 2007). Metcalf assessed the impact of a tax of $15 per metric ton of carbon dioxide and five major greenhouse gases. Revenues would be used to credit payroll tax paid on the first $3,660 of earnings per worker.

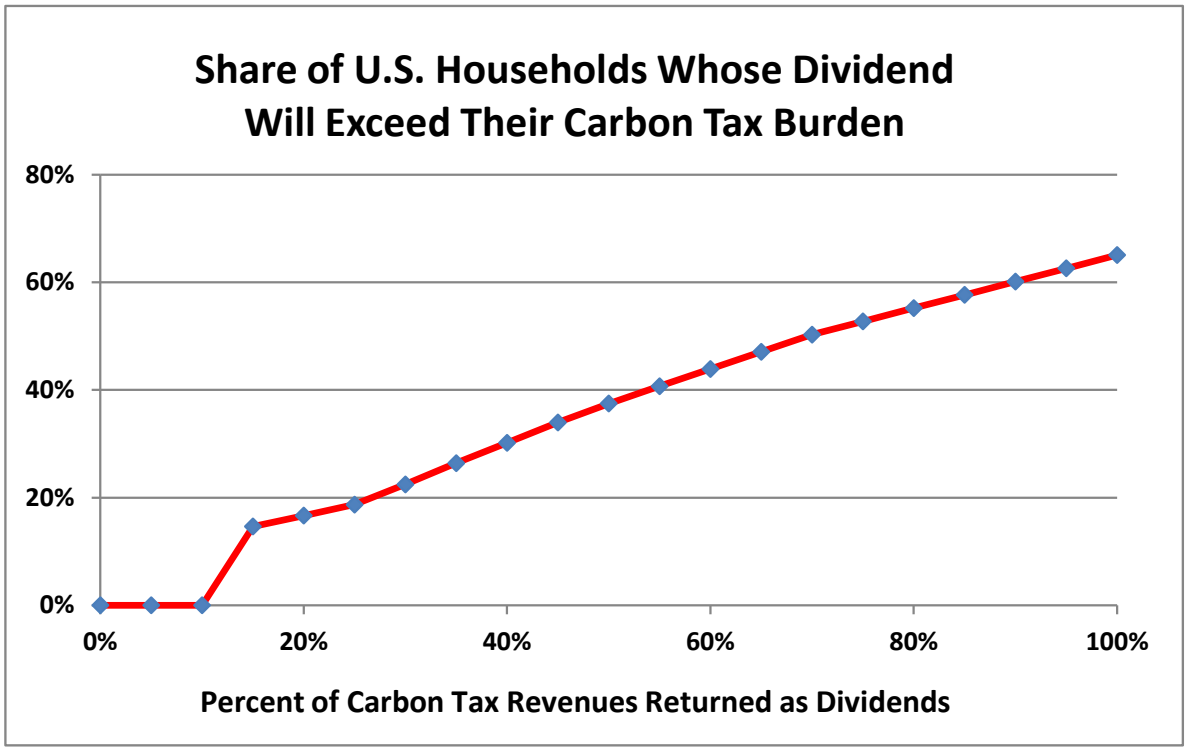
[14] HR-3416 (110th Congress), "America's Energy Security Trust Fund Act of 2009."

[15] See Aparna Mathur and Adele Morris, "Distributional Effects of a Carbon Tax in Broader U.S. Fiscal Reform" (2012), comparing a range of carbon tax shift options. Mathur (American Enterprise Institute) and Morris (Brookings Institution) point out the advantages of using carbon tax revenue to reduce marginal corporate income tax rates. Further supporting this option are Donald Marron and Eric Toder, "Carbon Taxes and Corporate Income Tax Reform," Urban-Brookings Tax Policy Center, 2013, and Ian Parry and Roberton Williams, "Moving U.S. Climate Policy Forward: Are Carbon Taxes the Only Good Alternative?," Resources for the Future, 2011.

[16] Some analysts suggest that high marginal corporate income tax (CIT) rates have a larger distortionary effect than payroll taxes, because U.S. CIT rates encourage capital investments to flow to jurisdictions with lower marginal rates. (See Marron and Toder, supra.) But because of numerous tax exemptions and deductions enjoyed by U.S. firms, cutting top marginal CIT rates may not offer the full benefits apparently assumed by those advocating use of carbon tax revenue to reduce CIT rates.

of British Columbia's 5-year-old carbon tax, which applies all of its revenue to reduce payroll, income and business taxes and to provide direct assistance to low-income households, suggests the strong appeal of a mixed revenue-return approach.[17]

Fig. 2



3. *Comparison and Conclusion*

The enormous revenue stream generated by a robust carbon tax affords a range of ways to compensate low- and moderate-income households for ostensible regressive effects of carbon taxes. Climate policies based on subsidies and regulations have similar regressive effects (subsidies by co-opting tax revenues; regulations by imposing costs which energy producers pass through to consumers) but produce no revenue with which to compensate low-income households.

Direct distribution of carbon tax revenue via periodic "dividends" offers a simple and highly-visible way to fully compensate low- and middle-income households. Indeed, dividends' transparent and income-progressive nature could, it is thought, create a popular constituency for ramping up the carbon tax rapidly from year to year, since the dividend would rise with the tax.

On the other hand, dividends do not offer the efficiency benefits available from using carbon tax revenue to reduce taxes that burden and hinder productive economic activity. Tax shifting, for example using carbon tax revenue to reduce payroll taxes, could eliminate the regressive effects of carbon taxes on net annual income and also confer efficiency benefits by reducing payroll taxes that discourage employment.

The success and popularity of British Columbia's revenue-neutral carbon tax commend a mixed approach, using tax shifting and direct mechanisms to return revenue, which mitigates regressive effects and increases efficiency.

[17] See "Three Things Everyone Should Know about British Columbia's Carbon Tax, In Pictures" (Sightline Institute, posted Jan. 30, 2013). http://daily.sightline.org/2013/01/30/three-things-everyone-should-know-about-bcs-carbon-tax-in-pictures/.

A Note About EPA Regulation of Carbon Pollution Under the Clean Air Act

The Committee Discussion Draft did not solicit comments on another possible approach to curbing U.S. CO2 emissions: using EPA regulatory authority under the Clean Air Act. But because this approach has been widely discussed of late, and because EPA is proceeding with rulemaking, it's pertinent to examine the emissions reduction potential of such a regulatory approach, to compare it with clean-energy subsidies and carbon taxes, and to consider how these approaches might interact. (We do not discuss Corporate Average Fuel Efficiency (CAFE) standards for cars and trucks.)

In 2011, analysts at Resources for the Future examined[18] the range of EPA's regulatory options for power plants, a sector that at that time accounted for just over 40% of U.S. CO2 emissions (the share has since fallen). They concluded that an optimally-designed program of EPA regulations involving tradeable performance standards or a carbon intensity standard, rather than conventional prescriptive (and costly) facility-specific technology mandates, could reduce U.S. electricity sector emissions by 32% below a 2005 baseline by 2020. That would represent a 13% reduction in total domestic emissions.

Even a flexible regulatory approach has only limited potential for further emissions reductions.

Those figures, while noteworthy, are less impressive than they may appear. First, compared to the RFF analysts' baseline year of 2005, electricity-sector CO2 emissions had already fallen 10% in 2011, when the paper was published. (The reduction swelled to nearly 16% in 2012, the last year for which definitive data are available.) Second, implementation by EPA of a flexible approach appears vulnerable to legal challenges.[19] Third, and most important, even this flexible regulatory approach has only limited potential for further emissions reductions. The RFF report concluded:

> EPA action under the Clean Air Act is inferior to new [carbon pricing] legislation from Congress, especially over the long term. Although it is possible to identify some readily available opportunities for emissions reductions and push them via regulation (with market tools to keep costs down), it quickly becomes difficult to identify what steps should be taken next. A carbon price (either cap-and-trade or a carbon tax) created by legislation would allow the market to make these decisions.[20]

Earlier (Table 1) we estimated that the Discussion Draft's proposed clean-electricity subsidy would reduce CO2 emissions from that sector by 16%, while a carbon tax at the same dollar level as the clean-electricity credit would reduce emissions by 31%. However, those reductions are relative to a moving trajectory of future (2024) emissions that already reflects both the 16% reduction in 2012 sector emissions vs. 2005 as well as continued future penetration by natural gas and renewables (wind and solar-PV). Taking the different contexts into account, it's clear that CO2 reductions from a carbon tax on electricity would far exceed those from RFF's optimal-regulatory approach. The clean-electricity subsidy and the regulatory approach might be roughly comparable in shrinking electricity's CO2 emissions.

[18] Dallas Burtraw, Arthur G. Fraas, and Nathan Richardson, "Greenhouse Gas Regulation under the Clean Air Act, A Guide for Economists," (Resources for the Future, 2011, RFF DP 11-08).

[19] See David Bookbinder and David Bailey, "Obama's power-plant plan won't work" (Politico, July 2013). The authors sketch an excruciating scenario with roughly two decades of rulemaking and litigation before EPA power plant regulations on CO2 emissions could take effect. A national standard, fifty state implementation plans, and enforcement actions would all need to work their way through the legal system.

[20] Burtraw et al., p. 24.

Needless to say, reductions from a regulatory approach would not be fully additive to reductions from either a clean-energy subsidy or a carbon tax. Rather, EPA carbon regulations would provide carbon taxes or subsidies with a "floor" on emissions reductions.[21] On the other hand, if EPA chooses technology mandates instead of flexible carbon intensity standards, the effect would be to add cost without additional emissions reduction beyond what would be achieved by subsidies or carbon taxes.

A further weakness of a regulatory approach is that it would impose disproportionate costs on energy intensive, trade-exposed industries without offering incentives for climate policy to "go global." In fact, a regulatory approach could create perverse incentives for domestic energy intensive industry to relocate to less-regulated jurisdictions.

Finally, as noted, promulgating and litigating EPA regulations would put its timeline well beyond those for subsidies or carbon taxes.

[21] An exception would be in the case where EPA allowed states to enact carbon taxes as alternative compliance. In that scenario, the cumulative carbon price (both state tax plus the federal subsidy or tax) would represent the total price signal, unless the federal tax pre-empted the state one. Note that economist Adele Morris of the Brookings Institution has suggested that EPA allow states to implement carbon taxes on utilities as alternative means of complying with the EPA standard for coal-fired power plants. See "Recommendations to the U.S. Environmental Protection Agency: Why EPA Should Offer a Price-Based Standard for Carbon Pollution from Existing Power Plants" (Brookings, November 2013).