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Carbon Taxes and Energy Subsidies: A Comparison of the Incentives and Costs of Zero-Carbon Deployment

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Analysis Summary

Carbon taxes like the ones being proposed by current and former member of Congress are unlikely to increase the deployment of zero-carbon energy technologies and would only modestly increase the incentive for utilities to shift from coal to gas, a new Breakthrough Institute analysis finds. Absent continued Congressional authorization of existing low-carbon energy subsidies, the price incentive for the deployment of zero-carbon energy sources would decline by between 50 to 80 percent.

These findings are consistent with the findings of other recent studies (MIT 2012) that find that a $20 per ton carbon tax — rising slowly to $90 per ton by 2050 — would have an only modest effect on emissions. Where those studies looked at the first-, second-, and third-order effects of carbon pricing, including effects on price indexes, equity of taxation, and broader emissions reductions, ours is focused exclusively on the impact of carbon pricing on the deployment of zero carbon energy sources.

The analysis also finds that current carbon tax proposals would impose greater costs upon the U.S. energy economy than would simply funding existing subsidy supports for deployment of zero carbon energy through a carbon tax that recycled all of its revenues to support those programs. Current annual federal spending on clean tech deployment subsidies totaled $11 billion in 2012, equivalent to a tax of $2.10/ton CO_2. At its recent peak in 2009, federal spending on clean energy subsidies amounted to $29.6 billion, equivalent a tax of $5.50/ton CO_2. By contrast, a $20/ton carbon tax would impose a cost of $100 billion annually on the U.S. energy economy, 900% more than the carbon tax that would be necessary to sustain today's current level of clean energy subsidies if the proceeds from the tax were used to fund those programs and 333% more than would be necessary to sustain the record levels of spending on clean energy subsidies in 2009.

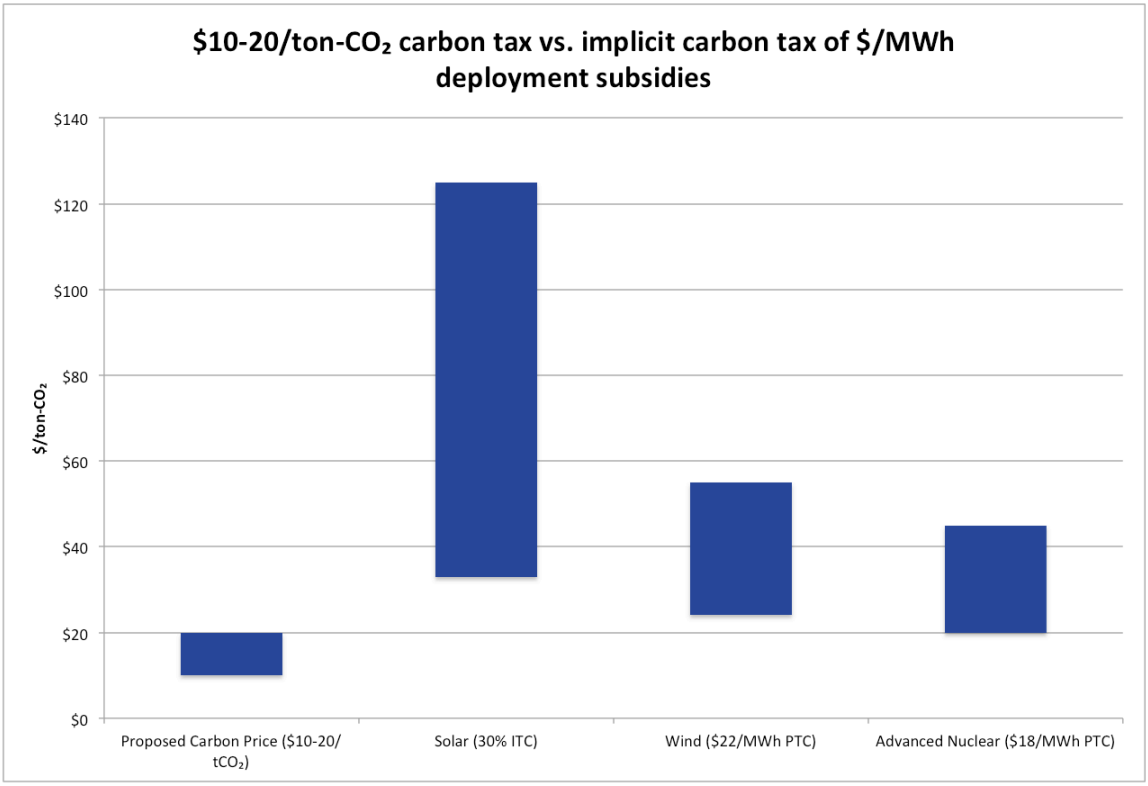
In order to make an apples-to-apples comparison of the economic incentives to zero-carbon energy deployment, we calculated the "carbon tax-equivalent" (sometimes referred to as the carbon price-equivalent, or implicit carbon price) of deployment subsidies in the United States for solar, wind and nuclear. Calculating the carbon tax-

equivalent is a way to compare the economic incentives for the deployment of zero-carbon energy provided by different policy mechanisms including subsidies, regulations, and taxes.

The carbon tax equivalent of the federal subsidy for wind (the production tax credit) ranges between $24 and $55 per ton, depending on whether wind is competing against coal or natural gas. For solar, the federal investment tax credit (ITC) provides a higher per-megawatt-hour incentive hour depending on the size of the system, so the ITC's carbon price equivalent ranges between $33 and $125 per ton. The carbon price equivalent of the production tax credit for nuclear power is between $20 and $45 per ton.

A carbon tax in the $10 - $20 per ton range would thus provide a far smaller incentive to deployment of nuclear, solar, and wind than existing subsidies. A carbon tax of $20 per ton would provide about one-third the incentive of wind subsidies when competing against natural gas, one-fifth the incentive of solar subsidies, and less than half the incentive of nuclear subsidies.

Our analysis finds that a carbon tax in the $10 - $20 per ton carbon tax would provide a minor incentive for utilities to switch from coal to gas. A $20 carbon tax would provide about half as much incentive as the current price gap between coal and gas provides.



Graph 1. The range of carbon price-equivalent of existing subsidies for solar, wind, and nuclear in the United States. (Department of Energy; Breakthrough Institute)

This analysis may underestimate the incentive provided by direct subsidies compared to the indirect incentive provided by a carbon tax. Federal tax incentives, combined in many cases with state-level requirements for utilities to purchase zero-carbon power, provide direct support for energy technologies that are currently more costly and technically challenging than incumbent coal and natural gas. Solar, wind, and nuclear also suffer from high upfront capital costs, and tax credits open up tax-equity markets so developers can attract project finance. The combination of the subsidies' price signal and the vehicle for project finance provided by tax breaks helps developers and utilities overcome the economic and technical challenges posed by renewables, while loan guarantees and insurance subsidies help lower the risk and finance costs of nuclear projects. By contrast, a carbon tax simply raises the cost of the incumbent without helping the challengers enter the market, weakens the incentive more than a carbon tax-equivalent methodology suggests. Because of the complexity of those interactions, it is difficult to estimate those non-price costs.

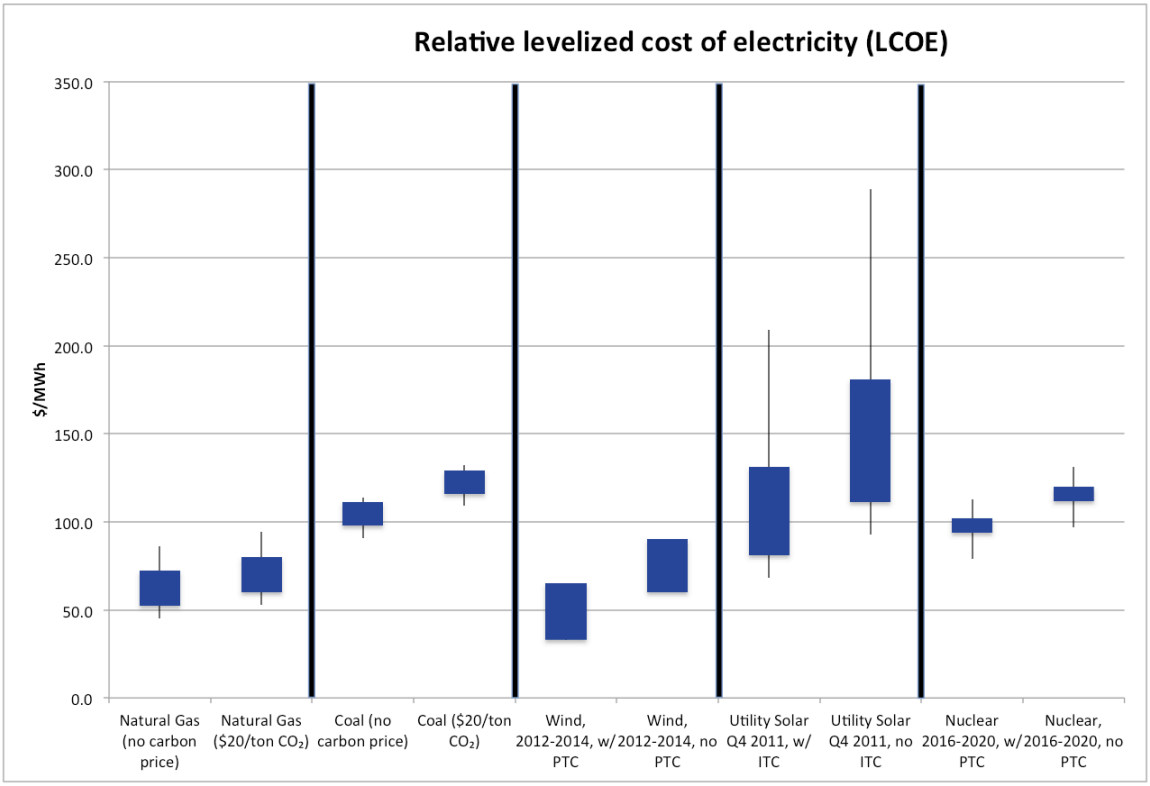
Other Key Findings:

Natural Gas. A $20/ton CO_2 tax would raise the total cost of gas-fired electricity by $8 per megawatt-hour (MWh) (from $52-72 to $60-80/MWh). But it would increase the cost of coal electricity by $18 per MWh — from $98-$111 per MWh to $116 to $129 per MWh.

Nuclear. The carbon tax-equivalent levied by nuclear's $18/MWh production tax credit is $45/ton CO_2. The costs of nuclear with its production tax credit range from $94 to $102 per megawatt-hour, while unsubsidized costs of new nuclear power stations range from between $112 and $120/MWh. But nuclear plants are subsidized in other ways, including Department of Energy Loan Guarantees for new plants, and capped risk insurance for the first six nuclear plants built after 2005.

Solar. Today, utility-scale solar power costs between $81 and $131/MWh in sites with adequate solar insolation, which makes it already competitive with coal at $98 – 111/MWh. Without federal subsidy (the Investment Tax Credit, or ITC), solar's cost ranges between $111 and $189. The difference between the cost of solar with and without the federal subsidy is $30 - $58/MWh, or two to three times more than the effect of the high carbon tax ($20/ton CO_2) scenario.

Wind. With its federal subsidy, (the Production Tax Credit, PTC) wind's costs range between $33 to $65, while without subsidy wind's costs would be between $60 and $90 per MWh. Wind is thus already cheaper than coal and even in some places than natural gas. The difference between the subsidized and unsubsidized costs is 2 times greater than the value to wind from the carbon tax on gas ($55/ton CO_2). While the carbon tax would likely have little impact on wind deployment, ending the PTC, which is set to expire at the end of this year, would reduce new wind deployment by 80 percent.



Graph 2: The relative levelized cost of electricity (LCOE) of different technologies. The left bar of each pair represents LCOE under today's subsidy regime, and the right bar represents a scenario in which subsidies are replaced by a $20/ton tax on CO_2.

Methodology

Establishing the implicit carbon price (or "implicit carbon tax" in some literature) as created through regulations and subsidies is a well-established analytical tool. It has been widely used for two decades to calculate the implicit carbon price of policies in OECD nations (Hoeller 1991; Burniaux), Europe (Pearson et al 1991), Japan (Yokoyama et al 2000), Canada (Lachapelle/Sustainable Prosperity, 2011) and in the UK (Advani/Institute for Fiscal Studies, 2001), and recently six large economies, including the U.S. (Vivid Economics/Climate Institute 2010).

Our calculations use short tons and carbon-dioxide (CO_2), not carbon (C).

To determine the implicit carbon price of a clean energy subsidy, we treated the clean energy incentive as a cross-penalty against competing dirty energy sources. We multiplied the $/MWh incentive for clean energy by the marginal emissions factor of dirty energy:

$$\frac{\$}{MWh} \; x \; \frac{MWh}{tCO_2} = \frac{\$}{tCO_2}$$

Wind receives a $22/MWh credit, while nuclear's credit is worth $18/MWh. Solar's tax credit is based on project investment, not energy production, and so we estimate the effective production incentive to solar to be between $30 and $50/MWh, depending on the size of the solar project. This results in a wider range of carbon tax equivalent for solar than wind or nuclear.

We assume coal-fired power plants emit 0.9 tons CO_2 per megawatt hour, and natural gas-fired power plants emit 0.4 tons CO_2 per megawatt hour. So, to determine the implicit carbon tax of the $22/MWh production tax credit for wind (PTC) when competing against coal and natural gas, simply plug in the numbers to the above equation:

$$Coal: \frac{\$22}{MWh}\ x\ \frac{MWh}{0.9tCO_2} = \frac{\$24.4}{tCO_2}$$

$$Natural\ Gas: \frac{\$22}{MWh}\ x\ \frac{MWh}{0.4tCO_2} = \frac{\$55}{tCO_2}$$

The Breakthrough Institute is a nonpartisan public policy think tank based in Oakland, California. For the past decade Breakthrough has advocated using a low, gradually rising carbon tax to fund public innovation and deployment investments.

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