Chapter 25. Tax Carbon Dioxide Emissions

1. Profile

Pricing mechanisms can be an important element in any effort to reduce electric-sector greenhouse gas (GHG) emissions. Pricing will be most effective when combined with related policies to encourage the use of other, less carbon-intensive resources. Policies that provide a real or implicit price of carbon internalize the cost of carbon emissions and can make renewables or other low-carbon resources more cost-competitive with other energy sources. This in turn creates incentives for producers and consumers to invest in low GHG products, technologies, and processes. Policies that provide a carbon price can also serve as a source of revenue for funding low-carbon technologies and programs.[1]

In its Fourth Assessment Report, the Intergovernmental Panel on Climate Change suggests that carbon prices have mitigation potential in all sectors. Modeling studies show that global carbon prices rising to \$20 to \$80 per metric ton of carbon dioxide (CO_2)-equivalent (CO_2-e) by 2030 are consistent with stabilization at around 550 ppm CO_2-e in the atmosphere by 2100.[2] Although this range of prices would seem politically infeasible in the United States, it is not necessary or even prudent to rely on a pricing mechanism alone. A carbon pricing policy can be combined with complementary measures to significantly lower the cost of achieving a given level of carbon reduction. Pricing mechanisms can work well in the context of market-based approaches, for example, which are discussed in Chapter 24.

Taxes and emissions caps are the two primary policy tools for placing a price on carbon emissions, and they can be applied to a specific sector or economy-wide. A tax provides price certainty, although the resulting quantity of emissions reduced may vary. A cap, on the other hand, provides certainty on the quantity of emissions to be reduced, but prices (and costs to emitters and consumers) are difficult to predict. Another mechanism for introducing a price on carbon emissions in the power sector is the use of a carbon adder in evaluating supply resources. This mechanism could be used to alter the order in which power plants are dispatched (discussed in Chapter 21) or incorporated into integrated resource planning (discussed in Chapter 22).

Carbon taxes have existed internationally for several decades, and more recently have been considered and implemented in limited contexts in the United States.[3] Any governmental entity – local, state, or federal – may seek to reduce CO_2 emissions through the levy of a tax on that pollution.

Economists characterize this approach as a “Pigovian tax” – a tax designed to reduce negative externalities associated with an activity – in this case, the consequences of putting carbon in the atmosphere.[4] The degree to which a carbon tax could reduce CO_2 emissions is determined in large part by the relationship between the level of the carbon tax and the cost of reducing emissions. In theory, reductions costing less than the tax would be implemented by emitters. An economically efficient tax would be set to equal the marginal benefit of reducing emissions (i.e., the cost of the damage avoided). Determining that number is no small task, however. The marginal benefit of reducing carbon emissions – also known as the “social cost of carbon” – is discussed in Section 6.

1 See the discussion of cap-and-invest in Chapter 24.

2 For the same stabilization level, induced technological change may lower these price ranges to \$5 to \$65 per metric ton of CO_2-e equivalent in 2030. See: IPCC (2007) Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R. K. & Reisinger, A.(eds.)]. IPCC, Geneva, Switzerland.

3 See: Sumner, J., Bird, L., & Smith, H. (2009, December). *Carbon Taxes: A Review of Experience and Policy Design Considerations.* National Renewable Energy Laboratory. Technical Report NREL/TP-6A2-47312.

4 So named after British economist Arthur C. Pigou, who originated this concept in the early 1900s.

There are numerous advantages attributable to a carbon tax. In a 2008 survey of the literature, the Congressional Budget Office concluded that the "net benefits … of a tax could be roughly five times those of an inflexible cap."[5] Revenue generation is one key benefit because tax proceeds can be used to lessen the price of other goods or services, or returned to taxpayers who have the least ability to modify their behavior in the face of a carbon tax.[6] Price stability is another benefit. When compared with a cap-and-trade program whose prices can vary significantly, a carbon tax provides a relatively stable price upon which compliance entities can plan.[7]

As a policy mechanism, a carbon tax and its benefits and drawbacks are frequently discussed in comparison with cap-and-trade systems.[8] A key criticism of a carbon tax is that it cannot provide the same certainty with regard to the level of emissions reductions that will occur that a cap-and-trade program can provide. This puts a carbon tax at a distinct disadvantage compared to several other policy options that states might use for complying with federal regulations for CO_2 emissions from existing power plants. In addition, a carbon tax, like all taxes, is often viewed with skepticism politically.

2. Regulatory Backdrop

Point of regulation is one way of thinking about how a carbon tax might be applied. A carbon tax can be focused on upstream, midstream, or downstream entities relative to their positions in the supply chain of producing and consuming fossil fuels. An upstream tax might apply to coal mines, oil wells, and the like, whereas a midstream approach might be directed at fossil fuel-fired power plants and industrial facilities. A downstream tax would apply to the ultimate consumers of fossil fuels (e.g., electric and natural gas customers and vehicle drivers).

In general, the further downstream a tax is applied, the greater the number of covered sources there would be, and hence the more extensive the administrative requirements. For example, in 2009 there were only 150 petroleum refineries in the United States, but there were 211 million drivers.[9] This does not mean that carbon pricing proposals always address upstream operators, however. There may be good reasons to choose a point of regulation further downstream, including the presence of existing infrastructure to facilitate administration or the desire to focus on or exclude certain sectors of the economy.

At whichever level a carbon tax may be enacted, mandatory reporting by covered sources is essential to the success of the tax. If, for example, the tax applies to sales of coal or gasoline, there must be some reporting of how many tons of coal or gallons of gasoline are sold. Additional questions might include how often covered sources need to report, to whom they report, and how that information would be shared with the tax administrator. Other important questions include whether there should be verification of reporting and a penalty for noncompliance, and whether the public should have access to these data. Depending on the point of regulation, existing reporting and taxation infrastructure may already be sufficient. For example, fossil electricity generators currently report their CO_2 emissions to the Environmental Protection Agency (EPA), thereby providing a sound basis on which to impose a carbon-related tax.[10]

Based on the EPA's proposed rule from June 2014, carbon taxes are one mechanism that could be available

5 In other words, a cap-and-trade program without, for example, banking or other cost containment mechanisms typically found in those programs. Congressional Budget Office. (2008, February). *Policy Options for Reducing CO_2 Emissions.*

6 The Congressional Budget Office assumes that revenue generation is not necessarily a part of a cap-and-trade program.

7 For example, over the period of 2006 to 2013, Acid Rain Program sulfur dioxide (SO_2) allowances have traded on the spot market at prices between $860.00 and $0.17. Although these changes are not necessarily examples of price volatility or even price instability, they still do constitute significant variations. EPA. (2014). *Acid Rain Program Allowance Auctions.* Available at: http://www.epa.gov/airmarkets/trading/auction.html

8 Nordhaus, W. D. (2007). *To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming.* Review of Environmental Economics and Policy. 1(1), pp. 26–44. See also: Morris, A., & Mathur, A. (2014, May). *A Carbon Tax in Broader US Fiscal Reform: Design and Distributional Issues.* Available at: http://www.c2es.org/publications/carbon-tax-broader-us-fiscal-reform-design-distributional-issues#endnote43.

9 See: https://www.census.gov/compendia/statab/2012/tables/12s1114.pdf; http://www.eia.gov/dnav/pet/pet_pnp_cap1_dcu_nus_a.htm.

10 See: http://www.house.leg.state.mn.us/hrd/pubs/ss/ssgastax.pdf

to states for complying with emissions guidelines for CO_2 emissions from existing power plants. (This proposal is often referred to as the proposed "111(d) rule," because the EPA is citing its authority under section 111(d) of the Clean Air Act; it is also referred to as the EPA's "Clean Power Plan.") However, under the EPA's proposal, states would be required to demonstrate how their compliance plans are expected to achieve specified emissions rates for affected sources. As noted in Section 1, the difficulty in using a carbon tax for this purpose is that the emissions reductions that will occur as a result of any specific level of taxation are difficult to predict. It would thus be challenging for states to demonstrate that a carbon tax will result in compliance with the specified emissions rates.

3. State and Local Implementation Experiences

The most comprehensive carbon tax in North America is at the provincial level in British Columbia (BC). This tax was enacted in 2008 and is based on the following principles:[11]

- All carbon tax revenue will be "recycled" by dedicating it to reductions in other taxes;
- 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; and
- The tax will be integrated with other measures.

Every three years, BC's Minister of Finance is required to prepare a plan showing how the revenues from the tax will be recycled back to taxpayers through reductions in other taxes. In the current plan, the revenue is returned through a combination of measures, including corporate and personal income tax reductions and tax credits to low-income residents and homeowners in northern and rural BC.[12]

The level of BC's carbon tax was established as follows:

Table 25-1

British Columbia's Carbon Tax[13]

Effective Date	Dollars per Metric Ton CO_2-e*
July 1, 2008	$10
July 1, 2009	$15
July 1, 2010	$20
July 1, 2011	$25
July 1, 2012	$30

In Canadian dollars.

The tax is applied on the consumption of fossil fuels, however, so it is necessary to translate it into the amount per unit of fuel. This translation is shown in Table 25-2.

Table 25-2

British Columbia's Carbon Tax by Fuel Type

Fuel Type	Unit for Tax Rate*	Tax Rate as of July 1, 2008[14]	Tax Rate as of July 1, 2012[15]
Gasoline	¢/liter	2.41	6.67
Diesel	¢/liter	2.76	7.67
Jet Fuel	¢/liter	2.62	7.83
Natural Gas	¢/gigajoule	49.88	148.98
Propane	¢/liter	1.53	4.62
Coal, Canadian Bituminous	$/ton	20.79	62.31
Coal, Sub-bituminous	$/ton	17.72	53.31

In Canadian dollars.

BC's carbon tax has been in place for six years and all available evidence indicates it has been successful.[16] It received a 64-percent approval rating in a 2012 poll,[17] and is credited for effectively reducing provincial gasoline consumption.[18] It covers approximately 70 percent of the province's GHG emissions, exempting carbon emissions from biofuels, landfills, air and marine travel outside the province, and certain industrial facilities.[19] Per capita fossil fuel combustion is down and the economy has performed

11 BC Budget and Fiscal Plan: http://www.bcbudget.gov.bc.ca/2008/bfp/2008_Budget_Fiscal_Plan.pdf

12 See: http://bcbudget.gov.bc.ca/2014/bfp/2014_budget_and_fiscal_plan.pdf#page=74

13 Supra footnote 11.

14 Ibid.

15 See: http://www.fin.gov.bc.ca/tbs/tp/climate/A4.htm

16 Horne, M., & Sauve, K. (2014, November 5). *The BC Carbon Tax Backgrounder.* Available at: http://www.pembina.org/pub/the-bc-carbon-tax

17 See: http://www.theguardian.com/sustainable-business/2014/jul/28/carbon-tax-australia-british-columbia-business-revenue-neutral

18 Rivers, N., & Schaufele, B. (2013, June 10). *Salience of Carbon Taxes in the Gasoline Market.* Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2131468

19 Supra footnote 11.

well relative to the rest of Canada. The policy has survived two provincial elections and a change in Premier. No studies have identified significant negative impacts.[20]

Finland, Netherlands, Norway, Sweden, Denmark, the United Kingdom, and Quebec are among the provinces and nations that also have or have had carbon taxes. Reports produced by the National Renewable Energy Laboratory (NREL) and Resources for the Future provide further details on these programs and are listed in Section 8.

In the United States, the city of Boulder, CO was the first municipality to tax CO_2. In 2006, voters approved a measure to levy a carbon charge on electricity use, and then renewed the tax at increased rates in 2012.[21] Although it is ostensibly a tax on carbon, Boulder's tax is, in fact, applied to electricity consumption. The ordinance, however, exempts the amount of wind-powered electricity that Boulder residents purchase from their power company, focusing instead on more carbon-intensive sources of electricity.

The current rate is \$0.0049 per kilowatt-hour (kWh) for residential customers, \$0.0009 per kWh for commercial customers, and \$.0003 per kWh for industrials.[22] Boulder directs these revenues to fund its Climate Action Plan, which includes, among other things, programs to promote energy efficiency and renewable energy.[23]

There continues to be interest in implementing carbon taxes in the United States. Oregon, for example, is investigating a carbon tax similar to BC's.[24] The legislature commissioned a state carbon tax study that is due in late 2014 and may result in proposed legislation in the 2015 session.[25] The tax level to be analyzed in the report starts at \$10 per ton of CO_2-e and escalates by \$10 per year until it reaches \$60 per ton. A citizens' initiative has also been active in Washington State under the name of Carbon Washington (www.carbonwa.org), developing state legislation that it hopes to introduce in an upcoming legislative session, perhaps as early as 2015.

Prominent economists, both Republican and Democratic, have endorsed the idea of a carbon tax as an effective way to address climate change, and several carbon tax proposals have been made in Congress. In 2013, US Senators Sanders and Boxer introduced the Climate Protection Act of 2013. The Act would have taxed fossil fuels based on their carbon content at the rate of \$20 per metric ton of CO_2 starting in 2014 and increasing 5.6 percent per year through 2023.[26] Two discussion drafts of alternative carbon taxes have also been released; one in 2013 by US Representative Waxman and US Senator Whitehouse, and another in 2014 by US Representative Delaney.[27] None of these proposals have yet been enacted.

4. GHG Emissions Reductions

The NREL, in reviewing nine carbon tax programs in 2009, observed that, "while the primary purpose of carbon taxes is to reduce GHG emissions, most existing carbon policies introduce no processes or specific requirements to evaluate policy effectiveness in reducing emissions...."[28] The NREL study concluded that making a determination as to overall carbon reductions attributable to a tax is especially difficult because numerous factors other than the

20 Supra footnote 16.

21 Meltzer, E. (2012, November 6). Boulder Issue 2A: Votes approve carbon tax extension by wide margin. *Boulder Daily Camera.* Available at: http://www.dailycamera.com/ci_21941854/boulder-issue-2a-carbon-tax-appears-likely-be

22 Boulder City Code: http://www.colocode.com/boulder2/chapter3-12.htm

23 Community Guide to Boulder's Climate Action Plan: https://www-static.bouldercolorado.gov/docs/community-guide-to-boulders-climate-action-plan-1-201305081129.pdf

24 Oregon lawmakers call for carbon tax study. (2013, December 6). *The Register-Guard.* Available at: http://registerguard.com/rg/news/30881173-76/story.csp

25 Liu, J. H. and Renfro, J. (2013) *Carbon Tax and Shift: How to make it work for Oregon's Economy.* Northwest Economic Research Center Report. http://www.pdx.edu/nerc/carbontax2013.pdf. See also http://gov.oregonlive.com/bill/2013/SB306/

26 Wara, M. W., Cullenward, D., Wilkerson, J. T., & Weyant, J. (2013, June 18). *Analysis of the Climate Protection Act of 2013.* Stanford Law and Economics Olin Working Paper No. 459. Available at SSRN: http://ssrn.com/abstract=2392656 or http://dx.doi.org/10.2139/ssrn.2392656. An analysis of the bill estimates that it would reduce CO_2 emissions from energy consumption by 16.8 percent below 2005 levels in 2020, return \$744 billion in rebates to households over ten years, and result in impacts to GDP of less than one half of one percent in 2020.

27 For a comparison of all three draft bills, see: http://www.c2es.org/publications/carbon-pricing-proposals-113th-congress

28 Supra footnote 3. NREL examines carbon taxes in Finland, Netherlands, Norway, Sweden, Denmark, United Kingdom, Quebec, British Columbia, and Boulder, CO. See id. at Table 6.

tax itself can affect emissions. Economic changes and other programs directed at carbon reduction or clean energy promotion are examples of such factors.[29]

Despite this difficulty, jurisdictions use various metrics to characterize emissions reductions from carbon taxes. A common approach relies on the use of emissions inventories, although as noted earlier, this approach captures not only emissions reductions attributable to a tax, but also those that may have resulted from other reasons, including other carbon policies or unrelated macroeconomic factors. Modeling can also be used to characterize the effectiveness of a tax at reducing emissions. Taking this approach, a 2013 Resources for the Future study found that a tax of $20 per ton at the federal level could reduce emissions 12 to 13 percent from business as usual and a tax of $50 per ton could reduce emissions 22 to 24 percent.[30]

5. Co-Benefits

The scope of a carbon tax's co-benefits will depend on the details of the tax. For instance, if the tax were sufficient to promote fuel switching from coal to natural gas, then air quality-related co-benefits would likely materialize. In a 2001 study, Resources for the Future found that a tax of $25 per ton would result in likely ancillary benefits of $13 to $14 per ton of carbon.[31] These benefits arose from avoided abatement costs for sulfur dioxide (SO_2) and nitrogen oxide (NO_X), as well as health-related impacts.

Other types of co-benefits also hinge on the nature of the policy implemented. A 2012 study by the Brookings Institution found that when revenues from a $15 per ton carbon tax are directed toward deficit reduction, lump-sum rebates to households, or payroll tax reduction, gross domestic product (GDP) and employment would shrink slightly on net.[32] When directed toward reducing corporate taxes, however, GDP and employment would increase for several

Table 25-3

Types of Co-Benefits Potentially Associated With Carbon Taxes

Type of Co-Benefit	Provided by This Policy or Technology?
Benefits to Society	
Non-GHG Air Quality Impacts	Yes
NO_X	Yes
SO_2	Yes
Particulate Matter	Yes
Mercury	Yes
Other	Yes
Water Quantity and Quality Impacts	Maybe
Coal Ash Ponds and Coal Combustion Residuals	Maybe
Employment Impacts	Possible disbenefit
Economic Development	Maybe
Other Economic Considerations	No
Societal Risk and Energy Security	Maybe
Reduction of Effects of Termination of Service	No
Avoidance of Uncollectible Bills for Utilities	No
Benefits to the Utility System	
Avoided Production Capacity Costs	No
Avoided Production Energy Costs	No
Avoided Costs of Existing Environmental Regulations	Maybe
Avoided Costs of Future Environmental Regulations	Yes
Avoided Transmission Capacity Costs	No
Avoided Distribution Capacity Costs	No
Avoided Line Losses	No
Avoided Reserves	No
Avoided Risk	Maybe
Increased Reliability	No
Displacement of Renewable Resource Obligation	No
Reduced Credit and Collection Costs	No
Demand-Response-Induced Price Effect	No
Other	

29 The observation about the difficulty of attributing emissions reductions to the tax is broadly true for any type of mass-based emissions reduction policy. For example, as noted in Chapter 24, the costs and emissions reductions attributable to a cap-and-trade program can also be significantly affected by various external forces.

30 Carbone, J. C., Morgenstern, R. D., Williams, R. C., III, and Burtraw, D. (2013, August). *Deficit Reduction and Carbon Taxes: Budgetary, Economic, and Distributional Impacts.* An RFF Report. Available at: http://www.rff.org/RFF/Documents/RFF-Rpt-Carbone.etal.CarbonTaxes.pdf

31 Dallas, B., Krupnick, A., Palmer, K., Paul, A., Toman, M., & Bloyd, C. (2001, December). *Ancillary Benefits of Reduced Air Pollution in the United States from Moderate Greenhouse Gas Mitigation Policies in the Electricity Sector.* RFF Discussion Paper. Available at: http://www.rff.org/Documents/RFF-DP-01-61.pdf

32 McKibbin, W., Morris, A., Wilcoxen, P., & Cai, Y. (2012, July 24).*The Potential Role of a Carbon Tax in US Fiscal Reform.* Climate and Energy Economics Discussion Paper. Available at: http://www.brookings.edu/~/media/Research/Files/Papers/2012/7/carbon%20tax%20mckibbin%20morris%20wilcoxen/carbon%20tax%20mckibbin%20morris%20wilcoxen.pdf

decades relative to projected baseline performance.

The full range of co-benefits that might be realized through carbon taxes are summarized in Table 25-3.

6. Costs and Cost-Effectiveness

As mentioned in Section 1, the most efficient carbon tax would be set at a price reflecting the marginal benefit of reducing CO_2 emissions. Put differently, an environmental policy is considered economically efficient when the cost of reducing one more unit of pollution is equal to the benefit of doing so. This marginal benefit is also called the "social cost of carbon" (SCC).

Although reasonably straightforward from a theoretical perspective, calculating the SCC is enormously difficult in practice. It requires an analyst to make assumptions about the stock of CO_2 in the atmosphere over many years, the nature of climate change's impacts to the environment and economy and, because this occurs over a long period of time, a discount rate.[33] As a result, there are a wide range of SCC estimates.

In the United States, the use of an SCC number is not just an academic exercise; it is used in cost-benefit analyses for a wide variety of federal initiatives from appliance standards to vehicle fuel economy standards. The federal government determines its own SCC, and in 2013 it updated its estimates to $46 per ton of CO_2 in 2020, assuming a three-percent discount rate (in 2011 dollars).[34]

7. Other Considerations

There are a number of implementation-related considerations that raise questions about the suitability of a carbon tax for the electric sector. For example, a carbon tax may be designed to apply to a broad economic base or just a single industry. Research on this topic tends to conclude that covering multiple sectors would reduce costs, but this could raise the possibility of "leakage" (i.e., emissions increases in non-covered sectors as a result of economic activity shifting to avoid sectors subject to the tax).[35] For instance, if electric heating is taxed but natural gas heating is not, consumers may shift toward natural gas heating, increasing emissions from that sector. Leakage can occur geographically across borders as well. If one state taxes gasoline but a neighboring state doesn't, increased purchases of gasoline – and associated emissions – can be expected in the latter state.

The inability to cover all sources is one of the reasons that pricing CO_2 emissions, regardless of the mechanism used, may not in and of itself be sufficient to address climate change. Market failures also suggest the need for "complementary policies."[36] Complementary policies like end-use energy efficiency programs help address barriers that a carbon tax cannot. Examples of these barriers include split incentives, such as when the builder of a new home is not the owner and therefore has no incentive to spend more on energy-efficient design, or tenant-landlord issues in which tenants are reluctant to invest in property they don't own, and landlords are little concerned because they don't pay the energy bill for the property. Lack of basic information can also be a barrier when, for example, homeowners do not recognize that the purchase of a more efficient refrigerator would lower their electric bills.[37]

Broadly applied, a carbon tax could also be "regressive," with disproportionate effects on lower-income segments of the affected population. By returning the revenue collected to taxpayers in the form of tax credits or other support, however, regressive impacts can be mitigated or even reversed.[38]

33 The discount rate assumes that we value a dollar in the future less than a dollar today. By the same token, damage from climate change would be more costly today than the same damage would be in the future.

34 See: http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf, and http://www.epa.gov/climatechange/Downloads/EPAactivities/scc-fact-sheet.pdf

35 Pizer, W. *Scope and Point of Regulation for Pricing Policies to Reduce Fossil-Fuel CO_2 Emissions: Issue Brief 4.* Available at: http://www.rff.org/RFF/Documents/CPF_6_IssueBrief_4.pdf

36 Because of the focus here on a carbon tax policy, the term "complementary policy" implies policies of secondary value. This, however, would be a mistaken interpretation. Complementary policies have the potential to be lower cost and more effective. See the discussion of market-based approaches in Chapter 24.

37 Western Climate Initiative, see: http://www.westernclimateinitiative.org/document-archives/Complementary-Policies-Committee-Documents/Final-Complementary-Policies-Whte-Paper/ Market failures are not limited to electricity production; complementary policies can also include such sectors as transportation, agriculture, and industry.

38 Williams, R. C., III, Gordon, H., Burtraw, D., Carbone, J. C., & Morgenstern, R. D. (2014, August). *The Initial Incidence of a Carbon Tax Across Income Groups.* RFF. Available at: http://www.rff.org/RFF/Documents/RFF-DP-14-24.pdf

Addressing this inequality could help to create a broad base of support for a tax.[39,40] However, there are good reasons to also devote revenue to carbon reduction measures such as research in and development of clean technologies and implementation of complementary energy efficiency programs. Doing so can also reduce the cost of the policy, making a carbon tax more politically palatable.[41]

There are also a number of implementation-related considerations that are specific to electricity markets in the United States and the manner in which electricity is sold. In 2008 and 2009, when Congress started considering developing a nationwide carbon policy, a number of critiques of carbon pricing in organized wholesale markets emerged identifying reasons a carbon tax might be a less than optimal carbon policy to apply in parts of the country.[42] This is partly attributable to the manner in which electricity is sold in the United States, and the disproportionately high cost that a carbon tax could impose on some ratepayers.

Only part of the electric power produced in the United States comes from traditionally regulated electricity markets. In these vertically integrated utility service areas, fossil generators subject to a tax would be able to pass through their direct costs via rate cases under traditional cost-of-service regulation. These utilities could charge consumers only their direct compliance costs.

In "restructured" or "organized" markets, however, a large amount of the power generated is provided by merchant generators not subject to rate regulation. In these markets, the effect of a carbon tax would be to raise the clearing price of all power sold in the market, including power from plants that have no carbon costs (e.g., nuclear, wind). As a result, a carbon tax that might be reasonably applied in the portion of the nation with traditionally regulated markets could confer windfall gains on generators and inequitable results for consumers in restructured areas of the country. In short, "whether firms can pass through the entire cost of the tax and emissions abatement to their customers depends on how prices are determined in their market."[43]

A second cause for concern about the suitability of a carbon tax for the electricity sector has to do with the actual manner in which carbon reductions in the electric sector could occur. Compliance controls for conventional pollutants like SO_2 and NO_X are different from those available for carbon reduction. With conventional pollutants, reductions can usually be achieved by generators at power stations through changes in fuel inputs — switching to low-sulfur coal, for example — or "end-of-pipe" plant modifications, such as scrubbers or selective catalytic reduction. In contrast, there may currently be limited economic practicality in adding a carbon scrubber to a conventional power plant.[44] As explained in Chapters 1 and 9, limited operational efficiencies at fossil plants and

39 Supra footnote 38.

40 Harrison, K. (2012). *A Tale of Two Taxes: The Fate of Environmental Tax Reform in Canada.* Review of Policy Research. 29(3). Available at: http://www.standupeconomist.com/pdf/carbon/2012.Harrison.TaleofTwoTaxes.pdf

41 Burtraw, D., & Setraw, S. (2013, October). *Two World Views on Carbon Revenues.* RFF Discussion Paper. Available at: http://www.rff.org/rff/Documents/RFF-DP-13-32.pdf

42 For a more extensive critique of carbon pricing effects in organized wholesale markets, see Testimony of Sonny Popowski, Consumer Advocate of Pennsylvania, Subcommittee on Energy and Environment, US House Energy and Commerce Committee, March 12, 2009; see also: Cowart, R. (2008). *Carbon Caps and Efficiency Resources.* 33 Vermont Law Review 201–223.

43 Morris, A., & Mathur, A. (2014, May). *A Carbon Tax in Broader US Fiscal Reform: Design and Distributional Issues.* Available at: http://www.c2es.org/publications/carbon-tax-broader-us-fiscal-reform-design-distributional-issues#endnote43

44 Scrubbing emissions of conventional pollutants may not materially alter the carbon content of the emission stream. As discussed further in Chapter 7, carbon capture and storage (CCS) has the potential to be a long-term carbon management solution in the electric sector. For example, on September 3, 2014, Power Engineering reported that the EPA has approved permits allowing FutureGen Industrial Alliance Inc. to inject CO_2 underground in Illinois. See: "FutureGen project approved to sequester carbon underground." Available at: http://www.power eng.com/articles/2014/09/futuregen-project-approved-to-sequester-carbon-underground.html?cmpid=enlpoe-weekly-september-04-2014. While, at present, CCS appears too costly to be considered a readily available and economic add-on option for existing power plants, CCS linked with enhanced oil recovery opportunities, despite uncertain net carbon benefits, is more likely to be economical. "CO_2-Enhanced Oil Recovery (EOR) storage has a 'negative cost' because of the value of the additional crude oil produced." Current State and Future Direction of Coal-fired Power in the Eastern Interconnection, Final Study Report. (2013, June). ICF Incorporated For EISPC and NARUC, Funded by the US Department of Energy. Page 35. Available at: http://naruc.org/Grants/Documents/Final-ICF-Project-Report071213.pdf

fuel switching and co-firing are available alternatives, but they also come with challenges.

As the EPA outlined in the broad definition of "best system of emission reduction" embodied in its proposed Clean Power Plan, reductions in carbon intensity will come not only from generation sources, but also from actions taken by power buyers. These actions include substituting gas or renewables in the resource mix of a load-serving entity or adding more efficiency and reducing consumption generally. For these reasons, it is apparent that a carbon tax — owing to the manner in which electricity is sold in many parts of the country, and the limited ability of individual power plants to invest in and produce significant (and economic) emissions reductions — will need to be thoroughly vetted against other compliance options before being implemented.

8. For More Information

Interested readers may wish to consult the following reference documents for more information on carbon taxes:

- Aldy, J. E., & Stavins, R. N. (2011, October 27). *The Promise and Problems of Pricing Carbon: Theory and Experience.* The Journal of Environment and Development. Available at: http://www.rff.org/RFF/Documents/RFF-DP-11-46.pdf
- *Testimony of Sonny Popowski, Consumer Advocate of Pennsylvania.* Subcommittee on Energy and Environment, US House Energy and Commerce Committee. (2009, March 12).
- Ramseur, J. L., Leggett, J. A., & Sherlock, M. F. (2012, September 17). *Carbon Tax: Deficit Reduction and Other Considerations.* Congressional Research Service. Available at: http://fas.org/sgp/crs/misc/R42731.pdf
- Sumner, J., Bird, L., & Smith, H. (2009, December). *Carbon Taxes: A Review of Experience and Policy Design Considerations.* National Renewable Energy Laboratory. Technical Report NREL/TP-6A2-47312.
- Cowart, R. (2008). *Carbon Caps and Efficiency Resources.* 33 Vermont Law Review, 201–223.
- Greenspan Bell, R., & Callan, D. (2011, July). *More than Meets the Eye: The Social Cost of Carbon in US Climate Policy, in Plain English.* Policy Brief by the Environmental Law Institute and the World Resources Institute. Available at: http://www.wri.org/sites/default/files/pdf/more_than_meets_the_eye_social_cost_of_carbon.pdf
- The Carbon Tax Center. See: www.carbonrtax.org
- Moylan, A. (2013, October 2). *How to Tax Carbon.* The American Conservative. Available at www.theamericanconservative.com/articles/how-to-tax-carbon/

9. Summary

David Stockman, former Congressional Budget Office director under President Reagan, has said, "If you want less of something, tax it more." Conceptually, carbon taxes can help correct the negative externalities associated with climate change, but taxing emissions is likely to have some economic consequences. Recycling of tax revenues, however, can help ensure that the tax is equitable and effective. The choice of these will impact such important questions as whether the tax is politically palatable and whether it positively or negatively impacts the economy. Although, in certain contexts, the level of the tax and its coverage of sources is a strong predictor of its success in reducing emissions, complementary policies must be included if a government seeks to correct market failures that promote CO_2-emitting activities.[45] The special market and technological contexts in which a carbon tax would be imposed on electricity producers should also be thoroughly analyzed.

45 Carbon tax revenues could be used, for example, to fund weatherization, energy efficiency improvement projects, and the installation of zero-carbon emitting generation.