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ISSUE BRIEF

KEEPING ELECTRICITY BILLS LOW AS THE POWER SECTOR CURBS CARBON POLLUTION

Carbon reduction programs can drive clean energy investments that present significant opportunities to cut electricity bills for all Americans. Mass-based carbon emissions trading programs are proven, efficient, market-based approaches to incentivizing cost-effective reductions of carbon dioxide pollution in the electricity sector, which represents one-third of the total climate-changing carbon pollution in the U.S. Cutting carbon pollution from this sector will benefit public health, the environment, and the economy by preventing the worst impacts of climate change.[1]

This issue brief explores how complementary policies and strong energy efficiency and renewable energy investments can be coupled with a mass-based trading program to reduce carbon dioxide emissions and keep electricity bills low for households and businesses. The program requirement to hold carbon allowances could increase operating costs for polluting plants and lead to rising electricity prices. However, energy efficiency investments, stronger incentives for low-cost renewables, and the reinvestment of allowance auction revenue can offset rising prices and reduce electricity bills for households and businesses.

HOW DO ALLOWANCE TRADING PROGRAMS WORK?[2]

This issue brief focuses on mass-based programs for reducing carbon dioxide pollution in the electricity sector. Mass-based carbon emissions trading programs limit pollution to a specified level by requiring generators to pay for the pollution they produce. The program sets an overall limit on emissions from power plants, then issues allowances equal to the number of tons of emissions under the limit. An allowance is a permit to emit one ton of carbon dioxide, and generators must surrender to the governing authority an allowance for each ton of pollution emitted. This creates a market for allowances: a generator with extra allowances can sell them to another generator that has more emissions than it has allowances.

The emissions limit and corresponding number of allowances gradually decrease according to a predetermined timeline until the program reaches a target level of emissions. In an efficient and well-designed program, generators will achieve the target level of emissions at the lowest cost because those who can cost-effectively reduce emissions will do so, and the remaining generators will need to purchase allowances to cover their emissions, making low- and zero-emitting generators more competitive.

HOW DOES AN ALLOWANCE TRADING PROGRAM IMPACT WHOLESALE POWER PRICES?

In wholesale power markets, generators submit their bids—or the amount of power they are willing to supply at a given price—to the system operator, an entity that procures sufficient power to meet customer demand as cheaply as possible while maintaining grid reliability.[3] Each generator includes in its bid the marginal operating costs (fuel and operations and maintenance [O&M] costs) of generating each additional megawatt-hour (MWh) of electricity.[4] The system operator ranks the competitive bids and dispatches generators (i.e., selects the generators that will run) from

For more information, please contact:

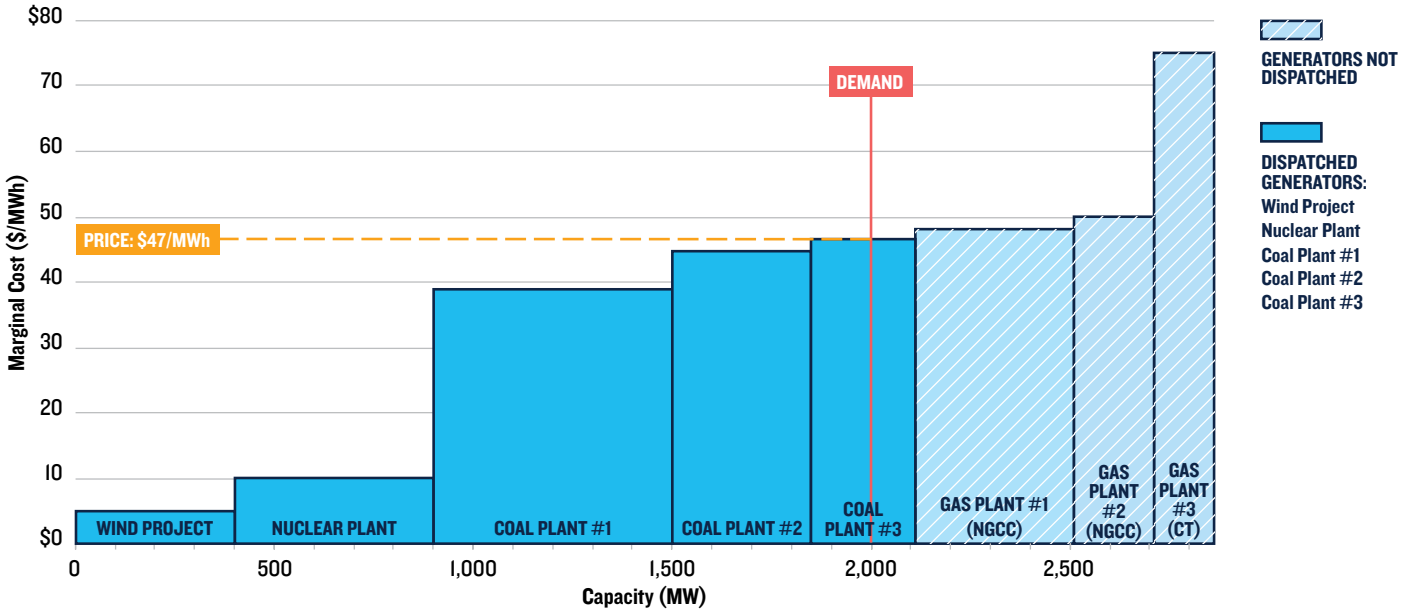
Rachel Fakhry
rfakhry@nrdc.org

www.nrdc.org/energy
www.facebook.com/nrdc.org
www.twitter.com/NRDCEnergy

Note: While this discussion is centered on competitive wholesale power markets, it is important to acknowledge that not all electric utilities currently operate in a wholesale market. Several regions in the country—including the Southwest Power Pool (SPP), California Independent System Operator (CAISO) and Western Electricity Coordinating Council (WECC), among others—consist primarily of regulated, vertically integrated utilities with a monopoly over service territories. However, the described market mechanism that underpins how generators are dispatched in a wholesale market can also apply to vertically integrated utilities, as these can act the same way as utilities and generators do in a competitive wholesale market. In the figures below, gas plants #1 and #2 are assumed to be natural gas combined cycle plants (NGCC), while gas plant #3 is assumed to be a combustion turbine plant (CT), which is dispatched to meet peak demand (also called a peaker plant).

FIGURE I: SIMPLIFIED WHOLESALE POWER MARKET—CASE WITHOUT AN EMISSIONS TRADING PROGRAM

This figure illustrates a simplified wholesale power market where generators are dispatched from cheapest to most expensive to meet demand. The last generator to be dispatched sets the wholesale power price, paid to all dispatched generators.



those with the lowest bid to those with the highest bid until demand is met. The generator with the highest bid to be dispatched sets the wholesale market price, which is paid to all of the dispatched generators regardless of their bid. This is illustrated in Figure 1, where the wholesale price to meet the electricity demand of 2,000 megawatt (MW) is set by coal plant #3 at $47/MWh. This is the price paid to all generators.

Under an allowance trading program, the regulatory authority must determine how to distribute emissions allowances to generators. There are many mechanisms for accomplishing this, including auctions and free allocations.[5] Generators are required to include the cost of allowances in their bids, regardless of how allowances are distributed. Fossil fuel–fired generators, which emit carbon dioxide, bid higher in the market than they would in a case without the mass-based trading program because they now have to account for the price of allowances to cover their emissions. Including the (partial) cost of pollution in bids allows electricity markets to function more fairly and efficiently by accounting for *all* costs.

To illustrate this dynamic, Table 1 assumes an allowance price of $8/ton. Given that one allowance is a permit to emit one ton of carbon dioxide, renewable and other non-emitting resources (including nuclear plants) do not need to use any allowances. Table 1 summarizes the addition of an allowance price to fossil fuel generators' bids, and Figure 2 illustrates the resulting change in the generators' dispatch order (i.e., which generators are selected to run). Coal plants #2 and #3 have high emissions rates that make them comparatively less economical to run under the program, and they are no longer dispatched. Gas plant #1 and gas plant #2 become more economical to run under the program and are dispatched in place of the two coal plants, because they need fewer allowances to account for their lower carbon emissions. The wholesale price is now set by gas plant #2 at $54/MWh, compared with the $47/MWh price set by coal plant #3 in the scenario without a carbon allowance price (Figure 1).

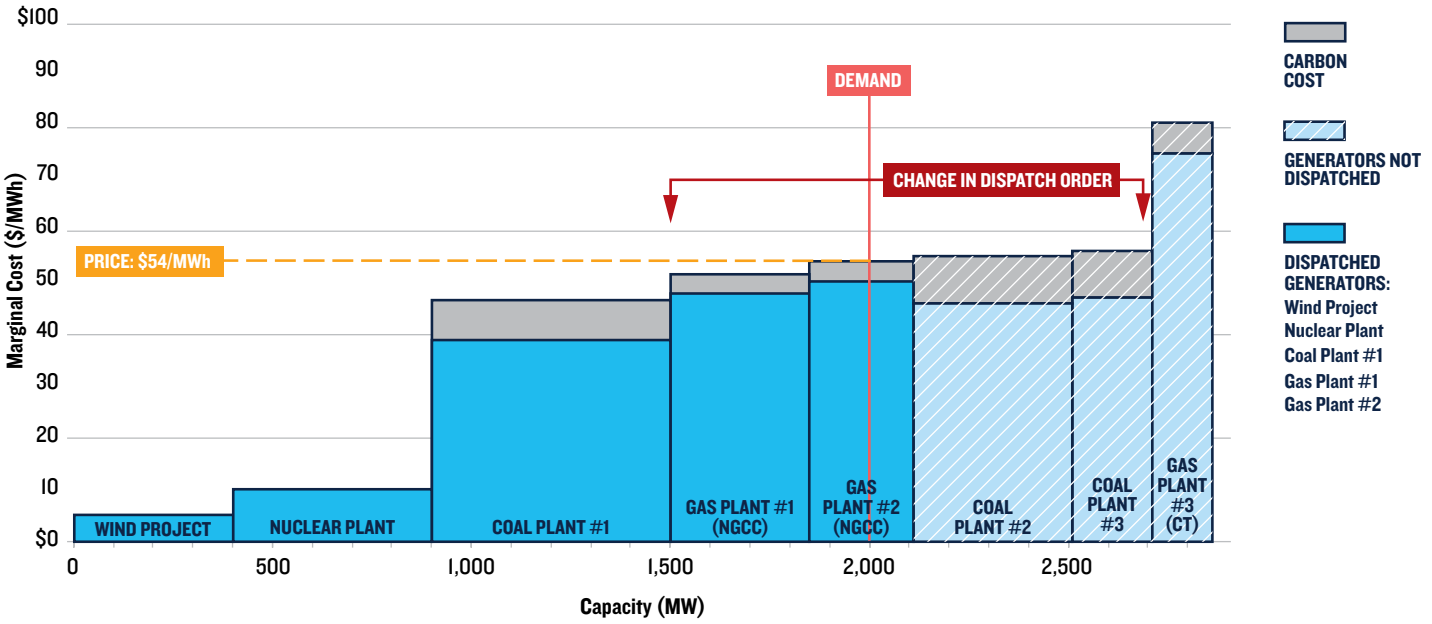
This is a simple illustration of how a mass-based emissions trading program can incentivize near-term shifts to lower- and zero-emitting energy sources because the plants will be dispatched in a different order reflecting the costs of

TABLE 1: CHANGE IN FOSSIL GENERATORS' BIDS WITH THE ADDITION OF THE ALLOWANCE COST ($8/TON)				
	Emissions Rate (short tons/MWh)	Illustrative Bid ($/MWh) No Allowance Costs	Number of Allowances Needed per MWh Generated	Illustrative Bid ($/MWh) Including Allowance Costs
Wind Farm	0	5	0	5
Nuclear Plant	0	10	0	10
Coal Plant #1	0.95	39	0.95	46.6
Coal Plant #2	1.1	46	1.1	54.8
Coal Plant #3	1.15	47	1.15	56.2
Gas Plant #1 (NGCC)	0.45	48	0.45	51.6
Gas Plant #2 (NGCC)	0.5	50	0.5	54
Gas Plant #3 (CT)	0.7	75	0.7	80.6

FIGURE 2: SIMPLIFIED WHOLESALE POWER MARKET—CASE WITH ALLOWANCE COSTS AND ASSOCIATED CHANGE IN DISPATCH ORDER

In this figure, the allowance price changes the dispatch order by increasing the bids of the carbon-emitting generators, and results in a shift from higher-emitting coal generation to lower-emitting gas generation. The wholesale price also increases from $47/MWh to $54/MWh.

While implementing an allowance trading program would increase wholesale electricity prices, at least in the short term, that *does not* mean that it would increase customer bills. Allowance revenues could be used in a manner that reduces customer bills by an amount greater than the increase driven by the need for generators to include allowance prices in wholesale energy market bids. Below, we discuss how investments in energy efficiency and renewables can cut electricity prices and bills while delivering additional benefits to consumers.



their pollution. In the longer term, the higher wholesale electricity price will encourage stronger investments in lower- and zero-emitting generators by creating opportunities for higher revenues.

States have a suite of well-established policies to complement mass-based trading programs and reduce harmful pollution at the lowest possible cost to customers while delivering significant additional economic and public health benefits. In particular, policies that scale up investments in energy efficiency and renewable energy and support allowance revenue recycling mitigate the impact on consumers.

The following sections discuss how energy efficiency, renewable energy, and allowance revenue cut electricity prices and bills while delivering additional benefits to consumers.

ENERGY EFFICIENCY

Proven to be the most cost-effective energy resource, energy efficiency reduces overall electricity system costs, allowance prices, and customer electricity bills.[6]

First, by reducing energy consumption, energy efficiency directly reduces customer electricity bills. Electricity bills are a function of the price of electricity and the amount of electricity the customer uses, and investments in efficient appliances, efficient lighting, and building efficiency retrofits can significantly reduce electricity use while providing the same amount of electric output. Additionally, states and utilities can maximize the benefit for those already carrying the greatest energy-related financial burden by focusing investments in low-income and disadvantaged communities where older, less-efficient homes are concentrated and where households spend a larger portion of disposable income on energy bills.[7]

Second, maximizing investments in energy efficiency lowers wholesale electricity prices. By lowering demand, energy efficiency reduces the need to run costlier and less-efficient plants, thereby decreasing wholesale prices for all customers. In our example, energy efficiency programs that would cut electricity demand by 200 MW (from 2,000 to 1,800 MW) would also reduce the wholesale price from $54/MWh to $51.6/MWh (Figure 3). This is because gas plant #2 would no longer be needed to meet demand, and the wholesale price would now be set by gas plant #1 at $51.6/MWh.

Finally, energy efficiency can reduce the costs of a mass-based trading program for affected generators. The effects of an emissions allowance market on electric generators in a region depend on many factors, such as generation mix, fuel prices, and the number and size of generating units. Still, under most circumstances, energy efficiency programs will reduce total electricity demand and the amount of fossil-fueled generation necessary. Dispatching fossil generators less means that generators will require fewer allowances, which will reduce total demand for allowances and reduce allowance prices. This, in turn, will decrease wholesale prices, costs for generators, and customer bills.

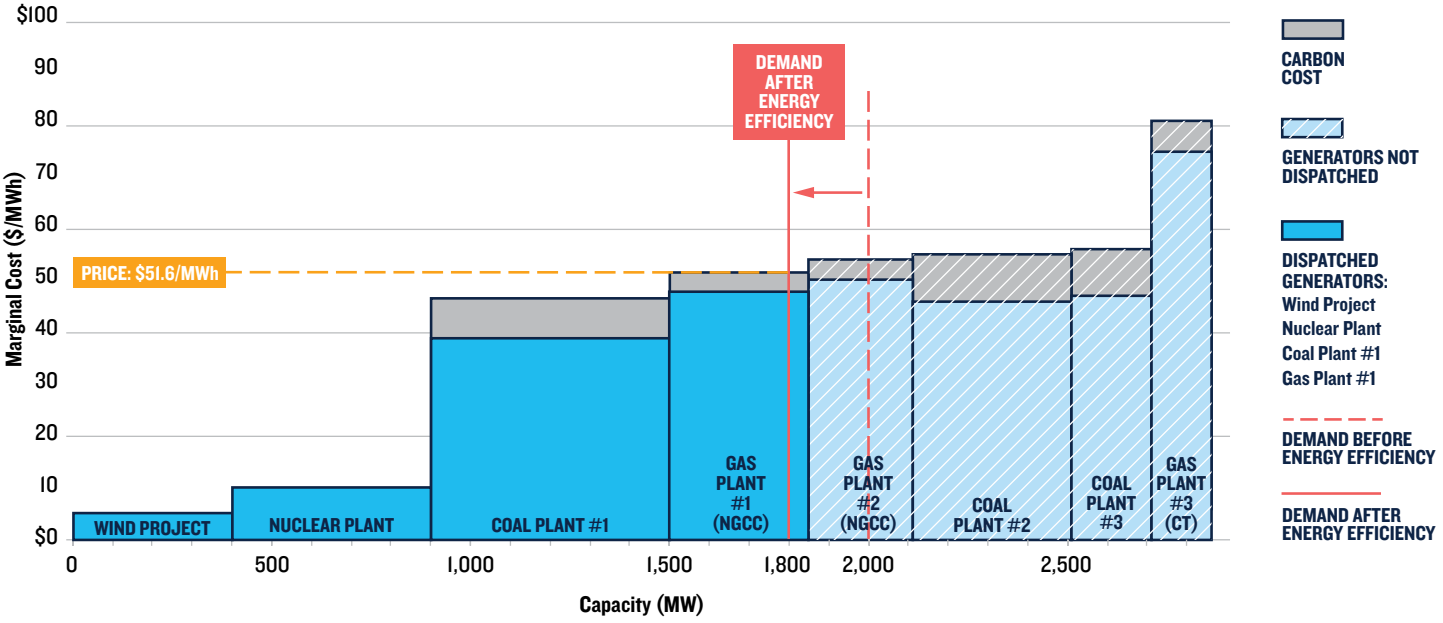
In addition, energy efficiency investments produce an array of economic benefits.[8] Investing in energy efficiency creates jobs in manufacturing and installation of efficient technologies.[9] Households and businesses that spend less money on their electricity bills will spend on other goods in the general economy. This drives job growth in a broad range of economic sectors.[10] Additionally, energy efficiency can reduce the need for more transmission infrastructure. This can help reduce a utility's cost of service and enable it to redirect that deferred capital into other investments for customers' benefit.[11]

RENEWABLE ENERGY

Renewable energy technologies, like solar and wind, have very low operating costs because they do not consume fuel in order to generate electricity. In fact, numerous studies focusing on regions as diverse as Ohio, Texas, and California have shown that clean energy investments tend to lower

FIGURE 3: SIMPLIFIED WHOLESALE POWER MARKET–CASE WITH ALLOWANCE COSTS AND DECREASE IN DEMAND FROM EFFICIENCY

In this figure, efficiency investments lower both demand and the electricity price. Gas plant #2 is no longer needed and gas plant #1 now sets the wholesale price at $51.6/MWh, lower than the case without efficiency ($54/MWh).



wholesale electricity prices.[12] By bidding very low prices in the wholesale market, renewable energy keeps wholesale prices low for the benefit of all customers.[13] In our example, investing in a 400 MW solar project would reduce the wholesale price from $51.6/MWh to $46.6/MWh, the price now set by coal plant #1 (see Figure 4). This wholesale price is slightly lower than the $47/MWh price in the scenario without the emissions trading program (Figure 1), illustrating how investments in cost-effective energy efficiency and renewable energy can drive down the wholesale electricity price, even with a carbon price.

At the same time, solar and wind technologies reduce total electricity production costs (fuel and O&M) across the market, as they displace fossil fuel plants that have high production costs. These savings can outweigh the higher upfront capital investments of renewables,[14] reducing power prices and delivering lasting bill savings. Additionally, recent analyses have found that states relying more on renewable generation have seen fewer increases in electricity prices over the past ten years compared to those states that lag in renewable deployment.[15]

Wind and solar will become increasingly smart investments as the capital costs of renewable energy continue to fall due to both continuous technology advancements and the recent multiyear extensions of the federal Production Tax Credit (PTC) for wind energy and Investment Tax Credit (ITC) for solar energy. In fact, tax credits are projected to drive unprecedented growth in wind and solar deployment in the next five years.[16]

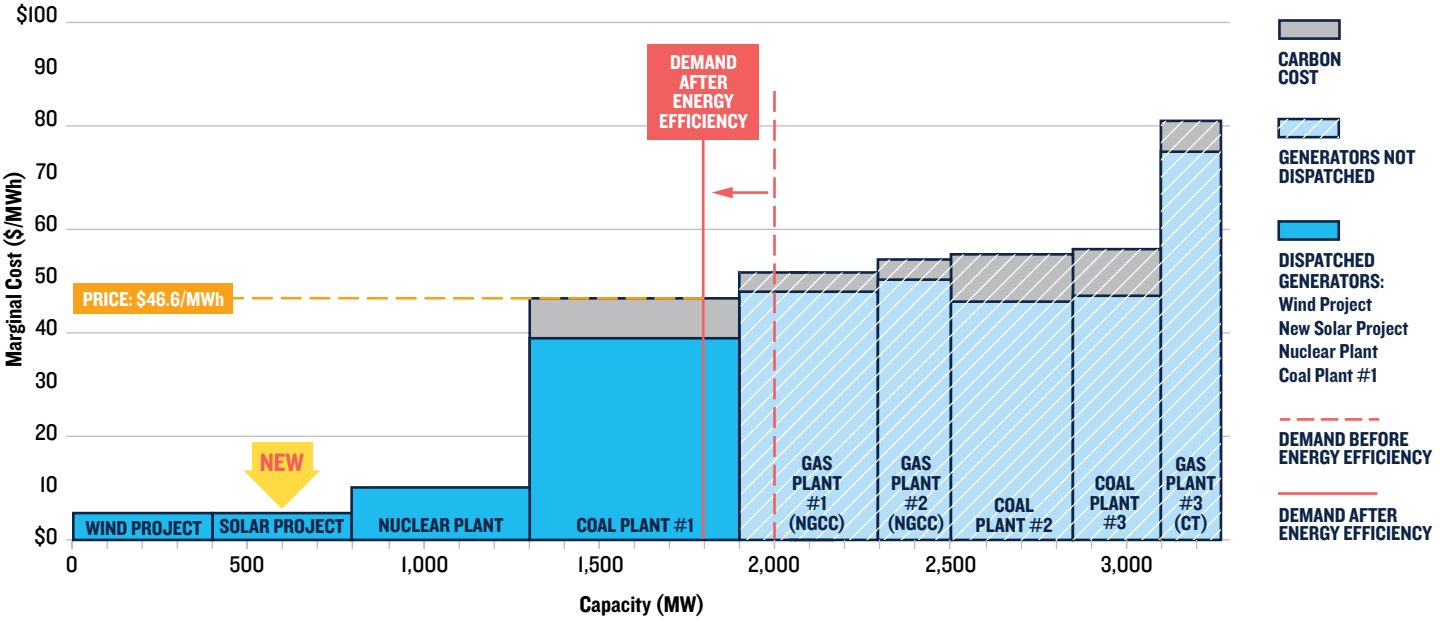
Renewable energy also delivers an array of economic benefits. Per MW of capacity, renewable energy generation (and energy efficiency) creates more jobs than fossil generation.[17] Investments in wind and solar developments also tend to benefit the local economy, while fossil plants often send money out of the local economy in order to import resources (coal or gas) from non-local, fossil-producing areas.[18] The U.S. solar industry employed 208,859 workers as of November 2015 and continues to add workers nearly 12 times faster than the overall economy. At the same time, the U.S. wind industry supported a record 88,000 jobs at the start of 2016—an increase of 20 percent from the previous year.[19] In fact, wind turbine technician is the fastest growing job in the U.S. economy.[20]

Additionally, renewable energy economically benefits low-income counties, with 70 percent of wind farms located in those counties.[21] U.S. farmers, ranchers, and other rural landowners now receive $222 million annually in land lease payments from wind developers.[22]

In addition to helping us cost-effectively cut carbon pollution, renewable energy benefits public health by cutting hazardous air pollution.[23] It also avoids harmful carbon dioxide pollution and reduces reliance on natural gas, indirectly lowering natural gas heating bills.[24] Solar and wind technologies are instrumental in helping us meet our climate goals as cost-effectively as possible, reducing electricity bills, and delivering significant additional public health benefits.

FIGURE 4: SIMPLIFIED WHOLESALE POWER MARKET—CASE WITH ALLOWANCE COSTS, DECREASE IN DEMAND FROM EFFICIENCY, AND A NEW SOLAR PROJECT[25]

In this figure, the new solar project adds to the resource queue while efficiency reduces demand, resulting in a lower electricity price for households and businesses. Note that this illustrative market selects the cleanest set of generators to be dispatched at the lowest electricity price of the examples we address in this discussion.



REINVESTING ALLOWANCE REVENUE

Under a mass-based carbon reduction trading program, states can sell allowances through an auction to benefit customers or provide allowances to generators at no cost to subsidize polluters (among other distribution options). Generators are required to factor the full market value of the carbon allowance into dispatch bids whether they had to purchase them or received them for free. While a generator's bid will be the same regardless of how allowances are allocated, conducting an allowance auction could generate billions of dollars in revenue that could be invested in programs that help keep electricity bills low, such as bill assistance rebates, energy efficiency, and renewable energy. The revenue could also be directed toward other public programs such as workforce retraining or green infrastructure.

Existing programs have demonstrated the efficacy of auctions. Under the Regional Greenhouse Gas Initiative (RGGI),[26] nine Northeastern and Mid-Atlantic states have cut carbon pollution by 37 percent since 2008 through a shift from high-emitting coal generation to lower-emitting gas generation and through strong investments in energy efficiency and renewables.[27] Because RGGI auctions its carbon allowances, states were able to reinvest $2 billion in the local economy over the program's first six years. These investments mostly supported energy efficiency programs, community renewable projects, electricity bill assistance—especially for low-income households—and worker retraining programs. A study by the Analysis Group found that RGGI generated $2.9 billion in net economic benefit to the region from 2009 to 2014, largely through auction revenues, even before accounting for environmental benefits. The study concludes, "In the end, consumers gain because their overall electricity bills go down as a result of state RGGI allowance revenue investments, primarily in energy efficiency but also renewable energy–focused programs."[28]

Similarly, under AB 32, which established California's economy-wide cap-and-trade system and requires the state to reduce its greenhouse gas emissions to 1990 levels by 2020, the state auctions almost half its emissions allowances.[29] Auction revenues are directed to the Greenhouse Gas Reduction Fund, which finances sustainable transportation, affordable housing and sustainable communities, energy efficiency, renewable power, urban forestry, and more. A quarter of the funds are earmarked for California's most disadvantaged communities. Further, California mandates that the value of allowances allocated to the state's investor-owned utilities be returned to customers through a "climate credit" bill rebate, to ensure ratepayers are protected from any bill increases and to encourage customers who receive the credit to use the money to invest in energy-efficient home upgrades.[30] This climate credit has repeatedly lowered customer bills and is expected to last through 2020. In fact, in April and October 2014, millions of California households saw an average $35 credit on their electricity bills.[31] A recent study by the UCLA Luskin Center found that AB 32 will financially benefit the typical low-income household to the tune of an estimated cumulative $215 to $246 by 2020.[32] The program is also proving that it is possible to reduce greenhouse gas pollution while spurring robust economic growth. In fact, emissions produced by facilities covered by the program decreased by almost 4 percent in the first year alone, while the state added 491,000 jobs during the program's first year and a half.

CONCLUSION

Market-based carbon pollution reduction programs provide important opportunities to keep electricity bills low for households and businesses. Complementary policies that support energy efficiency, renewable energy, and allowance revenue reinvestment under a mass-based emissions reduction program will help seize these opportunities and provide other economic and health benefits. Even better, these kinds of policies, including Renewable Portfolio Standards, rebates and incentives for specific emerging technologies, and energy efficiency standards and programs, are already well established, and their benefits are becoming increasingly clear.[33] By building on existing clean energy policies and expanding support for energy efficiency and renewable energy, states can keep customer bills low under a mass-based emissions trading program, enabling us to cost-effectively meet our climate goals.

ENDNOTES

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4 This assumes a perfect market. One example where this general rule does not hold is the case of nuclear generation. Despite high operating and fuel costs, nuclear generators bid low in the market because of the significant costs associated with ramping generation down.

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