Chapter 3

Costs and Benefits of Increasing Renewable Energy Use in the United States

Before the 1980s, the only widely used renewable electricity technology was hydropower. Hydropower is still the most significant source of renewable energy, producing 20 percent of the world's electricity and 10 percent of that of the United States. The 1973 oil crisis awoke the country to its vulnerability through dependence on foreign oil. Subsequent changes in federal policy spurred the development of renewable technologies other than hydro.

In 1978, Congress passed the Public Utility Regulatory Policies Act (PURPA), which required utilities to purchase electricity from renewable generators and from cogenerators (which produce combined heat and power, usually using natural gas) when it was less expensive than electric utilities could generate themselves.

Some states, especially California and those in the Northeast, required utilities to sign contracts for renewables whenever electricity from those sources was expected to be cheaper over the long term than electricity from traditional sources. These states saw the largest renewables development under PURPA. However, because oil price projections were high and because utilities were planning expensive nuclear plants, these renewables contracts turned out to be expensive relative to the low fossil fuel prices of the 1990s.

Nevertheless, under PURPA over 12,000 megawatts of nonhydro renewable generation capacity came on line. This development enabled renewable technologies to develop commercially. Wind turbine costs, for example, decreased by more than 80 percent.

Over the last five years, renewable energy growth has been modest, averaging less than 2 percent per year, primarily because of the low cost of fossil fuels.[1] In addition, the uncertainty around the deregulation of the utility industry largely froze investment in renewables, as utilities avoided new long-term investments.

Current levels of renewables development represent only a tiny fraction of what could be developed. Many regions of the world and the United States are rich in renewable resources. Winds in the United States contain energy equivalent to 40 times the amount of energy the nation uses. The total sunlight falling on the country is equivalent to 500 times America's energy demand. And accessible geothermal energy adds up to 15,000 times national demand.[2] Of course, there are limits to how much of this potential can be used, because of competing land uses, competing costs from other energy sources, and limits to the transmission system needed to bring energy to end users.

Below we summarize several studies from the late 1990s that have looked at scenarios involving a greater role for renewable energy technologies. These studies examined a number of policy mechanisms to increase the percentage of renewables in the electricity mix, then considered the costs and benefits of those policies. The results of these studies consistently show that the US can meet a significant share of its electricity needs from renewable resources at a modest cost, while reducing harmful air emissions, easing pressure on natural gas prices, and greatly diversifying the electricity mix.

UCS Renewable Portfolio Standard Analysis

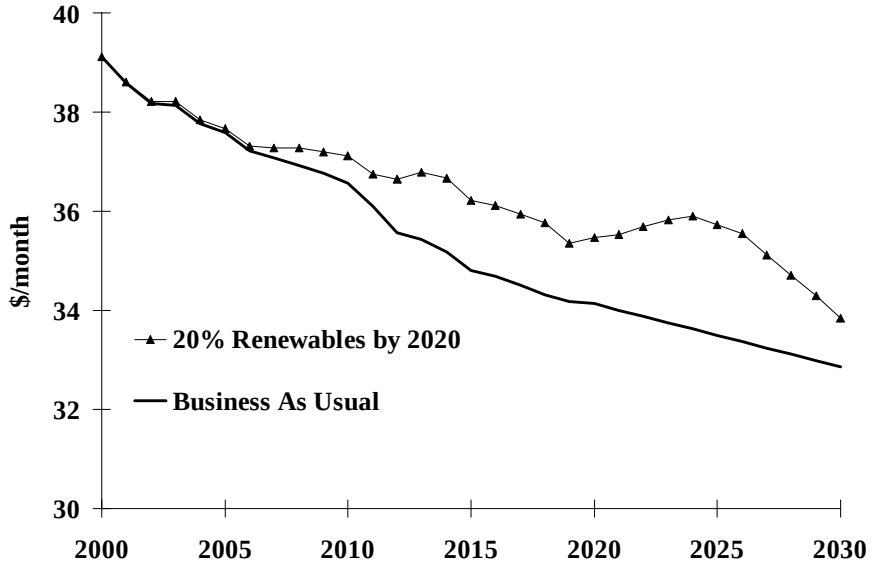
A 1999 study by UCS analyzed the costs and benefits of generating a gradually increasing share of the nation's electricity from wind, biomass, geothermal and solar energy, as proposed in six federal bills. [3] These renewable portfolio standards (RPS) range from 4 percent in 2010 to 20 percent in 2020. The study found that achieving the most aggressive renewables target of 20 percent in 2020 would freeze electricity-sector carbon dioxide emissions at year 2000 levels through 2020 at a modest cost of $18 per ton reduced. By contrast,

carbon dioxide emissions are projected to grow 24 percent over the same period under a business-as-usual scenario.

Meeting the 20 percent target would also result in renewable energy development in every region of the country. In particular, the Plains, Western, and Mid-Atlantic states are projected to generate more than 20 percent of their electricity from a diverse mix of renewable technologies. Biomass, wind, and geothermal energy are projected to provide the majority of new renewable generation.

The study also found that the RPS proposals would reduce a portion of the savings consumers are expected to realize from lower electricity prices under a business-as-usual scenario to achieve these benefits. But in every RPS proposal, customers would still be paying less for electricity than they are today. Even under the more aggressive 20 percent RPS, average consumer electricity prices were projected to fall 13 percent between 1997 and 2020, compared with 18 percent without an RPS. This would reduce a typical (500 kilowatt-hours per month) household's expected average electric bill savings of $5.90 per month between 1998 and 2020 under business as usual by $1.33 (figure 10).

Figure 10. Average Monthly Electricity Bill for a Typical Nonelectric Heating Household



Source: Steven Clemmer, Alan Nogee, and Michael Brower, *A Powerful Opportunity; Making Renewable Electricity the Standard*, Union of Concerned Scientists, January, 1999.

The UCS study also showed that increasing renewable energy use would reduce some of the projected growth in natural gas prices for all gas consumers. For example, the 20 percent RPS lowered the projected growth in average natural gas prices by 5 percent in 2020. For the over 50 percent of households that heat with natural gas, gas savings completely offset the slightly higher electricity costs over time. Even with a renewables target of 20 percent, however, total natural gas generation would still nearly quadruple from 1997 levels.

Energy Information Administration RPS Analyses

A 1998 study by the Energy Information Administration (EIA) found that achieving a 10 percent penetration of nonhydro renewables in 2010 would result in a 3 percent higher average electricity price in 2020 compared with a business-as-usual scenario, but the price would still be 17 percent lower than it was in 1996.[4] The study also showed that the RPS would reduce a portion of the average residential household's expected electricity bill savings of about $6.56 per month between 1996 and 2020, due to lower electricity prices under a business-as-usual scenario, by a *maximum* of $2.63 per month in 2020.

However, a close examination of the results revealed major savings for consumers that were not made explicit in the report. First, slightly higher electricity prices under the RPS compared with business-as-usual projections would stimulate investments in energy efficiency, reduce the demand for electricity, and lower consumer electricity bills. Second, by displacing some of the projected growth in natural gas use for electricity generation, the RPS was shown to reduce projected average natural gas prices by 6 percent and lower costs for all gas consumers.

Including these effects would reduce the projected peak cost of the RPS from $10.6 billion to $1.8 billion in 2020 and would actually produce a net savings of $1.8 billion in 2010.[5]

The EIA study also found that an RPS of 10 percent in 2010 would result in a 10 percent drop in projected carbon dioxide emissions and a 8 percent drop in projected nitrogen oxide emissions in 2020 in the electricity sector.

Energy Innovations Study

A 1997 study by UCS and others—*Energy Innovations*—analyzed the impacts of achieving a 10 percent penetration of non-hydro renewable electricity in 2010, as part of a more comprehensive set of policies to achieve a 10 percent reduction in carbon emissions below 1990 levels.[6] Researchers modeled a hybrid renewable portfolio standard/public benefits fund approach, in which funds were raised through a charge of 0.2¢ per kilowatt-hour (¢/kWh) on all electricity sales to "buy down" the projected capital costs of renewable generating technologies to levels competitive with fossil fuels. In addition, no single renewable technology was allowed to capture more than half the market share to spread out the costs among a number of technologies.

The study showed that the RPS reduced carbon emissions 7 percent below projected levels in 2010 at a cost of $26 per ton of carbon dioxide saved.[7] The RPS was also effective in dramatically lowering the cost of renewable technologies, which in turn reduce average electricity prices by more than 2 percent in 2010 and offset much of the higher initial costs. The study also found that combining the RPS with policies to increase energy efficiency would create jobs, produce savings for consumers and the economy, and greatly reduce air pollution.

Department of Energy Five-Laboratory Study

An analysis by a working group of staff from five Department of Energy national laboratories projected that between 40,000 and 80,000 MW of renewable generating capacity could be added to the US electricity mix by 2010 for under $50 per ton of carbon (or about $14 per ton of carbon dioxide).[8] This would increase the market share of renewables by 5 percent to 10 percent of total generation. A $50-per-ton charge is equivalent to adding 0.5 ¢/kWh to the cost of natural gas-generated power and 1.3¢/kWh to coal-generated power.

One conclusion of the DOE laboratories' research is that renewables are necessary for greenhouse gas reductions. "While aggressive energy efficiency and fuel switching can reduce domestic carbon emissions to approximately 1990 levels by 2010, controlling or reducing carbon emissions beyond that date will require greater energy contributions from low-carbon technologies such as renewables."

REFERENCES

[1] US Energy Information Administration, *Renewable Energy Annual 1997*, Volume I, October 1997, DOE/EIA-0603(97).

[2] Michael Brower, *Cool Energy: Renewable Solutions to Environmental Problems*, MIT Press, 1992.

[3] Steven Clemmer, Alan Nogee and Michael C. Brower, *A Powerful Opportunity: Making Renewable Electricity the Standard*, Union of Concerned Scientists, November 1998.

[4] Energy Information Administration, Office of Integrated Analysis and Forecasting, *Analysis of S. 687, the Electric System Public Benefits Protection Act of 1997*, prepared for Senator James M. Jeffords, February 1998, SR/OIAF/98-01. EIA also modeled two RPSs gradually increasing over time to 5 percent and 10 percent of total US electricity generation in 2020 for *Annual Energy Outlook—1998: With Projections to 2020*, December 1997, DOE/EIA-0383(98), on line at www.eia.doe.gov/oiaf/aeo98/homepage.html.

[5] Consumers gas savings and the impact on electricity sales from higher electricity prices under the RPS were calculated by UCS based on the detailed results of EIA's analysis, generated by the National Energy Modeling System and provided to us by EIA staff.

[6] Alliance to Save Energy, American Council for an Energy-Efficient Economy, Natural Resources Defense Council, Tellus Institute, and Union of Concerned Scientists, *Energy Innovations: A Prosperous Path to a Clean Environment*, Washington, DC: Alliance to Save Energy, 1997.

[7] The cost per ton of carbon dioxide saved comes from an update to *Energy Innovations* called *Policies and Measures to Reduce CO2 in the United States: An Analysis of Options Through 2010*, by the Tellus Institute and the World Wildlife Fund, 1998.

[8] Interlaboratory Working Group on Energy-Efficient and Low-Carbon Technologies, *Potential Impacts of Energy-Efficient and Low-Carbon Technologies by 2010 and Beyond*, Oak Ridge, Lawrence Berkeley, Argonne, Pacific Northwest, National Renewable Energy Laboratory, 1997, on line at www.ornl.gov/ORNL/Energy_Eff/CON444.