Congressional CBO Summary Budget Office

The Effects of Renewable or Clean Electricity Standards

Many policymakers have expressed interest in mandating that a minimum percentage of the electricity consumed in the United States be generated from renewable or "clean" sources of energy. A majority of states have implemented similar requirements in their jurisdictions. Such requirements—known as renewable or clean electricity standards—would reduce emissions of carbon dioxide (CO_2), the most prevalent greenhouse gas, by decreasing the percentage of electricity generated from fossil fuels. That change would not significantly reduce energy imports, however, because most of the energy used for electricity generation in the United States already comes from domestic sources.

How a Renewable or Clean Electricity Standard Would Work

Currently, only about 10 percent of U.S. electricity is produced from renewable sources of energy, such as hydropower, wind, and biomass (which includes waste products from the forest industry and farms). The bulk of electricity is produced using coal (45 percent), natural gas (24 percent), and nuclear power (19 percent).

Meeting a renewable electricity standard (RES) would generally entail replacing fossil-fuel-fired generation, which emits CO_2, with generation from renewable sources that would produce fewer, if any, CO_2 emissions. In particular, an RES would probably increase reliance on wind, biomass, solar energy, and geothermal energy to generate electricity. Hydroelectric power is usually excluded from RES proposals because of environmental concerns, although it accounts for more than half of all renewable generation at present.

A clean electricity standard (CES) would expand the set of qualifying sources to include not only renewable energy but also nuclear power, which produces no CO_2 emissions, and fossil-fuel-based generation that involves the capture and storage of CO_2 emissions (a process still under development). A more inclusive CES could allow the standard to be met with generation from natural-gas-fired plants, which release only about half as much CO_2 per unit of electricity produced as coal-fired plants do.

Utilities would typically be required to comply with a renewable or clean electricity standard by submitting "credits," each of which certified that a megawatt hour (MWh) of electricity had been produced from a qualifying renewable or other clean source. The number of credits that a utility would have to submit would depend on the standard and on the utility's electricity sales. For example, under a 30 percent RES or CES, a utility would have to submit 30 credits for each 100 MWhs of electricity it sold.

The federal government would give credits to generators that produced electricity from qualifying sources, and the generators in turn could sell the credits to the highest bidder. Utilities that generate at least some of their own electricity would comply with the policy either by using credits that they received for producing electricity from qualifying sources or by buying credits from other generators that use qualifying sources. Utilities that do not own generating facilities would need to purchase all of their credits. Utilities' demand for credits to comply with the standard would encourage generators to produce more electricity from qualifying renewable or other clean sources. If the credits were traded freely, the market could determine the least expensive method of achieving

the desired increase in renewable or clean electricity generation.

Potential Effects on Power Generation, CO_2 Emissions, and Electricity Prices

A national RES or CES would alter the mix of energy sources used to produce electricity, the amount of CO_2 emitted, and the price of electricity, with those effects varying by region. To illustrate the effects, the Congressional Budget Office compared the results of seven analyses of different potential federal standards conducted in the past two years by the Energy Information Administration or the National Renewable Energy Laboratory (parts of the Department of Energy) or by the independent research organization Resources for the Future. Those analyses examined renewable and clean electricity standards with a variety of design features and relied on models of the electricity sector that incorporated different assumptions about the costs of relevant technologies. The comparison reveals some common findings about the potential impact of a national RES or CES policy, offers insights into the effects of specific design features, and highlights the uncertainties underlying projections of policy outcomes.

Most analyses concluded that the bulk of the increase in renewable generation resulting from an RES or CES would come from additional wind generation (mainly in the High Plains region of the western and central United States) and from biomass generation (mainly in the Southeast). The relative importance of those sources depends heavily on assumptions about the availability of resources in different regions and about the relative costs of various technologies.

Including certain design features in an RES or CES policy could cause the actual percentage of electricity produced from qualifying sources to be less than the standard. That could happen if some utilities were exempt from complying with the standard; if some technologies were given preferential treatment, allowing them to earn more than one credit per unit of electricity produced; or if utilities were allowed to make "alternative compliance payments" instead of submitting the necessary credits. Those features were either included in RES and CES policies proposed in the previous Congress or are part of some state programs.

Either an RES or CES would reduce CO_2 emissions in the United States compared with the amount that would occur in the absence of the policy. The actual reduction resulting from a given standard and set of design features would be uncertain, however. For example, generators that substituted biomass for coal would reduce emissions more than generators that substituted wind for natural gas, because a MWh of electricity generated from coal produces about twice as much CO_2 as one generated from natural gas.

Either an RES or CES would also raise the average cost of generating electricity in the United States because, in the absence of the standard, regulators and generators would generally choose the lowest-cost method of producing electricity. Higher generation costs in turn would lead to higher electricity prices for many businesses and households; however, the price effects would differ among regions. A federal electricity standard would cause prices to go up in most parts of the country but down in other parts. Predictions about effects on regional electricity prices vary significantly among policies and when different models are used to analyze similar policies. Those effects are strongly influenced by regional patterns of investment in new generating capacity and by the extent to which electricity prices in a given area are set by regulators or determined by market forces.

Changes in electricity prices offer an indication of the effects of an RES or CES on electricity consumers, but they do not provide a comprehensive measure of the policy's overall cost. To the extent that a standard reduced electricity prices in a particular region, the cost of the policy would be borne initially by electricity producers in that region, or by consumers in other regions where utilities (taken together) were net buyers of credits. The cost to electricity producers would take the form of lower returns on their existing capital. Those lower returns would discourage new capital from being invested in the electricity sector, eventually reducing the supply of electricity and causing the price to rise. Thus, ultimately, the cost of the policy would be borne by electricity customers.

Implementing a federal RES or CES would be complicated by the fact that 31 states and the District of Columbia have some form of renewable or clean electricity standard already in place. The incremental effect that a federal standard would have on the amount of renewable or clean generation would depend on the provisions

of those state programs. If utilities could not count a given MWh of qualifying generation toward their compliance with both a state and a federal policy, the increase in renewable or clean generation necessary to meet the federal standard—and the cost of achieving that increase—would be much greater than would otherwise be the case. Moreover, regardless of whether a MWh of generation could qualify for credits at both the state and federal levels, the enactment of a federal standard would affect the prices of credits traded in state programs.

As a general rule, a given increase in renewable or clean generation, or a given decrease in emissions, could be accomplished at a lower cost through a single federal standard than through a combination of a federal standard and numerous state standards. The reason is that state policies would tend to constrain the pattern of renewable and clean generation across the United States, hindering the ability of a federal standard to spur the lowest-cost investments in such generation, at least in some regions.

Ways to Make an Electricity Standard More Cost-Effective

Although the costs of meeting a particular RES or CES cannot be predicted with certainty, they could be reduced by incorporating certain design features. For example, allowing unrestricted trading of credits, expanding the range of energy sources that could be used to comply with the policy, phasing in the standard gradually, and giving companies the flexibility to shift credits between years would all make an RES or CES policy more cost-effective.

Unrestricted Trading

The electricity market faces various regional limitations. For example, storing electricity or building transmission lines to move power over long distances is expensive and difficult, and some areas are better suited than others to certain types of generation. Letting utilities comply with a standard by submitting credits that could be bought and sold independently of the electricity generation with which they were associated—rather than requiring that each utility get a certain percentage of its electricity directly from renewable or other clean sources—would help overcome such limitations and thereby lower utilities' compliance costs.

Compliance costs could be reduced further by allowing financial firms that do not generate or distribute electricity to participate in credit trading. Participation by those firms would increase the liquidity of the market, meaning that utilities and generators could buy and sell large numbers of credits without affecting the price.

Expanded Compliance Options

Allowing as many energy sources as possible to qualify for credits (within the constraints of achieving the objectives of the policy, which might include reducing CO_2 emissions, avoiding further damage to the environment, or developing specific technologies) would help minimize the cost of meeting an RES or CES and of achieving any resulting emission reductions. In particular, a clean electricity standard would be likely to bring about a given reduction in CO_2 emissions at a lower cost than a renewable electricity standard because a CES provides incentives for a wider variety of low-emitting technologies than an RES does.

If regulators linked the amount of credits that various technologies could receive to their emissions, then letting both existing and new sources of electricity generation earn credits (rather than just sources that started operating after the policy began) could help better align financial incentives with actual emission reductions. For example, granting partial credits for both existing and new natural-gas-fired generation would give generators a larger financial incentive to substitute a megawatt hour of emission-free generation for a megawatt hour of generation from a high-emitting source, such as coal, than from a low-emitting source, such as natural gas.

Total costs of reducing CO_2 emissions could be lowered even further by allowing emission-reducing improvements in energy efficiency to qualify for credits. For example, generators could upgrade their plants in a manner that allowed them to produce the same amount of electricity from less fossil fuel, or large companies could install lighting that used less electricity. However, regulators would face significant challenges in accurately measuring the energy or fuel savings from such improvements.

Even with a wide variety of compliance options, neither an RES nor a CES would be as cost-effective in cutting CO_2 emissions as a "cap-and-trade" program. Such a program would involve setting an overall cap on emissions and letting large sellers of emission-creating

products (such as electricity generators, oil producers and importers, and natural gas processors) trade rights to those limited emissions. In that way, a cap-and-trade program would create a direct incentive to cut emissions; in contrast, an RES or CES would create a direct incentive to use more renewable or other types of clean electricity but would have only an indirect effect on emissions.

Gradual and Flexible Timing

Electricity generation typically involves investments in large-scale and long-lasting physical equipment, and U.S. demand for electricity is growing slowly enough that the potential for investment in new generation and distribution capacity is fairly small. Utilities and generators would therefore benefit from provisions that phased in an RES or CES gradually over an extended period. They would also benefit from being allowed to transfer credits between different time periods—by "banking" current excess credits for use in later years or by "borrowing" credits that they expected to earn in the future for use now. Such provisions would make it easier for utilities and generators to comply with the standard in the course of planning for moderate increases in new capacity, without prematurely retiring existing capacity. However, the standard would not be met if firms that borrowed credits failed to fulfill their obligations.