Stanford University • January 2014

SIEPR policy brief

Stanford Institute for Economic Policy Research

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Who Pays For Climate Regulation?

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This policy brief examines the question of who ultimately pays for U.S. greenhouse gas regulation to deal with climate change. When a regulation raises costs for a polluter, those costs are borne by owners, workers, and customers, to varying degrees. When the price of intermediate products change, then industries that buy those intermediate products may also pass costs along. Tracing the path of such price changes through the economy is necessary to determine who ultimately bears the costs of a regulation. Regional differences among final consumers appear modest, though labor in coal-intensive industries may suffer. Most industrial sectors are modestly impacted though a few, such as electric power, cement, and fertilizer, are hit hard by carbon regulations. In terms of consumers, carbon regulations do appear to be somewhat regressive, with households in the lowest 10 percent of the income distribution paying roughly three times what the richest 10 percent pays, in terms of cost as a percentage of income. These findings can help shape a fairer and more politically palatable path for regulating greenhouse gases in the United States, when and if the politics are right for such an action.

Doing something about climate change has been on the agenda in the United States for at least 20 years. The source of the climate change problem is emissions of carbon dioxide and other "greenhouse gases," primarily from the burning of fossil fuels. Although there is a lot of disagreement over what if anything should be done, certain conclusions are not in dispute, namely, combustion of fossil fuels leads to elevated levels of greenhouse gases in the atmosphere, which leads to

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a general warming of the earth. Global warming is problematic because it may lead to sea-level rise, local temperature and precipitation changes, and changed probabilities of extreme events, which affect everyone, though to differing degrees. Debatable issues, where the opinions of well-intentioned individuals may differ, include the magnitude of these effects, the significance of impacts of warming on humans, and the costs and effectiveness of actually doing something to slow change.

To summarize a very deep and nuanced debate, the issues are really twofold: (1) how much will it cost to cut back on greenhouse gas emissions and how does this translate into everyday standard of living terms and (2) if we don't cut back, what will be the consequences to our well-being from a changed climate. People have different opinions on these issues, in terms of the significance of these two dimensions of the problem and what to do to bring balance between cutting back emissions (acting) and the consequences of not cutting back emissions (not acting).

Drilling down into the cost of acting and the cost of not acting is the issue of who bears the costs and benefits. Few people care about the overall costs of acting or not acting; most people care about how they are affected personally. This is not so much selfishness as political reality—an individual's opinion and the politics of an issue depend, at least in part, on how that individual is impacted personally. Certainly for the politics of the issue, the aggregate costs and benefits are less important than who are the winners and who are the losers. To an economist, looking at economic activity that generates costs and benefits, the issue is the *incidence* of those costs and benefits—who ultimately pays or benefits and by how much?

A simple example is appropriate. We all know that a corporation is a paper entity with owners and workers. When a greenhouse gas regulation increases costs for a corporation, it is not the corporation that ultimately pays—the costs must ultimately be borne by a person, typically owners (shareholders), workers (labor), and customers. Assets may decline (or increase) in value, wages may also decline (or increase), and customers may see product prices change. Who bears the cost of the regulation among these three broad classes of individuals is critical to assessing the incidence of the cost of the regulation. In many cases, the customers for the firm are other firms, if intermediate goods are being produced. In this case, one must trace increased costs along from one firm to another, ultimately identifying the costs that are borne by capital owners, labor, and individual consumers. Equally important, though often neglected, is the question of who ultimately benefits from greenhouse gas regulation. After all, if a regulation is socially desirable, then presumably the aggregate benefits of the regulation will exceed the aggregate costs.

From a policy perspective, we are typically interested in various classes of individuals who are affected by an environmental policy—for instance, different income groups, different geographic regions, or different industries. The reason we are interested in the effects on these groups is primarily political, though not in a narrow vote-counting sense. However, votes are important for climate regulations to be enacted in law and survive over the long term. Many people are also interested in the fairness of governmental actions; regulations where the costs are disproportionately confined to low-income people or a few regions of the country can be viewed as less socially desirable.

The Incidence of a $15 Carbon Tax

Focusing just on the cost side of the equation and ignoring the benefits of avoiding climate change—all environmental regulations impose costs on polluters and yield reduced emissions or other environmental benefits. Rather than analyze the myriad of different types of regulations that could potentially apply to carbon emissions, we consider a generic regulation consisting of a price imposed on emissions (an emissions tax) of $15 per tonne of carbon.[1] The way such a tax works is that every entity (person or firm) that emits carbon into the atmosphere must submit an annual "tax return" showing total emissions (in tonnes) and tax due ($15 x total emissions). To a first approximation, the direct cost of the regulation to the polluter is the amount of the tax paid. In fact, this is probably an overstatement of the costs since polluters have an incentive to reduce carbon emissions to the extent that reductions are cheaper than paying a tax, thus reducing costs and the amount of the tax owed.

A. Impacts on Industry. Some industries are hit particularly hard by such a tax. The Input-Output tables of the U.S. economy can be used to trace how a tax on emissions would pass through the economy, assuming no

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1 $15 per metric ton (termed a tonne) of carbon dioxide emissions is a typical value for the marginal cost of greenhouse gas regulations in the United States. The cap and trade bill (Waxman-Markey), which passed the House in 2009 but failed in the Senate, was calculated by the U.S. Energy Information Administration as involving a marginal cost of pollution control of $21/ton of CO_2 (Burtraw et al 2009). The "social cost of carbon" was computed by the U.S. Government to be $21/ton of CO_2 (Greenstone et al 2013). The California Air Resources Board reports the price of permits in the November 2013 California auction (www.arb.ca.gov/cc/capandtrade/auction/november-2013/results.pdf) was $11-12/ton (depending on the vintage). Hassett et al (2009) assume $15/tonne. Others estimate prices a bit lower than this; others, a bit higher. $15/tonne is not the "right" number, just a typical number.

Table I:
Emissions per $ of sales; cost of $15/tonne CO_2 tax, as percentage of product value.

	Sector	Sector Description	Annual CO_2 Emissions (kg/$)	Cost Increase
1	327410	Lime manufacturing	9.8	14.8%
2	221100	Power generation and supply	7.5	11.2%
3	327310	Cement manufacturing	5.6	8.3%
4	325311	Nitrogenous fertilizer manufacturing	4.4	6.7%
5	325312	Phosphatic fertilizer manufacturing	3.7	5.5%
6	S00202	State & local govt. electric utilities	3.2	4.8%
7	324191	Petroleum lubricating oil & grease man.	2.8	4.1%
8	325120	Industrial gas manufacturing	2.7	4.0%
9	331312	Primary aluminum production	2.6	4.0%
10	325221	Cellulosic organic fiber manufacturing	2.5	3.7%
11	331311	Alumina refining	2.4	3.6%
12	331112	Ferroalloy and related product manuf.	2.4	3.4%
13	325130	Synthetic dye and pigment manuf.	2.2	3.2%
14	212210	Iron ore mining	2.1	3.1%
15	212390	Other nonmetallic mineral mining	1.9	2.9%
16	331111	Iron and steel mills	1.8	2.7%
17	311221	Wet corn milling	1.8	2.7%
18	486000	Pipeline transportation	1.6	2.3%
19	484000	Truck transportation	1.5	2.2%
20	325314	Fertilizer, mixing only, manufacturing	1.5	2.2%

Note: Emissions include direct and indirect emissions attributable to sales (2009$) from that sector, based on 1997 structure of U.S. economy, with no price effects on demand or supply. An emission rate of kg/$ is equivalent to metric tons per thousand $. The cost increase is computed assuming a $15 charge per tonne of CO_2 emissions. Adapted from Grainger and Kolstad (2010). Note: These sectors account for 3 percent of gross output in 2011, based on data from Bureau of Economic Analysis.

substitution or price effects. Table I shows the results of such a calculation in terms of the most impacted 20 narrowly defined industries in the United States and the cost they would incur based on the structure of the U.S. economy in 1997.[2] The top 5 industries in the table account for slightly more than 1 percent of total economic output in 2011 (based on value of gross output, as reported by the BEA); the 20 industries shown in the table accounted for 3 percent of gross output value in 2011.

Caution should be used in interpreting Table I, since there are no price or substitution effects incorporated into the analysis. Thus, an industry like coal mining does not show up, simply because direct emissions are modest and coal will suffer as a result of input substitution in fossil fuel use (and input substitution is suppressed in the analysis).

But what is clear from Table I is that some industries are hit hard by carbon taxes; although it is often the case that increased costs can be passed on to consumers. However, the implication of that would be that consumers of lime (agriculture in large part) would see significant price rises. So, simply being able to pass on costs does not necessarily neutralize the impact. A second thing that is clear from the table is that of all the many industries making up the U.S. economy, only a handful are significantly impacted by carbon regulations—cement manufacturing, electricity production, and fertilizer being the big ones (in excess of 5 percent of costs from a $15 levy). These are important sectors but in terms of gross output they made up only 1 percent of total gross output in the U.S. economy in 2011 (dominated by electricity production). This suggests that the adverse incidence of such a tax can be ameliorated through highly targeted financial assistance, without reducing the incentive benefits of a carbon tax.

B. Geographic Incidence. A second important lens through which to view incidence of carbon regulations is geography, that is, which regions bear the most or the least cost. This is a complicated question. For instance, Wyoming may have a very significant coal industry (EIA 2012 reports that 40 percent of U.S. production in 2011 came from Wyoming) but the coal companies operating in Wyoming may be owned by individuals living in New York or San Francisco. And consumers of Wyoming coal may live as far away as Florida. This makes it difficult to attribute geographically the carbon tax that may be paid by the Wyoming coal industry.

Burtraw et al (2009) and Hassett et al (2009) have calculated the regional incidence of a carbon tax based on different final consumption levels in different regions of the United States. Hassett et al (2009) conclude that the burden in terms of carbon tax payments as a percent of average income would range from 1.5 percent in New England to 1.9 percent in East South Central (Kentucky, Tennessee, Mississippi, and Alabama). The difference in burdens is almost entirely based on income differences in various regions.

Burtraw et al (2009) look at electricity prices, which can be highly sensitive to greenhouse gas regulations. The authors calculate that the carbon tax will increase electricity prices as much as 27 percent in the coal rich Ohio Valley of the Midwest but only 7 to 8 percent along the Pacific Coast (regions much less dependent on coal).

These results suggest that while the total out-of-pocket expenses from a carbon tax may be similar across the United States, visible indicators such as the price of electricity may vary considerably, depending on

2 Data on the detailed structure of the U.S. economy takes time to generate, particularly in conjunction with information on emissions. Data source on economic activity: Bureau of Economic Analysis (www.bea.gov).

Table II:
Estimated 2003 U.S. Household CO_2 Emissions by Income Quintile

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Household Income Range (after taxes)	$7,500-$14,761	$14,762-$28,594	$28,595-$47,801	$47,802-$77,670	> $77,671
Mean (After Tax) Income	$10,879	$19,982	$34,007	$54,546	$110,878
Mean Household Size	1.8	2.3	2.6	2.9	3.1
Mean Household Emissions (metric tons of CO_2 per household)					
Food & Alcohol	2.19	2.83	3.69	4.67	6.28
Shelter	1.87	3.68	6.04	7.32	14.74
Natural Gas	1.99	1.97	2.35	3.13	4.34
Electricity	7.26	8.91	10.68	12.08	15.30
Fuel Oil & Other Fuel	0.68	0.81	1.05	0.96	1.71
Telephone Services	0.06	0.07	0.09	0.11	0.15
Water & Other Public Services	0.17	0.21	0.28	0.34	0.47
Household Operations, Supplies, Furnishings, Equipment & Apparel	0.61	0.90	1.31	1.87	3.40
Transportation & Vehicle Expense	0.44	0.96	1.58	2.53	3.39
Gasoline & Motor Oil	4.99	8.15	11.59	14.92	18.38
Healthcare	0.29	0.33	0.42	0.42	0.62
Other Expenditures	1.16	1.66	2.38	3.65	7.21
Total Emissions	21.70	30.49	41.45	51.98	75.99

Source: Grainger and Kolstad (2010)

the extent to which electricity generation is dependent on greenhouse gas rich coal.

C. Incidence by Income. Perhaps the most important type of incidence is by income group: How much will the poor be affected by carbon regulation relative to the rich? Is a carbon tax highly regressive? What makes this question difficult is that different income groups consume different baskets of goods. For instance, the poorest households in society spend a higher percentage of their income on fuels, primarily for heating and transportation. Higher income individuals spend a proportionally greater amount on services, which typically have lower than average carbon emissions per unit of output.

The Consumer Expenditure Survey collects data on how people spend their income, by income group. Table II shows broad consumption categories for different income quintiles and the estimated greenhouse gas emissions associated with these categories.

As can be seen from the table, emissions increase as income increases. However, emissions increase more slowly than income increases. Thus, one would expect some regressivity in a carbon tax. To calculate how regressive a carbon tax would be, we couple these data with data on how a carbon tax will be transmitted through the economy from one sector to

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another (discussed above). This allows us to calculate the extent to which households at different income levels will pay for a carbon tax. Figure 1 shows the impact for a tax of $15/tonne.

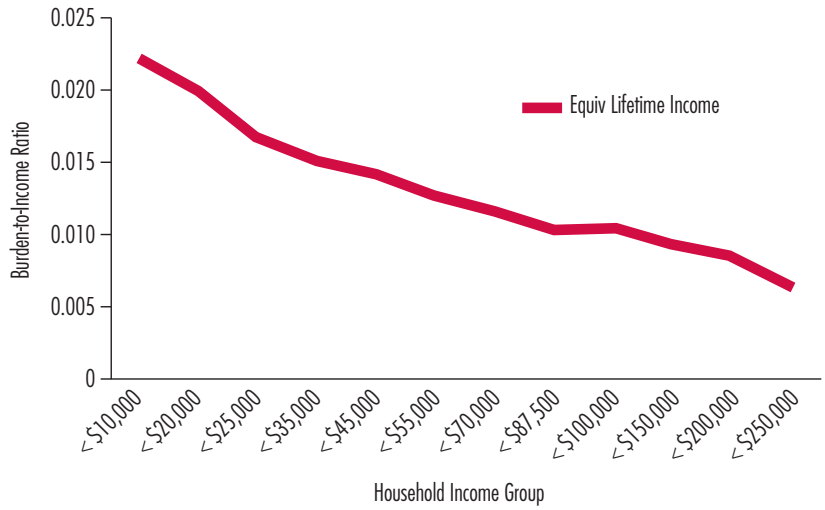
Note in Figure 1 that a carbon tax is regressive, though even for the poorest decile payments amount to only slightly more than 2 percent of income. This small impact suggests that it should be relatively easy to address this regressivity (should that be desired) with supplemental transfer programs, for example, reducing other regressive taxes such as the payroll tax (particularly if the greenhouse gas regulation enacted generates revenue). It should be mentioned that because there are no price effects embodied in this calculation, it is likely that the regressivity is overstated, though by how much is not known. One would expect that the most impacted segments of society would respond to increased prices by changing behavior (reducing demand). This would have the effect of flattening the curve in Figure 1, though by how much is unclear.

Policy Implications

The impact of greenhouse gas regulation, when broadly applied, does not only affect a narrow segment of our economy but in fact is broadly spread over the entire economy. A few industries are significantly impacted. These include electric power, fertilizer, and cement, as well as coal-related activities (mining and transportation). The extent to which these industries are ultimately disadvantaged depends on the extent to which they are able to pass costs on to customers. It is important to add the caveat that price and substitution effects are largely omitted. These can be significant.

Ultimately, it is people who bear the costs of regulation, not corporations. Focusing on consumers of products where greenhouse gases are emitted in production, the results reported here suggest that there is some regressivity in regulating greenhouse gases. Households in the lowest income group pay, as a percent of income, more than twice what households in the highest 10 percent of the income distribution pay. Taking price and substitution effects into account may dampen this regressivity somewhat. However, this regressivity can be addressed through transfer payments, if and when the United States decides to regulate greenhouse gas emissions leading to climate change.

Figure 1.
Tax burden from $15 per tonne tax on carbon dioxide relative to annualized equivalent lifetime income, which adjusts for economies of scale in family size (Cutler and Katz 1992), based on 2003 consumption patterns.



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SIEPR *policy brief*

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A publication of the
Stanford Institute for
Economic Policy Research

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