Reaffirming the Case for a Briskly Rising Carbon Tax

A response to the Breakthrough Institute's paper on "The Costs and Complexities of Carbon Pricing

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This paper responds to the Breakthrough Institute paper, "Costs and Complexities of Carbon Pricing – A Review of the Economic and Innovation Literature," by Ted Nordhaus, Michael Shellenberger, and Alex Trembath.

In its paper, BTI argues that the conditions under which pricing carbon emissions is "optimal" policy are "specific, limited and often overlooked." BTI asserts that unless *all* of the following four conditions are met, carbon taxes (or other carbon pricing policies) will be no more effective than other policies:

1) The carbon price is set to reflect the "social cost of carbon";
2) The carbon pricing mechanism is revenue-neutral;
3) All nations participate in pricing carbon pollution and agree on prices;
4) The carbon price is high enough to overcome low price-elasticity in the energy sector, high barriers to entry for alternatives, and the risk and cost of energy innovation.

Citing leading economists' recommendations of best practices for design of effective carbon pricing policies, BTI implies that only an optimally-designed carbon pricing system will have decisive advantages over other, non-price-based climate policies. Without considering whether suboptimally-designed carbon taxes can confer substantial beneficial effects in the real world, BTI leaps to the sweeping conclusion that the "broad based consensus" among economists for carbon emissions pricing (especially carbon taxes) as the "silver bullet" of effective climate policy is mistaken and naïve. Because, in BTI's view, it is highly unlikely that all four requisite conditions can be fully met, carbon pricing is likely to be "a good deal more costly and less effective than proponents imagine."[2]

Rather than using a carbon tax as the foundational policy to reduce CO2 emissions, BTI proposes a relatively small ($20-$30/T CO2) tax as an "obvious source of revenue" to fund targeted research, development and deployment of low-carbon energy.[3] BTI concludes that this modest carbon tax funding selectively-targeted clean energy RD&D holds greater promise for spurring carbon-reducing innovation and efficiency than do broad, economy-wide price incentives. Yet BTI does not appear to have examined fully the efficacy and potential benefits of a more briskly-rising revenue-neutral carbon tax. Further, BTI concludes that even if its proposed carbon tax to fund RD&D results in technological innovation, a portfolio of complementary energy regulations and subsidies will also be needed. This is because, in BTI's view, small carbon taxes simply aren't up to the task. And even with subsidies, BTI admits that clean energy breakthroughs are far from assured.

Below, we question each of BTI's assumed conditions for successful carbon taxing. We also respond to Breakthrough's proposal for a small carbon tax to fund targeted RD&D.

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[1] The Carbon Tax Center (www.carbontax.org) is a not-for-profit, public-interest, educational organization founded in 2007. We gratefully acknowledge the support of the Alex C. Walker Foundation for our research and writing of this discussion paper. The author thanks CTC director Charles Komanoff for editing and helping shape this paper.

[2] BTI, p 2.

[3] As an aid to help the reader gauge the end-user impacts of the BTI proposal, we note that a carbon tax of $25 per short ton of CO2 would raise pump prices by around 14 cents a gallon and U.S. average retail electricity prices by 1.3 cents a kWh. Higher carbon taxes would have subproportional impacts as producers decarbonize electricity and fuels.

I. While the "Social Cost of Carbon" remains an animated debate in academia, the discussion is largely irrelevant to the policy question of how to set the price trajectory of an environmentally-effective carbon tax. The relevant design question is simply: How fast must a carbon tax rise to reduce emissions to a safe level?

BTI asserts that, "[C]arbon pricing… hangs critically on… an economically optimal price… that depends further upon the ability of economists to determine what that price is."[4] The wide range of values for the social cost of carbon found in the economics literature is sufficient to disqualify carbon pricing as an economically-efficient policy for reducing emissions, suggests BTI.

The lively discourse about the "Social Cost of Carbon," ("SCC"), memorably embodied in the Stern-Nordhaus debate,[5] is largely a theoretical, academic discussion. Much of the controversy revolves around how deeply to discount future climate damage in order to set an optimal "Pigouvian tax" that would correct the market distortion that presently omits the cost of climate damage from fossil fuel prices.[6] Because the present value of future damages is highly sensitive to the choice of a discount rate, SCC estimates vary by two orders of magnitude.

Moreover, as economists Frank Ackerman and Elizabeth Stanton have shown, variables other than the discount rate can also greatly affect estimates of the social cost of carbon.[7] These include assumptions

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[4] BTI asserts (p 3):

> "There is broad agreement among economists that establishing a price on carbon is socially optimal only if the price reflects the true social cost of emissions. Establish a price that is too high, and the costs to present generations of mitigating emissions will significantly exceed the benefits experienced by future generations. Establish a price that is too low and the price will be insufficient to mitigate emissions sufficiently, imposing high social costs on future generations.
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> The consensus among environmental economists has been that it is not sufficient to simply "put a price on carbon." It is equally important that societies "get the price right." In this, the analytical case that carbon pricing is the most economically optimal means to reduce emissions hangs critically on the presumption that societies establish an economically optimal price, one that depends further upon the ability of economists to determine what that price is."

[5] See ***A Battle Over the Costs of Global Warming*** (David Leonhardt, NY Times, 2/21/07):

> "In practical terms [Nordhaus'] argument has a weak link… assuming that the economic gains from, say, education will make future generations rich enough to make up for any damage caused by climate change. Sea walls will be able to protect cities; technology can allow crops to grow in new ways; better medicines can stop the spread of disease. No one knows whether this is true, let alone desirable, because no one knows what life will be like on a planet that is five degrees hotter. "If ever there was an example where there was uncertainty, this is it," said Martin L. Weitzman, a Harvard economist who attended the debate."

[6] Even Arthur Pigou never suggested that taxes to correct market failures had to be set optimally in order to be effective.

[7] F. Ackerman, E. Stanton, ***Climate Risks and Benefits, Revising The Social Cost of Carbon*** (E3 Network, 2011),

> "…economists have very little information about damages at the much higher temperatures that will eventually result from unchecked climate change. [William Nordhaus'] DICE [model] simply extrapolates from its low-temperature estimate, implying that only when 19oC (34^{o}F) of warming has occurred do damages reach one half of world GDP. Martin Weitzman argues that this is a drastic understatement of high-temperature damages and suggests an estimate more in keeping with recent climate science: losses due to global warming could reach half of world GDP at 6^{o}C (11oF), and 99 percent of world GDP at 12^{o}C (22oF). This dire forecast may seem more plausible in light of a recent study showing that at 12^{o}C average warming, large parts of the world will, at least once a year, reach temperatures that human beings cannot survive."

about how heavily to weight high-risk and catastrophic scenarios, how to estimate climate sensitivity (temperature changes in response to radiative forcing), and the values assigned to ecosystem services. Also pertinent are moral questions about intergenerational and international equity above and beyond the discount rate.

These considerations have led some economists, notably environmental economist Martin Weitzman, to sharply question the use of standard risk-benefit analysis in the climate context.[8] Weitzman argues that using central-tendency or average values for expected climate damage misses the crucial scientific point: Global warming threatens irreversible, catastrophic damage that could overwhelm and destroy civilization. Weitzman makes a compelling case that conventional cost-benefit averaging so-called "fat tail" (low-probability but high- or maybe even infinite-cost) risks with low-risk scenarios is nonsensical

But the unpriced costs of fossil fuels aren't just in the climate realm. In 2012, Harvard Economics Professor Dale Jorgenson told the Senate Finance Committee that the known, well-quantified present-day health damage from fossil fuel pollution alone justifies a tax in the range of $50/T CO2.[9]

In our view, the Social Cost of Carbon debate misses the point of carbon pricing policy. Speculative valuations of future climate damage cannot be the basis for setting carbon taxes whose objective is limiting accumulation of atmospheric CO2 and other greenhouse gases to levels compatible with continuation of agriculture-based civilization. Instead, climate policies must be viewed as insurance and prevention sufficient to keep the risk of catastrophic outcomes within a tolerably low level. More specifically, ***a carbon tax should be viewed and designed as a policy to efficiently phase out and largely replace fossil fuels rapidly enough to avert climate disaster.***

The climate science consensus reflected in the IPCC Fourth Assessment[10] is that warming of more than 2 degrees Celsius poses substantial risk of passing critical climate tipping points that would result in catastrophic and runaway climate destabilization. Moreover, that report was published in 2007 and, thus, the scientific consensus it embodies is nearly a decade old. More recent work by MIT climate scientist Susan Solomon[11] has shown that once the "safe" level of CO2 has been exceeded, subsequent reductions in emissions (or CO2 sequestration) will not be able to reverse warming for millennia. This obviously raises serious questions as to whether the 2 degree C target is sufficiently protective, thus further underscoring the importance of early action.

The consensus view, based on historic climate sensitivity to CO2 concentrations, suggests that CO2 levels must be kept below 450 ppm in order to limit warming to 2 degrees C.[12] In turn, the IPCC estimated in 2007 that to stay within that CO2 "budget," global CO2 emissions need to be reduced by roughly 80% from their 1990 levels by 2050. On ethical as well as pragmatic grounds, to obtain that global reduction, U.S.

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[8] Martin Weitzman, ***On Modeling and Interpreting the Economics of Catastrophic Climate Change*** (Review of Economics and Statistics, 2009).

[9] Testimony of Dr. Dale Jorgenson, Samuel W. Morris University Professor, Harvard University, to Senate Finance Committee, June 12, 2012.

[10] IPCC Fourth Assessment Report (2007).

[11] Susan Solomon, Gian-Kasper Plattnerb, Reto Knuttic and Pierre Friedlingsteind, ***Irreversible climate change due to carbon dioxide emissions***, Proceedings of the National Academy of Sciences, 2008.

[12] Estimates of "climate sensitivity," defined as the amount of warming that would result from a doubling of CO2 concentrations from the historic background level of 270 ppm to 540 ppm, range from 1 to 4.5 degrees Celsius. Dr. James Hansen concludes that 2 degrees of warming would be disastrous. "2 Degrees of Warming a Recipe for Disaster, NASA Scientist Says" (*Science Live*, December 6, 2011.)

emissions would have to fall even more steeply. In broad strokes, climate science is telling Americans that we must phase out the overwhelming bulk of our fossil fuel combustion by mid-century.

"America's Energy Security Trust Fund Act of 2009," a bill introduced by Rep. John Larson (D-CT),[13] proposed a carbon tax starting at $15/T CO2 rising briskly to $100-150/T CO2 in a decade. Carbon Tax Center director Charles Komanoff has developed a model using historic price and income elasticities to project emissions reductions from any set of user-inputted carbon taxes and rates of increase. The CTC model predicts that the Larson price trajectory would reduce U.S. CO2 emissions by about a third in just a decade. Komanoff's model confirms that small carbon taxes that do not increase briskly over time, such as BTI's $20 – $30 T/CO2 tax, offer poor prospects for significant emissions reduction. ***A carbon tax will need to rise briskly with sustained and predictable price rises for a decade or more in order to create the requisite economy-wide price expectations for broad decarbonization and low-carbon innovation.***

II. Revenue-neutrality offers opportunities to: a) mitigate or eliminate regressive effects of carbon taxes, b) mitigate or eliminate adverse "income" effects of increased aggregate tax burdens, and c) build political support to continue the carbon tax and, perhaps, raise its level. Even so, the effectiveness of a carbon tax at reducing CO2 emissions does not depend on revenue return. With or without revenue return, carbon taxes offer efficiency benefits over other policies because they offer economic actors maximum flexibility to choose substitutes or alternatives. Revenue-return offers additional benefits and potential political "carrots," but it is not integral to the effectiveness of carbon pollution pricing policy.

BTI recapitulates[14] the conclusion of a broad range of economists that advantages may be had by returning revenue from carbon taxes, either via cutting other taxes ("tax shifting") or through distributing the revenues directly to households on a *pro rata* basis ("dividends"). However BTI then infers, incorrectly, that such revenue-neutrality is *required* for carbon pricing policies to be effective.[15]

A more accurate statement is simply that the literature strongly suggests that revenue return offers two sets of important economic benefits as well as political advantages. First, tax shifting offers distributional benefits. As Tufts professor (and former Deputy Assistant Secretary for Environment and Energy at the U.S. Department of Treasury) Gilbert Metcalf and others have shown, the disproportionate impacts of carbon taxes on low-income households can be largely eliminated by using the revenue from carbon taxes to replace certain existing taxes.[16] Not only that, such "tax shifting" also offers efficiency benefits. As

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[13] HR 1337. See ***New Larson Bill Raises the Bar for Congressional Climate Action*** (Carbon Tax Center, 3/6/09).

[14] BTI asserts:

> "Establishing the appropriate global price on carbon is further complicated by another condition that economists have long believed was necessary in order for pricing strategies to be economically efficient, namely that carbon taxes (or cap and trade programs that auction emissions allowances) be revenue neutral, meaning that they not increase the overall tax burden of a given economy but rather displace other sources of public revenue (Jaeger 1995, Parry and Bento 1999, CBO 2007, Aldy et al 2009)."

[15] The Waxman-Markey bill was hardly revenue-neutral and never pretended to be. In essence the bill was a hidden, volatile and regressive carbon tax, whose revenue would have been largely devoted to pay off fossil fuel interests. Harvard economist Rob Stavins praised Waxman-Markey as brilliant political economy, (See ***The wonderful politics of cap-and-trade***, Belfer Center, 2008), yet the bill's "Christmas tree" aura may have contributed to its narrow (7-vote) margin of passage in the House in 2009 and doomed its chances in the Senate a year later.

[16] Gilbert Metcalf, ***A Proposal for a U.S. Carbon Tax Swap*** (Brookings Hamilton Project, 2007) and Gilbert Metcalf & David Weisbach, ***The Design of a Carbon Tax*** (Harvard Envt'l Law Rev, 2009).

Goulder,[17] Parry & Williams[18] as well as Hassett[19] have shown, tax shifting can mitigate or eliminate the dampening effect on economic activity that would otherwise result from imposing new tax burdens. In effect, well-designed tax shifting offers the opportunity for a low or zero net (aggregate) cost environmental policy.

Finally, tax shifting offers political benefits. Public support for British Columbia's revenue-neutral carbon tax, which has been increased in four annual increments as planned, demonstrates that well-crafted return of carbon tax revenues can garner public support for maintaining and, indeed, raising a carbon tax. (We discuss this in greater detail in Section VI.)

Still, even if carbon tax revenue is used for other purposes — to reduce deficits, or to pay for energy efficiency projects, energy R&D, or social benefits — the tax's economy-wide price signal will reduce emissions more broadly and efficiently than will sector-specific regulations, subsidies, or opaque, complex and volatile cap-and-trade schemes. That's because the price signal of a carbon tax will motivate decision-makers across the entire economy rather than focusing subsidies or regulations on specific sectors or targets.

As a matter of economic principle, changing the price of carbon consumption will always be superior, in terms of efficiency, to changing the prices of selected means of reducing carbon consumption (i.e., subsidies) or to dictates of permissible levels of carbon emissions from specific functions or sectors of the economy. The literature of rational expectations theory[20] shows that price *expectations* drive decisions even more powerfully than current price levels.[21] This is confirmed in both British Columbia[22] and Australia,[23]

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[17] Ian Parry, Roberton Williams & Lawrence Goulder, ***When Can Carbon Abatement Policies Increase Welfare? The Fundamental Role of Distorted Factor Markets*** (Resources for the Future, 1998).

[18] Ian Parry & Roberton Williams, ***Moving U.S. Climate Policy Forward: Are Carbon Taxes the Only Good Alternative?*** (Resources for the Future, 2011).

[19] Kevin Hassett, Steven Hayward, Ken Green, ***Caps vs. Taxes*** (AEI, 2007):

> "There is substantial literature on the 'double dividend' that examines the economic conditions under which a carbon tax can be paired with a reduction in other taxes in a manner that improves the overall efficiency of the economy. Where such a double dividend is available, a carbon tax swap would be desirable, even if the environmental benefit of reduced carbon emissions failed to be realized. The concept of the double dividend stems from the observation that a tax on an environmental externality not only helps curb the externality (dividend 1), but also provides revenue with which other distorting taxes can be reduced, thereby providing efficiency gains (dividend 2)."

[20] See John F. Muth, ***Rational Expectations and the Theory of Price Movements***, Econometrica, 1961.

[21] Alan S. Blinder (writing as Federal Reserve Board vice-chair; he is currently a professor at Princeton University), ***Carbon Tax, The Miracle Cure,*** Wall Street Journal, 1/31/11):

> "[T]he CO2 tax should be enacted now [and] ramp up gradually… I'd like to see it top out at more than $200 a ton in, say, 2040… But the time pattern is more important than the exact dates and numbers. What's critical is that we lock in higher future costs of carbon today. Once America's entrepreneurs and corporate executives see lucrative opportunities from carbon-saving devices and technologies, they will start investing right away—and in ways that make the most economic sense… The next Steve Jobs, Bill Gates and Mark Zuckerberg are waiting in the wings to make themselves rich by helping the environment."

[22] ***Three Things Everyone Should Know about British Columbia's Carbon Tax***, Sightline Daily, 1/30/13***, B.C.'s carbon tax is driving down emissions,*** Vancouver Sun, 6/4/13.

[23] ***Emissions drop signals fall in carbon tax take***, The Australian, 1/23/13:

whose experience is demonstrating that a publicly-announced, visible and (in British Columbia's case) predictably-rising tax on CO2 pollution can be very potent in creating incentives to reduce emissions and innovate.

In sum, while revenue-neutrality is considered highly desirable by most economists as well as some advocates including the Carbon Tax Center, and though it definitely can build political support for raising carbon taxes briskly, it is not essential to the tax's *environmental* effectiveness.

III. BTI asserts that carbon taxes are virtually useless unless all nations enact carbon taxes and harmonize their price levels. We agree that effectiveness of carbon pricing (or for that matter, any climate policy) will increase with participation of other nations. Carbon leakage is a serious concern, but it and other cross-border distortions are more intractable under other less-transparent national-level climate policies. In contrast, carbon taxes can be harmonized using simple, established border tax adjustment mechanisms to minimize the perverse incentives that lead to carbon leakage.

Carbon taxes offer the potential for transparent, quantitative, WTO-sanctioned harmonizing border tax adjustments to prevent unfair competition from non-carbon taxing nations and to incentivize them to enact their own domestic carbon taxes. In effect, harmonizing tariffs would impose equivalent carbon taxes on imported goods from nations that have not enacted equivalent carbon pricing policies. This incentive will increase as the carbon tax rises and the amount of lost revenue mounts.

BTI implies (quoting Prof. Nordhaus) that unless all nations participate in and fully harmonize their carbon pricing, nations that do enact a carbon price will incur very high costs, rendering the overall policy ineffective and unworkable.[24] BTI then leaps to the conclusion that because full international participation is extremely unlikely, national carbon taxes should be abandoned as primary policy tools.[25]

Yet policies to mitigate "carbon leakage" — the incentive that national carbon pricing policies would create for manufacturers to move carbon-intensive activity to non-carbon taxing jurisdictions in order to evade carbon taxes — have been the subject of numerous studies[26] and Congressional hearings. In a study of carbon pricing policies, the Congressional Budget Office pointed to the simplicity of harmonizing carbon taxes, noting the much greater complexity of linking cap-and-trade systems, which involves harmonization of numerous parameters including allowance price, offset prices and standards, as well as borrowing and

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> Carbon emissions from the electricity sector have dived in the first six months under the carbon tax, with much greater use of renewable energy and cutbacks in consumption. While the government believes the 8.6 per cent fall in carbon emissions shows its policies are working, it also means it will collect less from the tax than the $4 billion it anticipated this year.

[24] BTI asserts: "In his modeling, Nordhaus (2009) finds that global emissions pricing schemes that are not harmonized will result in overwhelming economic inefficiency: *[U]niversal participation at a harmonized level is a critical part of an efficient global- warming regime. There are extremely high costs of non-participation."* BTI declined to provide page citations, so we are unable to contextualize this or a number other quotations in the BTI draft.

[25] This rhetorical stance (that all climate policies are futile unless all other nations adopt the same policies at the same time) is apparently becoming standard fare from climate denialists including David Kreutzer of the Heritage Foundation. See ***Whither The Carbon Tax*** (AEI, video 5/30/11).

[26] In ***Design of a Carbon Tax*** (Harvard Envt'l Law Rev, 2009), Metcalf and Weisbach (pp. 541-552) describe a simple system of harmonizing tariffs based on the carbon content of six carbon-intensive materials.

banking provisions.[27] CBO's assessments have proved prescient, as cap-and-trade systems have been plagued by fraud, gaming and poor accountability.[28]

While harmonization of carbon taxes has not been presented to the World Trade Organization, well-respected trade experts have pointed out that border tax adjustments are consistent with the literal language of the harmonization provisions of the WTO treaty. They conclude that well-designed non-discriminatory border tax adjustments would likely pass WTO scrutiny.[29] Border tax adjustments are firmly embedded in international trade law. For example, as anyone is aware who has traveled to and purchased goods in the EU, the EU's value added taxes are border-adjusted; refunds are provided to EU non-residents. It is true that some analysts suggest that international treaties relating to carbon trade would be preferable to reliance on WTO-based border adjustments with their attendant risk of trade-related disputes.[30] But existing WTO provisions offer a reasonable starting point. As more nations enact carbon pricing, we can expect increased impetus for carbon-specific trade agreements to supplement the existing WTO structure, if needed.

In contrast, regulations afford no such simple or transparent mechanism to address cross-border price distortions created by differences in policy. For example, EPA's rule limiting emissions from new electric utility generating units to 1,000 lb CO2/MWh can be expected to increase electricity rates (primarily by encouraging switching from coal to gas in instances where continuing to burn coal would be less costly). But unless electric utilities in other nations face the same regulatory requirements, the new rule will create incentives for electricity-intensive firms to relocate their activities to nations where electricity rates are lower. Subsidies that create unfair advantages to domestic industry are highly suspect under WTO rules. In contrast to regulations and subsidies, carbon taxes offer the potential for transparent, quantitative, WTO-sanctioned harmonizing border tax adjustments to prevent unfair competition from non-participating nations and to provide incentives for them to enact their own domestic carbon taxes (else forfeit the revenue that their trading partners collect as border adjustments).

IV. BTI asserts that carbon pricing cannot work efficiently without full participation of developing countries. Yet these countries cannot afford additional tax burdens, BTI argues. Nor can they enact revenue-neutral carbon taxes because they lack sufficient revenue from other taxes to shift against carbon taxes. We disagree. In developing countries, carbon taxes

[27] ***Policy Options for Reducing CO2 Emissions*** (Congressional Budget Office, 2008).

[28] Michele Chan, ***Ten Ways to Game the Carbon Market,*** Friends of the Earth 2010. See also, ***Lessons Learned from the European Union's Emissions Trading Scheme and the Kyoto Protocol's Clean Development Mechanism*** (Government Accountability Office, 2008).

[29] See Joost Pauwelyn, ***Carbon Leakage Measures and Border Tax Adjustments Under WTO Law****,* (2012). Prof. Pauwelyn concludes,

> "…a carbon tax or emission allowance requirement on imports could be framed as WTO permissible 'border adjustment' of a domestic carbon tax or cap-and-trade system. Crucially, if such 'border adjustment' does not discriminate imports as against domestic products (national treatment), and does not discriminate some imports as against others (most-favoured nation treatment), this type of competitiveness provision could pass WTO scrutiny without any reference to the environmental exceptions in Article XX of the General Agreement on Tariffs and Trade ('GATT')."

Pauwleyn gave similar testimony to the House Ways & Means Sub-committee on Trade, March 24, 2009.

[30] ***A Guide for the Concerned: Guidance on the Elaboration and Implementation of Border Carbon Adjustment*** (International Institute for Sustainable Development, 2012) cautions that "BCA [a Border Carbon Adjustment] is at best a fall-back measure in absence of multilateral agreement, and at worst a divisive and imperfect tool."

tend to be progressive; essentially luxury taxes. Thus, there is little or no need for tax shifting to address distributional impacts.

Fossil fuel use in developing countries is skewed heavily toward higher income households.[31] Indeed, many poor people in those nations have little or no direct access to fossil fuels (e.g., electricity, driving) and extremely limited indirect access (via purchase of manufactured goods).[32] To that extent, a carbon tax would be unlikely to impose regressive burdens in developing countries. Rather, it could become a reliable revenue source for developing countries to fund infrastructure development, education and other legitimate functions of government.[33] This requires not that carbon taxing be implemented with perfect transparency and 100% coverage, but only that it be less flawed than the taxes that would be levied otherwise.[34] And because carbon taxes can be collected upstream at a small number of distribution points, the administrative effort of imposing and collecting carbon taxes is likely to be less than that of other potential revenue sources.

The essential first step toward the crucial goal of a global carbon price is for blocs of major developed nations to enact carbon pricing systems that are consistent with existing trade structures and that minimize incentives for carbon leakage among those large developed nations.[35] Existing WTO structures offer good prospects for a simple harmonization system that includes incentives for wider participation.

V. BTI asserts that energy-demand elasticities are too low for a small ($20-30/T CO2) tax to induce significant reductions. And they assert that a higher carbon tax would seriously damage or destroy the economy. We disagree. If all or most carbon tax revenue is returned via well-chosen tax shifts, the net effect on aggregate welfare can be very slight or even positive.

We agree that energy-demand price elasticity is somewhat "sticky." Yet with reported price elasticities for the major energy sectors ranging from -0.4 to -0.7, it is far from zero. In layman's terms, consumers, businesses, entrepreneurs and investors respond less to increases in energy prices than they do to price changes in some other goods and services; but they do respond, and not minimally. Moreover, the price-responsiveness of key economic actors on the *supply side* has been shown to be considerable,

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[31] Parry, de Mooij, and Keen, ***Fiscal Policy to Mitigate Climate Change*** (International Monetary Fund, 2012), especially Chapter 6, "Mitigation and Fuel Pricing in Developing Economies." See also Thomas Sterner**, *How Regressive Are Fuel Taxes? A Comparison of Countries from Around the World*** (Resources for the Future, 2011):

> "One of the main reasons for resistance to fuel taxes appears to be the popular belief in many, many countries that fuel taxes hurt the poor. However, my studies with colleagues have found neutral or very weak regressive results in richer countries and quite strong progressive evidence in the developing countries, such as China, India, Ethiopia, Indonesian, Ghana, Nairobi, Mali, and several more. The intuition is not surprising; in most developing countries, the very poorest households cannot afford to own a car at all. Fuels have more of a "luxury" character and hence fuel taxes are more progressive. On the other hand, fuel taxes also increase the cost of public transportation (and other goods). Because the poor typically use public transportation more intensively, this effect might mitigate the progressivity of fuel taxes, but we have found that the net effect is still progressive in practically all developing countries."

[32] See ***On the Distributional Effect of Carbon Tax in Developing Countries: The Case of Indonesia,*** Yusuf and Resosudarmo, (Australian National University, August 2007).

[33] See ***Fiscal Policy***, *supra note 31.*

[34] *Id.* The authors conclude that considerations relating to existing tax structures *within* developing nations are at least as important in designing carbon taxes as the need for cross-border harmonization. See pp. 112–114.

[35] See Pauwelyn testimony, *supra note 29.*

particularly in the electricity sector. As BTI itself never tires of pointing out, from 2007 to 2012 alone, coal lost enormous market share (a full 25%, by our estimates[36]), largely to cheap natural gas enabled by fracking.

Whether or not gas continues to undercut coal in price, we can expect wind turbines and, before long, solar generation (via photovoltaic cells and "concentrated" turbine-based solar facilities) to penetrate further into coal's still-substantial share. In other sectors as well, electrification will enable both efficiencies and lower-carbon energy to displace fossil fuels, particularly petroleum products. But both developments will depend critically on rising prices for coal relative to gas, and petroleum relative to electricity, that only a predictably- and briskly-rising carbon price can guarantee.

Indeed, the Carbon Tax Center's modeling strongly suggests that carbon prices will need to rise briskly for years to produce substantial and sustained emissions reductions. Even so, recent results from British Columbia[37] and Australia[38] provide heartening evidence that sustained, pre-announced and predictable carbon price expectations can increase responsiveness. This is consistent with the growing body of "rational expectations" and "prospect" theory[39] which holds that individuals' behavior is guided more by *expectations* of future prices than by current prices. As a corollary, even when the long-term price trend has been upward, volatile and unpredictable pricing has discouraged substitution and innovation. For example, the real rise in U.S. gasoline prices over the past decade has been masked to a great extent by short-term volatility,[40] which confounds consumers and business' ability to make return-maximizing decisions.

BTI also cites the failure of the European Union's Emission Trading Scheme as evidence that a $20-30/T CO2 tax cannot be expected to spur much energy innovation in the U.S. As noted, our modeling results generally confirm the conclusion that much larger, sustained, upward-trending price signals will be needed. But clearly the extreme volatility in the EU ETS has largely cancelled out long-term expectations of an upward-trending carbon price, dampening or even suffocating investment in renewable energy by unnecessarily increasing the risk to investors in alternative energy.[41] This makes the ETS a very poor example[42] for estimating the effects of a similarly sized carbon tax. We would expect even a small, fixed

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[36] Calculation by Charles Komanoff from U.S. Energy Information Administration, Monthly Energy Review, Table 7.2a. Electricity Net Generation: Total (All Sectors). Coal-fired generation was 25% less in 2012 than in 2007.

[37] See note 22, *supra*.

[38] See note 23, *supra*.

[39] Daniel Kahneman and Amos Tversky, ***Prospect Theory: An Analysis of Decision under Risk,*** (Econometrica, 1979): "[P]eople underweight outcomes that are merely probable, in comparison with outcomes that are obtained with certainty."

[40] From early 2003 into 2013, a period spanning 123 months, the average U.S. pump price more than doubled, yet the month-to-month price fell 56 times, i.e., in 46% of the months. See "Price Elasticity of U.S. Gasoline Demand," a spreadsheet maintained by Charles Komanoff, available at < http://www.komanoff.net/oil_9_11/Gasoline_Price_Elasticity.xls>.

[41] Metin Celebi and Frank Graves, ***CO2 Price Volatility: Consequences and Cures***, (Brattle Group, 2009):

> "[H]igh level of price volatility, exceeding that of natural gas prices, will likely deter investors' willingness to undertake long-lived, capital-intensive, and low-CO2 technologies. By increasing investors' hurdle rates, making debt financing more difficult, and creating an option value for waiting to invest, CO2 price volatility will cause carbon abatement technologies to be deferred for ten years or more, until CO2 prices are perhaps double the levels needed to justify these investments, absent the volatility. study of price volatility in EU ETS."

[42] ***The state of the European carbon market in 2012*** (Report from the Commission to the European Parliament and Council).

carbon tax of $20-$30 to induce more efficiency, fuel switching and innovation than has been evident in the EU ETS, simply because a stable and predictable price reduces risk and increases investor returns on alternatives to fossil fuels.

BTI's related assertion, that a higher carbon tax would be too "costly" and would damage or destroy the economy, seems to be based on a fundamental misunderstanding of tax policy. Taxes do not represent losses but are more appropriately viewed as potential allocation of monetary resources toward social goods. Every dollar of carbon tax revenue is a dollar that can be reallocated for societal benefits. (We acknowledge the potential for large inefficiency and so-called deadweight loss from poorly designed tax policy.[43]) It is simply incorrect to regard the dollar value of carbon taxes as the "cost" of carbon taxing as climate policy. That reasoning would lead one to assume that regulations and subsidies are costless, which is absurd.

All climate policies have costs and benefits; as BTI itself notes, the overwhelming consensus of the economics literature is that Pigouvian taxes have much smaller costs and greater benefits than any other pollution abatement policies.[44] Rather than dictating specific behavior as regulations and subsidies do, they provide incentives for decision-makers across the economy to find, develop and deploy least-cost abatement measures.

Like most of the classically-trained economists cited by BTI, CTC advocates carbon taxes with revenue return as a way to reduce or completely eliminate the aggregate cost of climate policy. One of the more intriguing possibilities is that when "Pigouvian" carbon taxes are structured so as to reduce other "distortionary" taxes, the result can be a very low- or possibly no-cost climate policy that instead of damaging or destroying the economy could have broad welfare benefits. This "double dividend"[45] results from the efficiency advantage of taxing what we don't want rather than taxing what we do want.[46] (This efficiency advantage will become increasingly important as carbon taxes are incremented at a rate and to the levels necessary to briskly phase out fossil fuels in time to avert climate disaster.)

VI. BTI asserts that because the carbon price can't go high enough, a range of complementary policies will be needed, including subsidies and regulations. We agree that complementary policies, especially government support for alternative energy R&D, will be needed. But we generally oppose BTI's insistence on using carbon taxes as a source of funding; "revenue return" is needed to create the conditions for an ongoing upward carbon tax trajectory.

[43] See e.g., Gilbert Metcalf, ***Allocation Issues in Greenhouse Gas Cap and Trade Systems,*** Testimony before the Senate Energy and Natural Resources Committee, 10/21/09.

[44] This is hardly a new, or by this point, even a controversial idea. (See ***Pollution, Prices and Public Policy***, Brookings & Resources for the Future, 1976.)

[45] Lawrence Goulder, ***Environmental Taxation and the Double Dividend*** (Stanford, 1994). See also***, Caps vs. Taxes***, Hasset et al, *supra*, note 19. A "strong" double dividend results when the cost to the economy of the new carbon tax is less than the current cost (e.g., discouragement of investment or employment) of the distortionary tax being reduced. Such a carbon tax would effectively pay for itself in the savings from reducing the other tax(es). A "weak" double dividend occurs when some but not all of the cost of the carbon tax is reduced or offset by cuts in other taxes. The weak double dividend seems uncontroversial even if the strong double dividend remains mostly a theoretical possibility.

[46] The Carbon Tax Center takes an agnostic view of the various mechanisms for revenue return. In addition to tax shifting, we also point to the benefits of direct equal distribution of revenue (often referred to as a "dividend"). The dividend approach offers the benefits of distributional progressivity and may have political advantages of even greater transparency and creditability; however, it does not offer the efficiency benefits of tax shifting which are the basis of the "double dividend." Parry and Williams find that direct distribution of revenue would drastically increase the aggregate cost of carbon tax policies compared to well-designed tax shifting or even use of revenue to reduce future taxes by paying down deficits. See *supra*, note 18.

We agree with BTI that basic energy research and development is a social good that is under-supplied by the private sector. Nevertheless, we disagree with BTI's suggestion that carbon tax revenue is an "obvious source" of funding for such R&D programs. As outlined above, we find that carbon taxes will need to escalate briskly for decades.[47] With broad popular support and no apparent economic distress, both British Columbia[48] and Sweden[49] have successfully used carbon taxes to begin replacing revenue from other taxes, suggesting that transparent revenue return can help overcome resistance to carbon taxes.

British Columbia's carbon tax was enacted in 2008 with the explicit promise that every dollar would be returned to the public — a pledge enforced by a provision docking the pay of the finance minister if any revenue is not returned.[50] British Columbia's carbon tax revenue is returned via a mix of tax shifts including reductions to business taxes, income taxes, sales taxes and direct assistance to low-income families. Premier Gordon Campbell was handily re-elected in 2009, in part on the basis of his steadfast defense of the revenue-neutral carbon tax his administration instituted a year earlier.[51] And British Columbia's mix of revenue return enabled the province to raise the carbon tax annually in $5/T CO2 increments for four years, to its current level of $30/T CO2. Reports suggest that British Columbia's carbon

[47] We agree with BTI's conclusion that the economic literature conveys widespread agreement that fossil fuel energy prices are relatively inelastic. The results of the DICE, FUND and NEMS models all point to a similar conclusion that carbon taxes will need to rise briskly to substantial levels in order to achieve the needed emissions reductions. Given this apparent consensus, we are surprised that more mainstream economists seem unwilling to articulate the benefits of more aggressively-rising carbon taxes than the modest proposals that dominate current discourse.

[48] See "***We have a winner -- British Columbia's carbon tax woos sceptics***" (The Economist, 7/21/11).

[49] Thomas Sterner, ***Carbon Taxes, Simplicity and Happiness*** (Environmental Defense Fund, 4/16/13):

> "One of the countries that has succeeded in passing a carbon tax is Sweden and it is a very high one (over $150 per ton, compared with the $10 to $25 per ton discussed in the United States). Perhaps the most surprising thing is that most Swedes never think about it! It was passed and has been accepted politically in part because it was part of a general reform of the whole tax code. Even Sweden's carbon tax has a number of exceptions, but the overall package was popular: It lowered total taxes, lowered the top marginal tax rates and simplified the tax scheme by removing all the exemptions and deductions it used to have. Today most Swedes do their income returns quickly (many with a few clicks on their cell phones) and pay a much lower income tax than before."

[50] ***British Columbia Budget and Fiscal Plan, 2008/09 – 2010/11*** (Ministry of Finance, 2/19/08). The plan explains that the British Columbia carbon tax is based on the following principles (pp 11-12):

- **All carbon tax revenue will be recycled through tax reductions**
- **The tax rate will start low and increase gradually**
- **Low income individuals and families will be protected**
- **The tax will have the broadest possible base**
- **The tax will be integrated with other measures**

"Accountability for full revenue recycling will be achieved primarily through a legislated requirement that each year the budget include a three-year plan for carbon tax revenue recycling… Failure to table a revenue neutral plan will mean that the Minister of Finance is ineligible to receive the 10 per cent salary holdback." (p 14.)

[51] ***British Columbia re-elects Liberals*** (AFP, 5/13/09): "[T]he environment -- and especially the carbon tax -- became the key election issue. The tax, the first straight carbon tax in North America, was introduced by the government of British Columbia Premier Gordon Campbell in 2007 to help fight climate change. The tax is revenue neutral -- the collected tax money is paid once a year to provincial residents."

tax is working even more effectively than expected to reduce emissions in the province when compared to its neighbors and the rest of Canada.[52]

We suspect that a carbon tax to fund R&D would never have been enacted in British Columbia or Sweden and that a similar dynamic is at work in the U.S. Congress where many House Republicans have signed pledges not to increase tax burdens.[53] Tax shifting offers the potential to sidestep this ideological landmine by assuring voters that a carbon tax will not add revenue but will instead replace other taxes.[54]

VII. BTI asserts that carbon pricing is not technology-neutral — that it tends to favor low-cost but potentially unsustainable options that can't be scaled. We agree that small carbon taxes that do not transparently escalate briskly would create a risk of locking in low-carbon technology without sufficient investment in innovation and zero-carbon energy. Conversely, a carbon tax with a brisk price trajectory would announce that investment in low and zero-carbon energy can pay off.

BTI's concern that small ($20 - $30/T CO) taxes will tend to lock in investment in low-cost, transitional low-carbon technologies strikes us as well-founded. This is one of the reasons we recommend a brisk, predictable price trajectory, so that investment in more costly and speculative zero carbon technologies will be encouraged at the outset. While we agree that subsidies for basic research may be appropriate, we conclude that a carbon tax rising to roughly $100-$150/T CO2 within a decade, as does the tax proposed by Rep. Larson cited earlier, would provide ample incentives for deploying low- and zero-carbon energy sources as well as greatly improving the efficiency of energy use. We are concerned that the gas "bubble" arising from the fracking boom is undercutting investment in renewable energy,[55] and we would expect similar reaction to a small carbon tax that did not rise briskly.[56]

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[52] See "***British Columbia's Carbon Tax is Driving Down Emissions***," Vancouver Sun, 6/3/13, and ***"4 Key Reasons Why BC's Carbon Tax is Working,"*** Financial Post, 7/5/12. The Post story drew heavily on a report by Sustainable Prosperity, ***British Columbia's Carbon Tax Shift: The First Four Years***, June, 2012.

[53] Nevertheless, following a debate sponsored by the American Enterprise Institute in November 2011, I asked Grover Norquist to comment on a revenue-neutral carbon tax. He replied that a fully revenue-neutral carbon tax would not offend his "no new tax" pledge. (But he personally opposes it.) See also, "***Norquist: Carbon-Tax Swap for Income-Tax Cut Wouldn't Violate No-Tax-Hike Pledge,"*** National Journal, May 30, 2013.

[54] As noted above, we view the Larson carbon tax bill as the best model to date of good design; it dedicates a fixed stream amounting to 1/12 of the initial year's carbon tax revenue to clean energy R&D. We view that as a reasonable compromise, but would suggest that energy R&D needs separate and specific funding aside from the carbon tax, because of the need for transparent revenue return.

[55] Moverover, shale gas may not offer the expected climate benefits if fugitive methane and gas leak rates are not substantially reduced. See Robert W. Howarth, Renee Santoro, Anthony Ingraffea, "***Methane and the greenhouse-gas footprint of natural gas from shale formations,"*** March 2011. On the other hand, see ***"EPA methane report further complicates fracking debate"*** (Associated Press, 4/13/13), reporting that EPA reduced its estimate of methane leak rates from shale gas drilling.

[56] Unfortunately, small carbon taxes with small percentage increases with decade-or-longer doubling times have become more or less standard proposals. For example the "Sanders-Boxer" bill starts at $20/T CO2 and rise to just $33 within a decade. Similarly economists Warwick J. McKibbin, Adele Morris and Peter J. Wilcoxen suggest a tax of $15/per metric ton CO2, rising at 4% above inflation each year through 2050. See "***The Potential Role of a Carbon Tax in U.S. Fiscal Reform,"*** Brookings, 7/24/12. We view these as inadequate. Without much larger price increases we see little hope that broad economy-wide decarbonization will occur at scale. And we are forced to concede that if these proposals are considered the only viable carbon tax options, a range of complementary policies will be needed to drive down emissions, including potentially intrusive and draconian regulations in virtually every aspect of commerce.

VIII. BTI concludes that a modest carbon tax should be used to fund clean tech RD&D. We disagree not only because of the need to return carbon tax revenue, but also because markets guided by appropriate price signals are far more likely to select effective low-carbon technologies than Congress or even specialized government agencies.

We have agreed above with BTI that clean energy R&D is under-funded and that increased government funding of such research would be socially beneficial. Nevertheless, we have deep concerns about how those subsidies would be allocated and targeted. So-called "incumbent technologies" tend to garner the lion's share of subsidies, crowding out and marginalizing nascent ideas that haven't yet built a political constituency and lack funds to retain lobbyists. In short, ***Congress has no particular comparative advantage at choosing which technologies deserve research and development.*** Indeed, members tend to be strongly biased in favor of those that are already entrenched.

To be clear, we don't dismiss the benefits of public funding for basic energy research. Yet we are uncomfortable with BTI's "targeted" approach to technology development.[57] The continued funding of efforts to develop "carbon capture and sequestration" strikes us as a particularly egregious and wasteful example of "targeted" RD&D spending.[58] Similarly, for decades we have been witnesses to (and taxpayer losers on account of) colossal waste and market distortions of subsidies for ethanol and nuclear power, and, more recently, to misallocation of resources to government-selected contracts to Solyndra. We are also critical of the production tax credit for "renewable" energy which perversely includes some very carbon-intensive energy sources including biofuels that should be taxed on their carbon content rather than subsidized. Dependence on the production tax credit also seems to be perversely creating a costly "stop and go" cycle for construction of wind generation capacity.[59]

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[57] ***Federal Financial Support for Fuels and Energy Technologies***, Terry M. Dinan, Senior Advisor, Congressional Budget Office, Testimony Before the House Subcommittee on Energy Committee on Science, Space, and Technology, 3/13/13:

> "The most cost-effective way to reduce the external costs associated with energy would be to enact policies, such as taxes, that would increase the prices of various types of energy to reflect the external costs that their production and use entail. That approach would provide a financial incentive for businesses and households to consider those external costs when deciding on the types and amounts of energy to use … [T]he government could directly subsidize the investment in (or use of) technologies that lead to lower external costs… Subsidies, such as tax preferences or direct payments, are typically less cost-effective than incorporating external costs into energy prices [because] they typically support particular technologies, which may not be the least expensive method of reducing external costs..." (p. 11).

[58] Basic thermodynamic considerations raise grave doubts about the viability of carbon capture and sequestration. The theoretical minimum total energy required to capture and sequester carbon from coal-fired power plants approaches 40% of the net output of such power generation facilities. This physical fact, along with the lack of private sector investment in CCS technology, suggests that CCS RD&D may be more of a Trojan horse to support the myth of "clean coal" than a potentially viable technology. See ***The energy penalty of post-combustion CO2 capture & storage and its implications for retrofitting the U.S. installed base***, Kurt Zenz House, Charles F. Harvey, Michael J. Aziz, and Daniel P. Schrag (Energy & Environmental Science, January 2009).

[59] See ***"Congress extends wind energy tax credits for projects that start in 2013"*** (American Wind Energy Association, 1/1/13):

> "America's wind energy workers have been living under threat of the PTC's expiration for over a year and layoffs had already begun, as companies idled factories because of a lack of orders for 2013. Uncertain federal policies have caused a 'boom-bust' cycle in U.S. wind energy development for over a decade. Half the American jobs in wind energy – 37,000 out of 75,000 – and hundreds of U.S. factories in the supply chain would have been at stake had the PTC been allowed to expire, according to a study by Navigant Consulting."

We are confident that a briskly- and predictably-rising carbon price would create the needed incentives for a broad range of innovation and development — and with the risk borne by private sector investors rather than the tax-paying public.[60] A briskly rising carbon tax would encourage investors willing to take some risk, knowing that a carbon price would assure them of a return on investment if they can succeed at providing energy at less than the taxed cost of fossil fuel energy.

Summary of Conclusions:

1) **We do not agree with BTI that to be effective, a carbon tax has to be fully "optimized" in terms of price, revenue return, and global participation by all nations.**

2) **We agree with BTI that low carbon taxes (in the range of $20–30/T CO2 rising only by small percentages) cannot be expected to reduce emissions enough to allow pre-emption of complementary regulatory, subsidy and research policies.**

3) **If forced to choose between the approach of starting with a small (and slowly rising) revenue-neutral carbon tax and a similarly small (and slowly rising) carbon tax to fund targeted RD&D, we would recommend the revenue return option for two reasons: First, we believe the evidence suggests that broad, predictable price signals are far more likely than Congress to elicit development at scale of promising technologies. Second, the experience in British Columbia and Sweden shows that revenue return can help build the political support for briskly raising the carbon tax — which in our view remains the only policy offering the broad potential to decarbonize our economy in the time and at the scale needed.**

[60] ***"Documents show politics infused Obama 'green' programs,"*** Washington Post, Dec. 25, 2011.