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State Efforts to Promote Renewable Energy: Tripping the Horse with the Cart?

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*by Benjamin K. Sovacool & Christopher Cooper**

Introduction

Conventional electricity generation is by far the largest source of air pollutants that harm human health and contribute to global warming. For instance, emissions from just nine conventional power plants in Illinois directly contributed to 300 premature deaths, 14,000 asthma attacks, and more than 400 thousand daily incidents of upper respiratory symptoms per year among the 33 million people living within 250 miles of the plants.[1] Moreover, fossil-fueled power plants in the United States emitted 2.25 billion metric tons of carbon dioxide ("CO_2") in 2003, more than ten times the amount of CO_2 compared to the next-largest emitter, iron and steel production.[2] Of all American industries, electricity generation is—by substantial margins—the single largest contributor of the pollutants responsible for global warming.

For these and other sobering reasons, many state governments promote renewable energy technologies though policies such as renewable portfolio standards ("RPS") and fees such as a systems benefit charges ("SBCs"). By these mechanisms, state regulators intend to correct three major failures of the existing "free" market for electricity fuels. First, electricity prices do not reflect the social costs of generating power. Hidden costs, or negative externalities such as the need to secure foreign imports of fuel, environmental damage from resource extraction, air and water emissions, medical expenses associated with air pollution, and the risk of climate change, are not typically reflected in the rates Americans pay for electricity.

Energy subsidies create an unfair market advantage for conventional energy technologies.

Second, energy subsidies create an unfair market advantage for conventional energy technologies. A majority of the federal budget for energy research and development over the past fifty years has gone to conventional fossil fuel and nuclear industries and not toward renewable energy technologies. From 1948 to 1998, for instance, roughly eighty percent of U.S. Department of Energy appropriations for research and development ("R&D") have gone to nuclear and fossil fuel technologies.[3] Even though coal, natural gas, and nuclear energy industries are relatively mature sectors, federal R&D expenditures continue to favor these industries. In fiscal year ("FY") 2006, for example, the federal government allotted $580 million in R&D funds to fossil fuels and $221 million to the nuclear industry. The wind industry, in contrast, received only $38.3 million.[4]

Third, renewable energy generation is subject to a free rider problem. Since everyone benefits from the environmental advantages of renewable energy, private companies that invest millions of dollars in researching and developing clean energy technologies are often unable to recover the full profit of their investments. Inevitably, the market allows some consumers to be free riders, benefiting from the investments of others without paying for them.

State Government Mechanisms for Promoting Renewable Energy

State policy interventions intend to stimulate a market for renewable resources and spur additional research, development, and implementation of renewable energy technologies. So far, state governments in the United States have relied predominately on RPSs and SBCs to level the playing field by neutralizing a legacy of unequal federal subsidies and directly requiring renewable energy. While state policies are innovative and well intentioned, the time has come to shift to federal regulation and intervention. Continued reliance on state-based activity alone will ironically promote more market externalities and "free riding" than harmonized federal action.

System Benefit Charges

Systems benefit charges (also called public benefit funds, system benefit funds, and clean energy funds) originated in the 1990s at a time when state policy makers were considering electric utility restructuring legislation. Afraid that gains made in pursuing research, development, and implementation of environmentally-preferable renewable energy technologies would end after markets were deregulated, advocates of the novel

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technologies won concessions in some states for a new funding mechanism for high-risk or long-term projects. A SBC places a small tax on every kilowatt hour ("kWh") of electricity generated and utilizes those funds to pursue socially-beneficial energy projects.[5] Lawrence Berkeley National Laboratory estimates that SBCs have been responsible for promoting 1,117 megawatts ("MW") of renewable energy capacity.[6]

SBCs were first implemented in Washington State in 1994 and were endorsed by the Federal Energy Regulatory Commission in 1995 as a way to fund services that had previously been included in customers' bills from regulated utility companies.[7] As part of the negotiations for California's restructuring law, environmental advocates won a provision for a public benefit fund that would expend at least $872 million on energy-efficiency work from 1998 to the end of 2001 and would allocate $540 million on renewable energy projects.[8] To develop renewable energy technologies and other programs expected to struggle after deregulation, the California Energy Commission created its Public Interest Energy Research program, which initially drew about $62 million annually from the state's SBC.[9]

By 2006, fifteen states created SBCs. The seventeen organizations that administer the funds, which are scheduled to total $4 billion by 2017, collaborate through a nonprofit organization called the Clean Energy States Alliance. The organization sponsors original research, collects information and analyses, and seeks to expand the use of clean energy technologies with a special emphasis on solar, wind, and fuel cells. Moreover, the group seeks to increase the efficiency of state research by eliminating duplication of efforts and by providing forums for the states to share knowledge and insights.[10]

Renewable Portfolio Standards

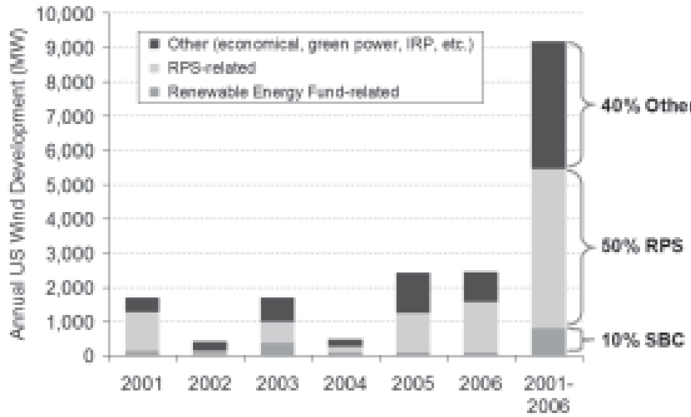
An RPS is a legislative mandate requiring electricity suppliers (often referred to as "load serving entities") in a given geographical area to employ renewable resources to produce a certain percentage of power by a fixed date.

An RPS program transfers the risk of renewable energy investments from regulators to investors.[11] RPS uses the market as a mechanism to determine the efficacy of any given technology; as a result, higher costs, if they occur, are distributed evenly throughout society to those that benefit from them, and are blended with the lower costs of existing conventional generation.[12]

Unlike instruments developed by public utility commissions with long and complex procedures, often followed by litigation, RPSs are bureaucratically simple.[13] RPSs enable customers to pay producers directly for renewable energy, obviating the need for the administration of funds by government agencies. And, unlike a one-time award for funds, no project is guaranteed a place in the market.[14]

First implemented by Iowa and Minnesota in the 1980s, twenty-four states and the District of Columbia have already passed RPS laws requiring utilities to use renewable resources as a portion of their overall provision of electricity.[15] Four other states have nonbinding renewable energy goals.[16] Five more states—Florida, Indiana, Louisiana, Nebraska, and Utah—are considering mandating some form of RPS. Of the approximate 9,000 MW of wind energy in the United States, roughly fifty percent, or 4,500 MW, have been promoted directly by RPS policies, whereas ten percent, or 900 MW, have been promoted by SBCs from 2001 to 2006.[17]

Figure 1: Annual U.S. Wind Energy Development by State Policy Mechanism, 2001 to 2006



The Case for Federal Intervention

There are three reasons, however, why continued reliance on state-based efforts such as SBCs and RPSs will be insufficient to promote renewable energy technologies in the United States on the scale needed to fight climate change.

Improving Reliability

First, federal intervention is needed to improve electricity reliability. Contrary to what some opponents of renewable energy assert, the variability of renewable resources becomes easier to manage the more they are deployed. Electrical and power systems engineers have long held the principle that the larger a system becomes, the less reserve capacity it needs. Demand variations between individual consumers are mitigated by grid interconnection in exactly this manner. When a single electricity consumer, for example, starts drawing more electricity than the system allocated for each consumer, the strain on the system is insignificant because so many consumers are drawing from the grid that it is entirely likely another consumer will be drawing less to make up the difference. This "averaging" works in a similar fashion on the supply side of the grid. Individual wind turbines average out each other in electricity supply.[18] So when the wind is not blowing through one wind farm, it is likely blowing harder through another.

Because the technical availability of one wind turbine rivals that of a single conventional power plant, wind farms of hundreds or thousands of turbines have even greater reliability because it is unlikely that all turbines would be down at the same time. Furthermore, when turbines do malfunction, they take far less time to recover than massive conventional power plants or nuclear reactors that have literally millions of individual components, arranged in complex circuits prone to mechanical failure.[19] Analysts already confirmed the benefit of wind power's greater technical availability in the United States. Indeed, a November 2006 study assessing the widespread use of wind power in Minnesota concluded that "wind generation does make a calculable contribution to system reliability" by decreasing the risk of large, unexpected outages.[20]

Improved reliability of supply is important, as blackouts and brownouts exact a considerable toll on the American economy. The U.S. Department of Energy ("DOE") estimates that while power interruptions often last only seconds or minutes, they cost consumers an average of $150 to 400 billion every year.[21] The Electric Power Research Institute projects the annual costs of poor power reliability at $119 billion, or forty-four percent of all electricity sales in 1995.[22]

However, to capture such benefits, renewable energy technologies must be spatially deployed in every state and must have national penetration rates above ten percent. Penetration rates of renewable energy technologies nationwide are still low—around three percent of overall installed electricity capacity in 2007. Collective state efforts are expected to increase this amount to only around four percent by 2015 and five percent by 2030, but the environmental benefits of renewable energy only really start to accrue at penetration rates well above this rate. Federal intervention in the form of a nation-wide SBC or RPS aiming for targets of ten to twenty percent by 2020 would expand the diversity of technologies used to access renewable resources.

Improving Energy Security

Second, larger penetration rates are needed to ensure energy security. This is because the geographical dispersion of generators not only improves their overall reliability; it makes them more secure—and thus resilient to accidental power outages and failure, or intentional attack and disruption. Notwithstanding intense media focus on the security dangers from nuclear reactors and natural gas facilities, the nation's power grid represents an equally serious threat to energy security. The security issues facing the modern electric utility grid are almost as serious as they are invisible.

For example, in 1975 the New World Liberation Front bombed assets of the Pacific Gas and Electric Company more than ten times, and members of the Ku Klux Klan and San Joaquin Militia have been convicted of attempting to attack electricity infrastructure.[23] Internationally, organized paramilitaries such as the Farabundo-Marti National Liberation Front were able to interrupt more than ninety percent of electric service in El Salvador and even had manuals for attacking power systems.[24]

Some caution that all it would take to cause a "cascade of power failures across the country," costing billions of dollars in direct and indirect damage, is a few motivated people with minivans and a couple of mortars and balloons, which they would use to chaff substations and disrupt transmission lines.[25] A deliberate, aggressive, well-coordinated assault on the electric power grid could devastate the electricity sector. Replacement time would be "on the order of Iraq," not "on the order of a lineman putting things up a pole."[26]

A deliberate, aggressive, well-coordinated assault on the electric power grid could devastate the electricity sector.

Several recent trends in the electric utility industry have increased the vulnerability of its infrastructure. To improve their operational efficiency, many utilities and system operators have increased their reliance on automation and computerization. Low margins and various competitive priorities have encouraged industry consolidation, with fewer and bigger facilities and intensive use of assets in one place. As the National Research Council noted, "control is more centralized, spare parts inventories have been reduced, and subsystems are highly integrated across the entire business."[27]

Federal promotion of renewable energy on a national scale can improve the security of the grid by decentralizing electricity generation. Even when renewable resources like wind and solar are concentrated, the tendency for them to produce power in incremental and modular amounts makes it much more difficult to disrupt large segments of generation. The International Energy Agency has noted that centralized energy facilities create significant targets for terrorism because attacking a few facilities can cause large power outages.[28] In contrast to the security risks of large centralized generators, decentralizing energy facilities and providing power through more modular and distributed energy systems minimizes the risk of accidents and grid failures, and does not require transporting or storing hazardous or radioactive materials. Analysts have tended to refer to renewable energy systems (and other forms of distributed generation such as fuel cells and small-scale cogeneration units) as "supple" power technologies because they are modular suited to dispersed siting.[29] A national RPS or SBC promoting renewables could greatly contribute to the overall security of the nation's electric infrastructure by forcing more technologies into the portfolio of all American utilities.

Providing Climate Benefits

Third, and perhaps most important, federal intervention is needed to fight climate change and minimize "free-riding" going on in states that have chosen to rely on nuclear and fossil fuels to generate electricity, instead of promoting renewable energy. The DOE has already determined that only "the imposition of [a national] RPS would lead to lower generation from natural gas and coal facilities."[30] Examinations of fuel generation in several states confirm this finding, as well as the tendency for a national RPS to displace oil-fired generation, which is still a significant source of electricity in Florida, New York, and Hawaii. Equally important, but often overlooked, is how SBC- or RPS-induced renewable generation would offset nuclear power in several regions of the United States.

Researchers in North Carolina, for example, determined that a state-wide RPS would displace facilities relying on nuclear fuels and minimize the environmental impacts associated with the extraction of uranium used to fuel nuclear reactors.[31] In Oregon, the Governor's Renewable Energy Working Group analyzed a twenty-five percent statewide RPS by 2025 and projected that every fifty MW of renewable energy would displace approximately twenty MW of base-load resources, including nuclear power.[32] Environment Michigan estimates that a twenty percent RPS by 2020 would displace the need for more than 640 MW of power that would have otherwise come from both nuclear and coal facilities.[33]

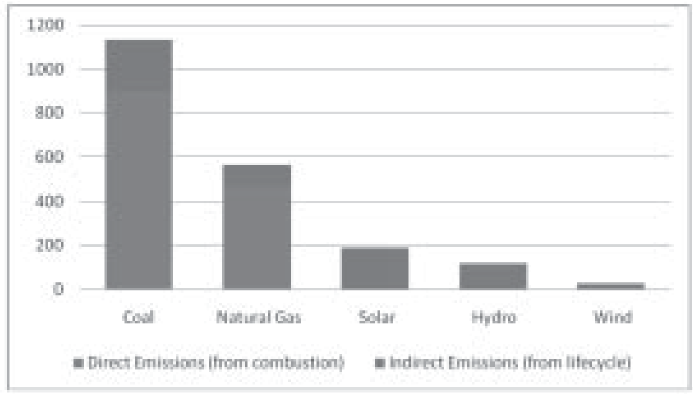
By offsetting the generation of conventional and nuclear power plants, only large-scale renewable energy penetration rates would avoid many of the environmental and social costs associated with the mining, processing, transportation, combustion, and clean-up of fossil and nuclear fuels. By promoting technologies that displace conventional forms of electricity generation, federal promotion of renewable energy would substantially decrease air pollution in the United States. A single one MW wind turbine running at only thirty percent of capacity for one year displaces more than 1,500 tons of carbon dioxide, 2.5 tons of sulfur dioxide 3.2 tons of nitrous oxides, and 60 pounds of toxic mercury emissions.[34]

An RPS program transfers the risk of renewable energy investments from regulators to investors.

One study assessing the environmental potential of a 580 MW wind farm located on the Altamont Pass near San Francisco, California, concluded that the turbines displaced hundreds of thousands of tons of air pollutants each year that would have otherwise resulted from fossil fuel combustion.[35] The study estimated that the wind farm would displace more than twenty-four billion pounds of nitrous oxides, sulfur dioxides, particulate matter, and carbon dioxide over the course of its twenty-year lifetime—enough to cover the entire city of Oakland, California in a pile of toxic pollution forty-stories high.[36]

Renewable energy technologies possess an even greater ability to mitigate climate change. The International Atomic Energy Agency estimates that when direct and indirect carbon emissions are included, coal plants are around ten times more carbon intensive than solar technologies and more than forty times more carbon intensive than wind technologies. Natural gas fares little better, at three times as carbon intense as solar and twenty times as carbon intensive as wind.[37] The Common Purpose Institute estimates that renewable energy technologies could offset as much as 0.49 tons of carbon dioxide emissions per every MWh of generation. According to data compiled by the Union of Concerned Scientists, a twenty percent RPS would reduce carbon dioxide emissions by 434 million metric tons by 2020—a reduction of fifteen percent below "business as usual" levels, or the equivalent to taking nearly seventy-one million automobiles off the road.[38]

Figure 2: Direct and Indirect Carbon Emissions by Electricity Technology (equivalent grams of CO_2/kWh) [39]



These estimates are not simply theoretical. Between 1991 and 1997 renewable energy technologies in the Netherlands reduced that country's annual emissions of CO_2 between 4.4 million and 6.7 million tons. Renewable technologies were so successful at displacing greenhouse gas emissions that Europe now views renewable energy as "the major tool of distribution utilities in meeting industry CO_2 reduction targets."[40]

Conclusion

Given such obvious and overwhelming advantages, it is hard to believe that many utilities and policymakers diligently oppose national promotion on renewable energy, repeating myths that have long since been debunked. Largely, the remaining objections to federal intervention constitute a diminishing series of canards that mischaracterize a national SBC or RPS as an unnecessary federal intervention in a relatively free market. Forgetting that a majority of states are well on their way to imposing their own clunky, overlapping, inconsistent, competing, and sometimes irrational mess of mandates, opponents churn out four war-torn myths every time the issue is considered:

The first criticism is that a national SBC or RPS would create "winners and losers." In reality, all states have renewable resources they can affordably develop. However, under the current system of state mandates, some states are "losers" by subsidizing the cheap, polluting electricity in other states. Other states are victims to inconsistencies between state mandates that produce perverse predatory trade-offs and require them to export their cheap in-state renewable electricity in exchange for more expensive electricity or renewable energy credits. A national mandate would level the playing field by creating consistent, uniform rules and by allowing utilities to purchase renewable energy credits or develop renewable resources anywhere they are cost competitive.

The second criticism is that a national mandate would increase electricity rates. However, in most states, renewable energy mandates have not significantly increased rates and a consensus of economic models predict that a national policy would generate substantial consumer savings over the existing patchwork of state programs. By expanding the amount of energy that would offset gas-fired generation, a federal intervention would reduce demand on a strained and volatile natural gas market. Renewable energy units with markedly faster lead-times than conventional and nuclear reactors speeds the cost recovery of critical transmission investments and reduces the rate increases needed to pay for new transmission.

Another common criticism is that a federal mandate would harm the utilities sector in the form of future profits they will not be able to recover from consumers through higher electricity rates. For policymakers, balancing utility profits with electricity prices is one of the hard decisions we elect them to make. However, elected officials should consider that utility claims of lost profit are short-sited and strategically unsound. In reality, a more predictable regulatory environment decreases utility litigation and compliance costs relative to a growing tangle of vague and unstable state mandates. Expanding the universe of eligible renewable resources and establishing clear, uniform trading rules creates far more flexibility for regulated utilities and rewards utility investments on the basis of smart market strategy. By promoting a robust domestic renewable energy manufacturing sector, a national mandate reduces the costs utilities pay in unfavorable exchange rates for foreign parts and labor and redirects those investments to the U.S. labor market.

A final criticism is that a national RPS or SBC would promote only least-cost options such as wind turbines and landfill gas generators (and not solar photovoltaic, solar thermal, small-scale hydroelectric, and geothermal plants). Existing state programs, however, reveal that mandates with broad qualifying resource eligibility actually have led to the development of many different renewable resources. Utilities have already demonstrated that they can meet state requirements by deploying a diverse portfolio of renewable resources that best match their service areas. By geographically and monetarily expanding the market for renewable resources, a national RPS is likely to further diversify the deployment of renewable energy technologies. In Nevada, geothermal energy may be cheaper to develop than wind. In the Pacific Northwest, incremental hydroelectric power may be cheaper than solar. In the Southeast, biomass may be the most affordable. A national RPS mandate with a fuel-based definition of eligible renewable resources ensures that free market principles, rather than regulatory set-asides or political patronage, determine which technologies will be most cost competitive in certain areas of the country. An added bonus is that a national RPS decreases compliance costs for regulated utilities, since a technology-neutral mandate allows utilities to meet RPS obligations using the technology that is most cost competitive for the fuels available.

Ultimately, by establishing a consistent, national mandate and uniform trading rules, a national SBC or RPS can create a more just and predictable regulatory environment for utilities while jump-starting a robust national renewable energy technology sector. By offsetting electricity that utilities would otherwise generate with conventional and nuclear power, a federal action would decrease electricity prices for American consumers while protecting human health and the environment at a scale and magnitude not possible with state programs.

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