

Thank you for the opportunity to provide a contribution to this important process. What follows are brief overviews of two topics: (1) why the carbon prices needed to achieve emissions targets may be lower than models predict; and (2) how a carbon price affects individuals across the income spectrum. In both cases, text is drawn from peer-reviewed issue briefs published with colleagues at the World Resources Institute.

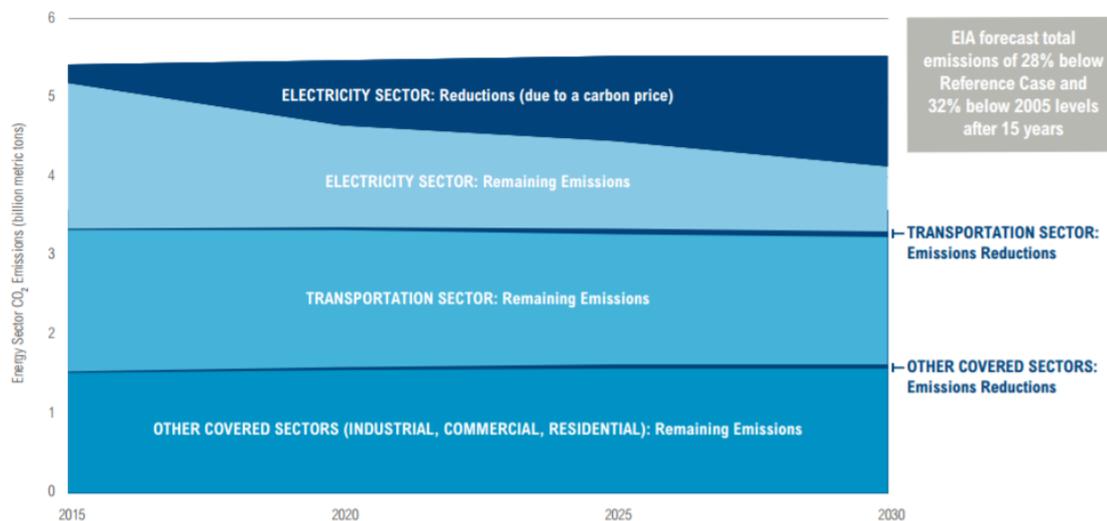
**1. Why carbon prices may be lower than models predict (for more, including references, see: <http://www.wri.org/publication/putting-price-carbon-reducing-emissions>)**

A carbon price reduces emissions by increasing the price of a carbon intensive product, which encourages consumers to purchase less of that product or a different product altogether, and it encourages producers to develop less carbon-intensive products. Economy-wide (or energy system-wide) models are often used to determine what carbon prices are needed—in other words, by how much must we raise the prices of carbon-intensive goods to incentivize a given level of emissions reductions?

Models are highly useful in highlighting areas of the energy system in which cost-effective alternatives to carbon-intensive already exist. For example, in the United States, the electricity sector offers the greatest potential for major, and immediate, emissions reductions. A strong carbon price will make many coal-fired power plants more expensive than their competition, and systems are in place to ensure that lower-carbon generation alternatives are dispatched and built.

In the most recent “carbon price case” of the U.S. Energy Information Administration’s (EIA) highly influential Annual Energy Outlook (AEO), EIA projects that a \$25 per metric ton carbon price, increasing by 5% per year, would reduce emissions to 27% below 2005 levels by 2025. However, nearly all reductions are projected to take place in the electricity sector, as displayed in the figure below.

### EIA'S PESSIMISTIC FORECAST OF CO<sub>2</sub> EMISSIONS REDUCTIONS FROM A CARBON PRICE



Notes: Data from EIA's Annual Energy Outlook 2014. EIA Reference Case (dark + light blue) scenario is a forecast of the U.S. energy system assuming only "on the books" policies as of late 2013, and its carbon pricing scenario (light blue area only) scenario reflects a \$25 per metric ton carbon price implemented in 2015 and increasing 5% per year thereafter.

Emissions from the transportation, industrial, commercial, and residential sectors exclude emissions from electricity generation.

EIA's forecasts are conservative—they portray emissions reductions that are virtually certain to take place under a carbon price, while accounting for few emissions reductions that are encouraged but less predictable. The response to a carbon price outside of the electricity sector is almost trivially small, despite the financial incentives for individuals and businesses to change their behavior in all energy-intensive sectors. In other words, with minor exceptions, EIA assumes that households and businesses will not respond to increasing heating bills, manufacturers will not adjust to rising input costs, and neither producers nor consumers will adjust to the increased costs of transportation fuels.

In addition, EIA assumes very little technological progress—for example, solar energy does not become significantly less expensive, advanced “smart grids” do not enable consumers to respond more rapidly to price signals, and alternative-fuel vehicles remain uncompetitive with gasoline powered vehicles. If, instead, producers and consumers across the economy respond to incentives, and if recent progress in clean energy technologies continues, the EIA's forecast greatly underestimates the effectiveness of a carbon price at reducing emissions.

The EIA model is not an aberration—comparable estimates using different energy/economic models make similar assumptions and display similar results. One notable exception is a recent analysis by the Department of Energy displayed in the United States Mid-Century Strategy for Deep Decarbonization.<sup>1</sup> Using the same model as the EIA AEO 2014 analysis (NEMS) but assuming far more ambitious reductions in clean energy technology costs, the DOE analysis shows that a carbon price starting at \$20 per ton in 2017 would lead to emissions reduction of 37 percent below 2005 levels by 2025—emissions reductions in 2025 are over 35 percent larger than the EIA analysis, despite a lower trajectory of carbon prices.

While real-world experience with strong economy-wide carbon prices is limited, the existing empirical evidence suggests that price signals cause significant behavioral changes both within and outside of the electricity sector. In British Columbia, a carbon tax of C\$10 per metric ton was implemented in 2008 and increased by C\$5 per year until 2012. Over those five years, despite starting with over 90 percent renewable electricity generation and very little fossil-fuel generation (the “low-hanging fruit”), CO<sub>2</sub> emissions in British Columbia decreased by 5 to 15 percent compared to a no-policy scenario (Murray and Rivers 2015), and the decline in gasoline usage has been over five times larger than expected (Rivers and Schaufele 2014).

We conclude that due to their conservative assumptions related to technological progress and the tendency to forecast an energy system largely as it exists today, most current energy/economic models are likely to be overestimating the carbon prices needed to achieve a given emissions reduction level. This bias of energy/economic models should be recognized by policymakers as they design carbon taxes, and by businesses as they make long-term investments with future carbon prices in mind. In the future, models should be designed that more explicitly recognize the potential for considerable progress in clean energy technologies.

**2. How a carbon price affects households across income levels (for more, including references: [http://www.wri.org/sites/default/files/Putting\\_a\\_Price\\_on\\_Carbon\\_Ensuring\\_Equity.pdf](http://www.wri.org/sites/default/files/Putting_a_Price_on_Carbon_Ensuring_Equity.pdf))**

A carbon price affects households in four main ways:

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<sup>1</sup> See: [https://www.whitehouse.gov/sites/default/files/docs/mid\\_century\\_strategy\\_report-final.pdf](https://www.whitehouse.gov/sites/default/files/docs/mid_century_strategy_report-final.pdf), page 46.

1. **Effects on household expenditures.** A carbon price affects household expenditures through the price of carbon-intensive energy products and services like electricity, gasoline, and heating, and through the price of other goods and services that are energy-intensive to produce.
2. **Effects on household income.** Households' wages and investment incomes depend on the performance of companies across the economy. A carbon price affects the costs of inputs of carbon intensive companies and the market share of these companies and their competitors, which affects the incomes of these companies' workers and investors.
3. **Carbon pricing revenue use.** A carbon price generates revenue that can be allocated to a variety of important purposes, including providing household rebates, reducing taxes, investing in clean energy, reducing the federal deficit, addressing regional disparities or compensating households that cannot afford to pay the carbon price.
4. **Environmental benefits.** Reduced climate change and local air pollution caused by a carbon price leads to improved health and economic outcomes.

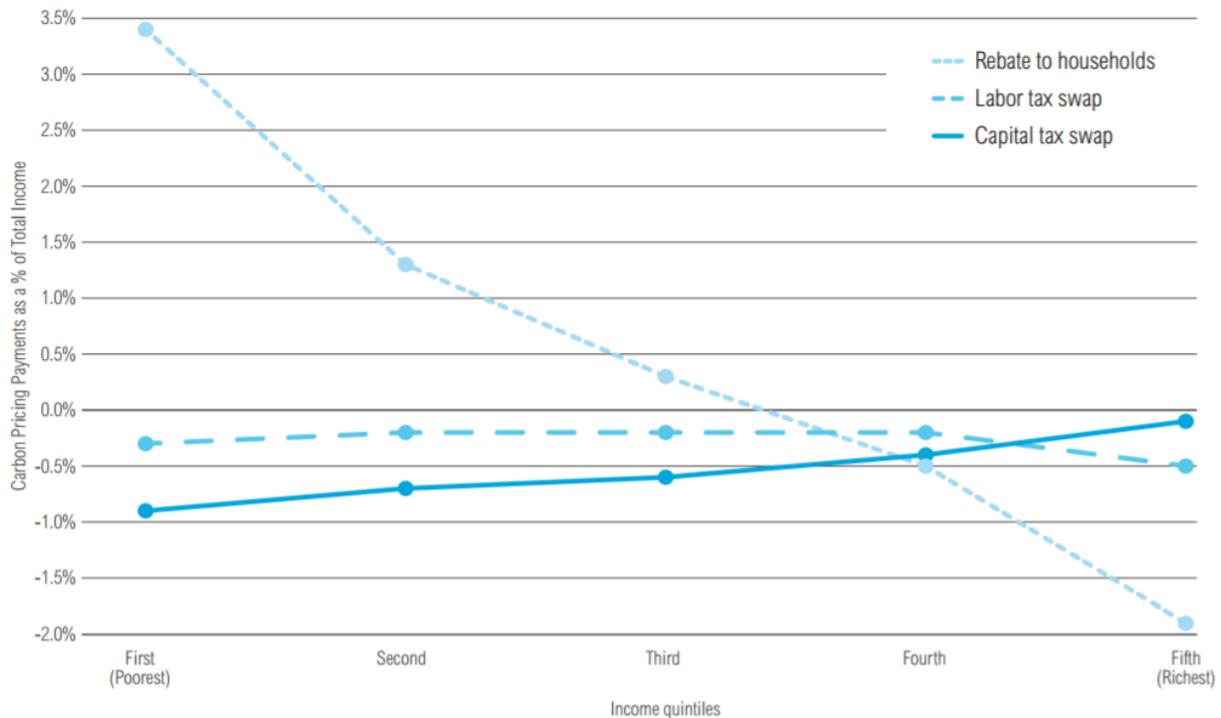
Most households are affected by all four of the above in their various roles as consumers, workers, business owners, shareholders, taxpayers, recipients of government benefits, and residents of communities across the country. The magnitude of the various effects of a carbon pricing policy on a given household depend on the characteristics of the household and the details of the policy.

Empirical analyses of the distributional effects of carbon pricing policies across U.S. households suggest the following broad patterns:

- Lower-income households see larger proportional increases in their expenditures because a larger share of their consumption is devoted to energy-intensive products.
- Higher-income households see larger proportional decreases in their incomes as a result of greater dependence on capital income, which is more affected by a carbon price than is income from wages or government transfers.
- The harms of air pollution and climate change tend to accrue disproportionately to lower income households, so these households are likely to see the largest environmental benefits from a carbon price.
- The use of carbon pricing revenue is the most influential factor determining the policy's distributional effects.

Policymakers determine how carbon pricing revenues are used, so the progressivity or regressivity of the policy is largely in their hands. The figure below shows the effects of carbon price on U.S. households, divided by income quintile (adapted from Williams et al. 2015): one revenue use results in a highly progressive policy (rebate to households); a second revenue use results in a regressive policy (capital tax swap); a third revenue use results is neither strictly progressive or regressive (labor tax swap).

## EFFECTS OF THREE CARBON PRICING POLICIES ON TOTAL INCOME ACROSS SOCIOECONOMIC GROUPS

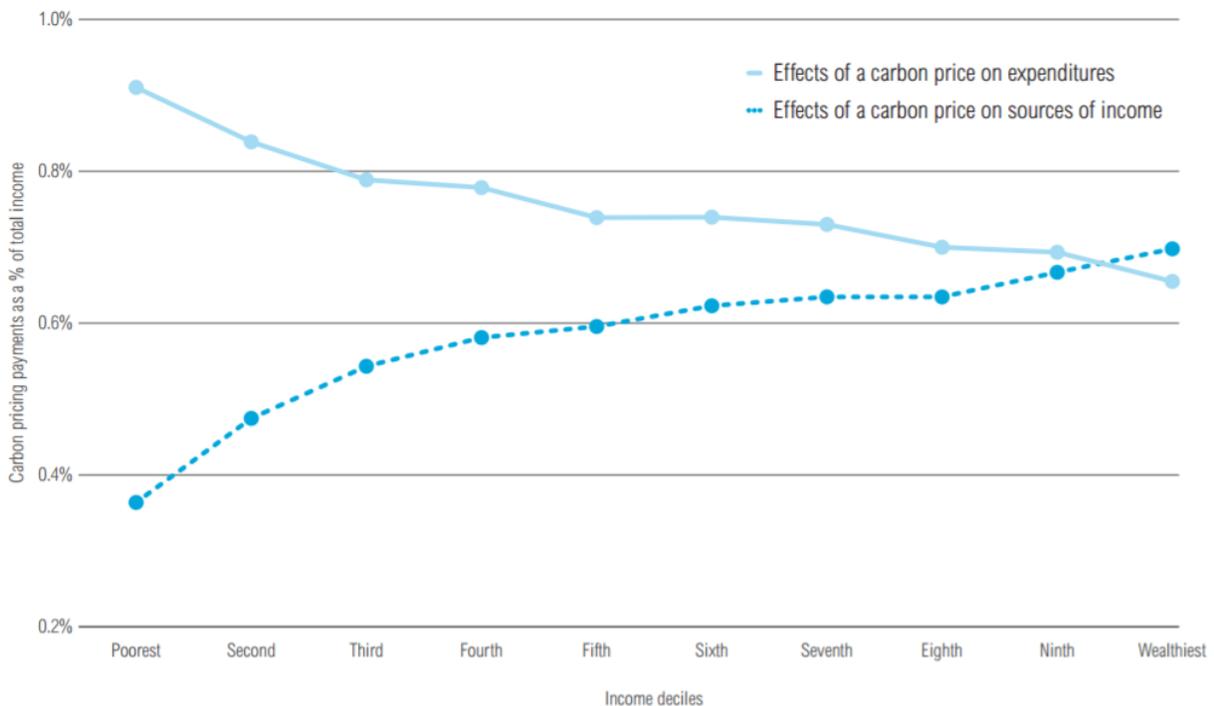


Source: Data from Williams et al. 2015.

Such empirical studies of the distributional effects of carbon pricing typically miss a few important factors. First, studies do not account for the environmental benefits of the policy. Second, distributional effects of a carbon pricing policy are typically compared to an unrealistic “no climate policy” scenario. In reality, other policies are likely to be relied upon to achieve at least some degree of emission reductions. For example, emissions standards often raise energy prices, and the benefits of government spending on subsidies for low-carbon or energy-efficient products may disproportionately accrue to the corporations that sell these products and the households that can afford to buy them.

Taken as a whole, carbon pricing policies clearly should not be labeled as inherently progressive or regressive. In fact, according to the best empirical studies, **a carbon price is not inherently regressive even before the effects of revenue use and the environmental benefits are considered** (i.e. considering only the effects on household expenditures and income). The figure below (adapted from Rausch, Metcalf and Reilly 2011) that shows the estimated effects of carbon price across U.S. households, divided by income decile, and before accounting for the use of revenues. The regressivity of the effects of a carbon price on household expenditures is offset by the progressivity of the effect of carbon price on sources of household income.

## EFFECT OF A CARBON PRICE ON SOURCES OF INCOME AND EXPENDITURES (IGNORING REVENUE USES)



Source: Rausch, Metcalf, and Reilly 2011.

Of course, to ensure an equitable policy, policymakers must consider not only the aggregate or average effects on regions and socioeconomic groups but also the effects on smaller groups of vulnerable households. We argue that two vulnerable groups are in particular need of additional support. First, many low-income households may not be able to afford any increase in expenditures, and a carbon pricing policy should ensure that these households are not driven deeper into poverty. In the United States, studies have estimated that protection for low-income households can be achieved using about 10 percent of the total carbon pricing revenue (Morris and Mathur 2014). Second, certain communities of households with livelihoods tied to a high carbon economy may need additional support. For example, in the United States, billions of dollars in annual investments to revitalize struggling coal communities could be funded with a very small portion of carbon pricing revenue.

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I hope you find some the above useful. Please do not hesitate to reach out if I can be of any further assistance as you move forward in this important process.

All the best,

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