Renewing America

The Case for Federal Leadership on a National Renewable Portfolio Standard (RPS)

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Dr. Benjamin Sovacool, Senior Research Fellow

Forward by Marilyn Brown
National Commission on Energy Policy

NETWORK FOR NEW ENERGY CHOICES
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Christopher Cooper founded the Network for New Energy Choices (NNEC), a national non-profit organization committed to reforming U.S. energy policy to expand the energy choices of American consumers. Working with a growing coalition of non-profit groups, municipal officials, business leaders and academics, NNEC is promoting creative ideas for financing community-based energy projects and advocating for progressive utility policy reform. For NNEC, Mr. Cooper has published the nation's most comprehensive ranking of state net metering programs, has authored multiple trade press articles and is regularly quoted in the national news media on trends utility policy reform.

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FORWARD

By Dr. Marilyn Brown, National Commission on Energy Policy

"Renewing America: The Case for Federal Leadership on a National Renewable Portfolio Standard" has been published at an opportune time. Momentum is gathering to convert the patchwork quilt of state renewable portfolio standards (RPS) and goals into a more uniformly woven national policy, and this report by Chris Cooper and Benjamin Sovacool will help raise the debate to a higher level of factual basis.

One bellwether of this mounting support for a national RPS is the recently modified policy recommendations of the National Commission on Energy Policy (NCEP). For those who are unfamiliar with the NCEP, it was established in 2002 with funding from the Hewlett Foundation (in partnership with The Pew Charitable Trusts, John D. and Catherine T. MacArthur Foundation, David and Lucile Packard Foundation, and Energy Foundation), to develop a revenue-neutral package of policies designed to ensure affordable and reliable energy for the 21st Century while responding to growing concerns about the nation's energy security and the risks of global climate change. Since publishing its 2004 report, *Ending the Energy Stalemate,* which was silent on the future of a national RPS, the NCEP has now embraced the concept. The evolution of this position reversal is instructional.

At its inception in 2002, the Commission elected to focus on the virtues of an economy-wide greenhouse gas (GHG) tradable-permits system as the cornerstone of its climate policy. The Commission's economic analysis projected that the contribution of non-hydro renewable electricity resources would grow to as much as 10% of total generation by 2020 were a GHG cap-and-trade program implemented in conjunction with a significant increase in energy R&D funding. In contrast, business-as-usual policies would result in a U.S. electric system with only 3% non-hydro renewables in 2020.

The Commission's latest policy recommendations (released in April 2007) reflect the sense that progress in addressing climate change needs to be accelerated beyond the originally proposed pace of policy intervention. As a result, it calls for more aggressive emissions targets and a higher safety valve price, coupled with two complementary policies: a federal RPS aimed at increasing the share of electricity generated by renewable resources nationwide to at least 15 percent by 2020 and an increase in vehicle fuel-economy (CAFE) standards. The Commission believes that this portfolio of policies will produce significantly larger environmental benefits over the next two decades while still meeting the economic test of "no significant harm."

Many of the virtues of a national RPS are articulated in unprecedented detail in this report by Cooper and Sovacool. The development of a national program would help to avoid "free riders" and would prevent predatory trade-offs by creating a uniform definition of eligible renewable fuels. In addition, Federal Renewable Energy Credit

(REC) trading rules would create a uniform price for renewable energy credits and would establish a more predictable financing environment for investors.

At the same time, the report describes some of the reasons why many stakeholders do not support the promulgation of a national RPS. Recognizing the critical role of utilities in delivering successful growth scenarios for renewable energy, the report explores their sources of resistance. To the extent utilities are viewed as blocking renewable energy, we all need to understand the realities and drivers of the utility business to determine which concerns about renewable energy are legitimate and work together to reduce any unnecessary disincentives that may be embedded in our regulatory policy.

- Investor-owned utilities seek to deliver affordable and reliable electric services along with shareholder value. This report summarizes a substantial body of evidence suggesting that a national RPS would generate at most only modest increases in electricity costs, and in many states it could produce cost reductions. Depending on the regulatory regime in place in any particular state, cost reductions could mean savings to consumers at the expense of utility profitability.

- Electricity providers and regulators have cautioned that a greater deployment of renewables could strain the reliability and stability of their systems due to the intermittency of wind and solar resources. This report, however, suggests that an order of magnitude increase in renewables could produce greater reliability. When a single wind turbine fails or when wind or solar resources in one area subside, a system with ample and dispersed renewable generators can normalize quickly.

- The report also challenges the view that some states do not have sufficient renewable resources to meet a quota without importing resources or buying renewable energy credits from other states.

Coming from the Southeast, I am sensitive to the uneven geography of renewable resources. To address the greater challenges faced by resource-poor regions, I recommend the expansion of a national RPS to accommodate investments in energy efficiency improvements that displace electricity consumption as is currently done in three state portfolio standards (Brown, et al., 2007). By broadening the eligible clean energy resource mix, the economic efficiency of meeting resource targets can be maximized and costs minimized. In addition, equity is advanced: utilities in states with scarce renewable resources can place relatively more emphasis on energy efficiency than utilities operating in resource-rich regions. Lastly, allowing for a renewable energy and energy efficiency mix enhances the flexibility with which states can meet overall sustainable energy goals.

To promote investments in energy efficiency, Cooper and Sovacool recommend that a national RPS should apply to electricity demand, not installed capacity. This provides utilities with an incentive to pursue cost effective demand-reduction strategies as a way of reducing the total compliance level. This is perhaps a simpler mechanism for promoting energy efficiency, and one that I would support. However, I do not believe it provides as powerful an incentive as an RPS that allows any combination of energy efficiency and renewable energy to meet the RPS goal.

The capstone of Cooper and Sovacool's detailed review of the state RPS experience is its eight lessons of RPS design (Table 8.2). The NCEP has also identified a number of principles as starting points for consideration as Congress begins debating various RPS proposals. Despite the use of entirely independent and distinct methods, these two sets of principles are remarkably consistent with one another. What follows is a list of the NCEP principles followed by a reference to the Cooper and Sovacool "lesson."

- "Apply to all retail electricity providers, not just electric utilities" (Cooper and Sovacool's Lesson 4)

- "Complement but not pre-empt state programs and recognize credits that are used for compliance with state RPS requirements" (Cooper and Sovacool's Lesson 7)

- "Be technology neutral—the program should be designed to treat all covered renewable sources equally" (part of Cooper and Sovacool's Lesson 2)

- "Provide credit for early action—utilities that have invested in renewable energy prior to the enactment of a federal RPS should not be penalized" (part of Cooper and Sovacool's Lesson 2)

- "Allow for national trading, including efforts to standardize the monitoring, verification, and distribution of credits in a fair and efficient manner taking into consideration the significant variation that currently exists across state programs" (Cooper and Sovacool's Lessons 5 and 6)

- "Include express provisions assuring retail electricity providers of cost recovery and a fair rate of return for renewable energy investments undertaken to comply with a federal RPS." (NCEP, 2007, p. 24).

This last NCEP principle is the only one that Cooper and Sovacool do not address explicitly in their list of lessons – quite a remarkable congruency of the two sets of guidelines given their independent derivation.

"Renewing America: The Case for Federal Leadership on a National Renewable Portfolio Standard" is going to be a major resource for stakeholders and an asset for our political representatives and their staff as the United States enters an active season of debate about the possible establishment of a national RPS. I am delighted to be a part of this fact-filled report's publication and strongly recommend that stakeholders and policy analysts take the time to read it.

Dr. Marilyn Brown

Dr. Brown is a Commissioner for the National Commission on Energy Policy, former Director of Oak Ridge National Laboratory's Engineering Science and Technology Division, and currently teaches in the School of Public Policy at Georgia Tech. Prior to Oak Ridge, she was a tenured Associate Professor in the Department of Geography at the University of Illinois, Urbana-Champaign. Dr. Brown has a Ph.D. in Geography from the Ohio State University, a Masters Degree in Resource Planning from the University of Massachusetts, and is a Certified Energy Manager. She has authored more than 140 publications and has been an expert witness in hearings before Committees of both the U.S. House of Representatives and the U. S. Senate. Dr. Brown serves on the boards of directors of the American Council for an Energy-Efficient Economy and the Alliance to Save Energy, and on the editorial boards of several journals.

References:

Brown, Marilyn A.; Dan York; Martin Kushler, 2007. "Reduced Emissions and Lower Costs: Combining Renewable Energy and Energy Efficiency into a Sustainable Energy Portfolio Standard," *The Electricity Journal, 20 (4)*: 62-72.

National Commission on Energy Policy. 2007. *Energy Policy Recommendations to the President and the 110th Congress of the United States.* (Washington, DC: National Commission on Energy Policy), http://www.energycommission.org/site/page.php?index.

Executive Summary

In a little over the last decade, at least 21 states have passed renewable portfolio standards (RPS) – laws requiring electricity suppliers to employ a certain percentage of renewable energy to meet growing energy demands. In that same time, Congress has considered (and rejected) at least 17 different proposals for a national RPS.

Each time a national RPS is debated, opponents argue that a federal mandate will increase electricity rates and cost utilities billions of dollars by forcing investments in expensive renewable technologies. The Bush Administration officially rejects a national RPS on the grounds that it would create "winners and losers" among regions of the country and increase electricity prices in places where renewable resources are less abundant or harder to cultivate.

This summer, Congress will again take up the issue of a national RPS and this report is designed to ensure that the debate moves beyond repetition of the war-torn canards that have plagued past discussions. "Renewing America" is designed as a comprehensive briefing book on RPS issues.

This report moves beyond past evaluations in a very important way. Instead of analyzing how a federal RPS would affect ratepayers, utilities and the environment relative to a world without any RPS policy, "Renewing America" evaluates the efficacy of a national standard given the existing (and expanding) universe of state-based RPS laws. "Renewing America" is unique from other reports by answering a question most have not yet tackled:

Is a *national RPS better or worse than a patchwork of state-based standards?*

Cost -
A National RPS Lowers Energy Costs

• Consumers in every region save billions, a total of $49.1 billion nationwide.

A 20 percent by 2020 federal RPS would decrease consumer energy bills by an average of 1.5 percent *per year*, and save consumers in ever region billions of dollars:

- West South Central: $13.3 billion
- East North Central: $8.4 billion
- California: $6.0 billion
- Mid-Atlantic: $5.7 billion
- Mountain: $5.0 billion
- South Atlantic: $2.9 billion
- Northwest: $2.6 billion
- West North Central: $2.2 billion
- East South Central: $1.6 billion
- New England: $1.4 billion

• Larger economies of scale decrease costs 20% to 60%.

A national RPS by 2020 could lower construction costs for wind turbines by more than 20 percent and decrease the cost of biomass generators by nearly 60 percent.

• Lower natural gas prices save consumers $10 to $40 billion.

Renewable generation offsets natural gas combustion. A 1 percent decrease in natural gas demand can reduce the price of natural gas by up to 2.5 percent. Nine of fifteen studies found that a national RPS would save consumers $10 to $40 billion in natural gas expenditures.

• Higher RPS targets save utilities 0.4 to 0.6 cents per kWh.

Renewable resources can serve as a "hedge" against the financial risks associated with volatility in the natural gas market. The value of this "hedge benefit" increases as the percent of the RPS mandate increases.

• Uniform rules for trading renewable energy credits (RECs) save utilities $14 billion.

By eliminating geographical barriers, a national REC trading system would increase market volume and provide a predictable rate of return for investors. A federal RPS with a nationwide REC trading system saves utilities $14 billion compared to an RPS without national REC trading.

• Renewables generate 80% more jobs than equal investment in fossil fuels.

A 20% RPS by 2020 would create as many as 240,000 new jobs – in manufacturing, construction, operations, maintenance, shipping, sales and finance – versus 75,000 jobs if the energy were provided by fossil fuels.

• **A national RPS creates new jobs in states with the greatest manufacturing losses.**

The 20 states that would gain the most manufacturing jobs from a national investment in wind energy, for example, represent more than 2/3 of the manufacturing jobs lost in the U.S. between 2001 and 2004.

• Quicker lead times minimize expensive construction cost overruns.

Renewable technologies have quicker lead times (2 to 5 years) than conventional or nuclear plants (10 to 15 years), decreasing the financial risk associated with borrowing millions of dollars to finance generators that take10 to 15 years before they start producing a single kilowatt of electricity.

Industry -
A National RPS will jump-start U.S. materials and manufacturing sectors

• American companies have enough materials for major expansions in wind energy.

American composite manufacturers say they can provide enough fiberglass at competitive prices in the next three years to power 100,000 MW of new wind energy (nearly 6 percent of the country's entire electricity supply).

• Increased demand for wind components creates new American industries.

Increased demand for wind turbine materials and components will allow more than 16,000 companies (with over 1 million employees) to enter the turbine manufacturing market.

• A national RPS will improve manufacturing efficiency.

More domestic renewable energy manufacturing facilities will save utilities money by decreasing reliance on overseas shipments of materials, which suffer from unfavorable exchange rates.

Transmission –
A National RPS Speeds Investment in Critical Infrastructure

• Utilities benefit from congestion pricing

When transmission is saturated, prices increase because there is not enough electricity to meet demand. Market forces create perverse incentives for some utilities to profit from congestion prices, delaying new transmission until the system is at risk of catastrophic failure.

• A national RPS forces critical transmission system upgrades

Maintaining adequate transmission will require the construction of 26,600 miles of new transmission in the next decade, quadrupling planned expenditures to $56 billion by 2011.

• Renewable energy overcomes public objection to new transmission lines

Case studies show that public opposition to transmission lines turns into widespread support when utilities justify the infrastructure with the need to interconnect new renewable generation.

• A national RPS speeds recovery of transmission investments

Because of their quicker lead-times, renewable energy systems can start providing revenue to help pay down debt on transmission investments while conventional plants are waiting to come online. Expedited debt repayment decreases capital costs and lowers electricity rates.

• Increased deployment of renewables improves system reliability

The variability of renewable resources becomes *easier* to manage the more they are deployed. When energy is not available in one area, it is made up by larger outputs of renewable energy in other areas.

• More renewable energy decreases the need for reserve capacity

Modern wind turbines have a technical reliability of 97.5 percent, compared to coal and natural gas plants with a reliability of 85 to 90 percent. Higher technical reliability lowers the probability of unexpected outages and requires less short-term operating reserve.

Fairness – *A National RPS Creates a Level Playing Field for States*

• Uniform rules avoid "free riders"

Some states enjoy artificially deflated electricity prices from cheap, dirty sources of energy, while ratepayers in RPS states pick up the tab for cleaning the air and water and diversifying the nation's electricity generation.

• A national RPS prevents utilities from profiting off of inconsistencies

Because Washington's RPS excludes hydropower, for example, Washington's low-cost renewable energy is sold to consumers in neighboring states, while Washington ratepayers are forced to buy higher-cost renewable energy credits from generators outside the state. In effect, Washington consumers are subsidizing cheaper renewable energy for surrounding states. A national RPS prevents these kinds of predatory trade-offs by creating a uniform definition of eligible renewable fuels.

• All states have renewable resources

The Southeast has the potential to add 2,941 MW of electricity from additions to existing hydroelectric facilities. The Tennessee Valley Authority has documented nearly 900 MW of "cost competitive" renewable energy from wind, biomass, solar and incremental hydropower just in TVA's service territory. And researchers at the University of Georgia have found commercially significant wind resources off the coast of Georgia and South Carolina.

• A national RPS allows utilities to develop resources anywhere

A national renewable energy market allows regulated utilities to invest in renewable resources wherever their development is most cost competitive.

• Federal REC trading rules create a uniform price for renewable energy credits (RECs)

A national REC trading market would allow generators to sell their RECs at a uniform price to retail suppliers anywhere in the nation. An expanded REC market generates more investment capital for renewable technologies by guaranteeing a more stable and predictable rate of return.

Litigation – *A National RPS Avoids Costly Court Battles*

• Ambiguous state mandates invite law suits.

Utilities have gone to court over vague state RPS laws in Connecticut, Iowa, Massachusetts and New Mexico. New legal battles could be waged in Oregon and Washington.

• State RPS laws are vulnerable to Constitutional challenge.

California, Washington, DC, Maryland, Nevada, New Jersey, Pennsylvania and Texas have all adopted restrictions on out-of-state renewable energy that many scholars agree violate the Commerce Clause of the U.S. Constitution.

• A Constitutional challenge is inevitable.

Growing tension between state and federal utility regulators has engendered a kind of "Commerce Clause brinksmanship," that invites interstate utilities to challenge the constitutionality of state RPS mandates.

• The Supreme Court has already given FERC the authority to intervene.

The practical affect of the Supreme Court's 2002 decision in New York v. FERC is that "the federal government could assert jurisdiction all the way to the consumer's toaster if it so chose."

• A successful federal lawsuit could destroy state RPS programs.

One successful Commerce Clause challenge risks a cascade of copy-cat litigation, collapsing the entire state-based RPS structure and destroying the emerging interstate renewable energy market.

Environment – *A National RPS Better Conserves Water, Air and Land*

• A national RPS would displace coal and natural gas.

In a 2002 assessment of a 10% national RPS, the Department f Energy determined that "the imposition of a national RPS would lead to lower generation from natural gas and coal facilities." Analysts have confirmed this trade-off in RPS states like Michigan, New York, Virginia, and Texas.

• Renewable energy offsets nuclear power.

Studies from Michigan, North Carolina, and Oregon found that renewable generation displaces new nuclear reactors and decreases the mining of uranium.

• A national RPS saves billions of gallons of water.

Conventional and nuclear power plants will soon be withdrawing more water for electricity production than America's farmers use for all the irrigated agriculture in the entire nation (over 3.3 billion gallons *each day*).

A nuclear reactor requires 600 times as much water to generate the same amount of electricity as a wind farm. A coal-fired plant uses 500 times as much water as a wind farm; A gas-fired plant uses 250 times as much.

A single 100-watt solar panel saves up to 3,000 gallons of water over its lifetime.

• A national RPS reduces air pollution.

Air pollution from conventional power plants kills between 50,000 and 70,000 Americans each year. A single 1 MW wind turbine (operating at only 30% capacity) displaces 96 tons of nitrous oxides, 69 tons of sulfur dioxide and 1800 pounds of toxic mercury during its 30-year lifespan.

• A national RPS reduces greenhouse gas emissions.

Renewable energies could offset almost ½ ton of carbon dioxide for every MW generated. A 20% by 2020 national RPS could reduce as much carbon dioxide as taking 71 million cars off the nation's roads.

• Renewable energies require *less* land then conventional power plants.

Including the land used for mining, transportation and generation, conventional coal-fired power plants use as much as 100 square kilometers of land for every GW of electricity generated.

> ***Wind farms use up to 75% less land.***
>
> Over 95% of the land used for wind farms remains free for other uses like ranching and farming. Less than 40 square miles could support 38,000 wind turbines producing up to 4% of the nation's electricity demand each year.
>
> ***Solar PV uses up to 90% less land.***
>
> America's entire current electricity demand could be generated by installing PV panels on only 7% of the country's available roofs, parking lots, and highway retaining walls.

Conclusion
Now is the Time for Federal RPS

It is time that federal policymakers engage in an informed, comprehensive and rational debate about the few remaining objections to a federal RPS mandate. America faces serious and mounting energy problems:

- continued dependence on dwindling foreign sources of fossil fuels and uranium
- an undiversified electricity fuel mixture that leaves the nation vulnerable to serious national security threats
- reliance on an ancient and overwhelmed transmission grid that risks more common, more pronounced, and more expensive catastrophic system failures
- an impending climate crisis that will require massive and expensive emissions controls costing billions of dollars and substantially reducing U.S. GDP
- loss of American economic competitiveness as Europe and Japan become the major manufacturing center for new clean energy technologies

It is time to decide. By establishing a consistent, national mandate and uniform trading rules, a national RPS can create a more just and more 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 national RPS would decrease electricity prices for American consumers while protecting human health and the environment.

There is a time for accepting the quirks and foibles of state experimentation in national energy policy; and there is a time to look to the states as laboratories for policy innovation. Now is the time to model the best state RPS programs and craft a coherent national policy that protects the interests of regulated utilities *and* American consumers.

Now is the time for federal leadership.

Renewing America

The Case for Federal Leadership on a National Renewable Portfolio Standard (RPS)

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1. Introduction: Leadership is Making Tough Choices

For a brief time in the late 1950s, Minnesotans waged a battle over whether to adopt daylight savings time. While a majority were in support of "fast time", as it was called then, rural farmers complained that they could not get into the field any faster because "the morning sun does not dry the dew on daylight savings time."[1]

Unwilling to take a firm stand either way, state legislators passed a bill that allowed some counties to adopt their own rules. In the meantime, an alliance of movie theater owners, worried that people would not go to the movies when it was light out, sued the state. Their efforts backfired when the Minnesota Supreme Court issued a ruling that barred counties from adopting a different time from the rest of the state and encouraged the state legislature to resolve the issue one way or another. But, in a contortion of legal reasoning that would make a justice's eyes cross, the state's Attorney General declared that the high court's action could not be enforced against counties that kept whatever time they wanted. The result was that some parts of the state were on a different time than others – including within the state Capitol, where the Governor's Office adopted daylight savings time, while the Legislature and Supreme Court remained on standard time.[2]

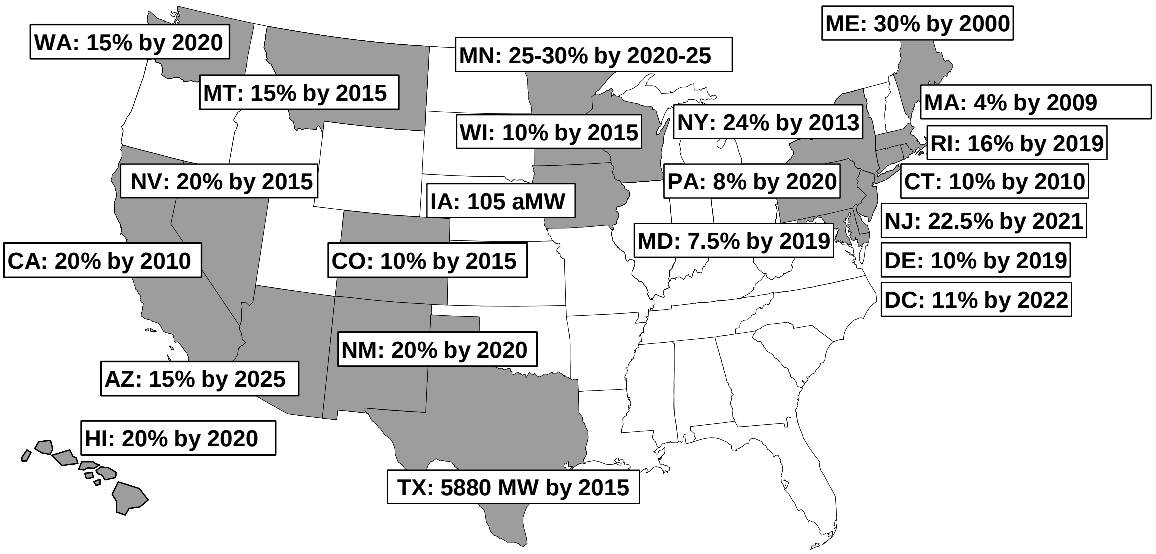
Minnesota's rebel counties were joined by others across the nation, until a tangle of state and local legislation created as much confusion as a British farce. At one point, if you drove the 35 miles from Steubenville, Ohio to Moundsville, West Virginia and wanted your watch to keep local time, you would have to change it seven times en route.[3]

The chaos created by multiple time zones could not stand for long. Someone needed to make a choice, even if it meant siding with one constituency over another. Fortunately, Congress tired of the hodgepodge of time zones dividing the nation and in 1966 passed a law that preempted the states and made daylight savings time uniform across the country.[4]

While the value of a uniform, national renewable portfolio standard (RPS) is not as universally recognized as daylight savings time is today, it should be.

Today, there exists such widespread consensus on the financial, environmental and security benefits enjoyed by diversifying our nation's electricity fuels with clean, renewable resources that 21 states and the District of Columbia have already passed laws requiring utilities to use more of these resources.[5] Seven more states—Florida, Indiana, Louisiana, Nebraska, Utah, Vermont, and Virginia—are considering mandating some form of RPS.

Figure 1.1: State Renewable Portfolio Standard (RPS) Policies (as of March 2007)



Source: Lawrence Berkeley National Laboratory. We have chosen not to include Illinois, which set a voluntary standard of 8 percent by 2013, or Vermont, which mandates that all load growth must be satisfied by renewable energy. We have also excluded New Hampshire, which passed an RPS on April 26, 2007, but had not yet signed the bill into law before the publication of this report.

While most state efforts have been laudable, state RPS statutes have created a patchwork of inconsistent, often conflicting mandates that distort the market for renewable energy technologies and unintentionally inflate electricity prices. By subjecting an increasingly interstate electric utility market to confusing and sometimes contradictory state regulations, this tangle of state-based RPS programs discourages long-term investments and, in some cases, encourages utilities to exploit the inconsistencies.

The federal government has refused to orchestrate some harmony out of the chaos, despite repeated appeals. Indeed, Congress has rejected proposals to establish a uniform national RPS 17 times in the last 10 years.

Table 1.1: Proposals for a National RPS, 1997-2006

Bill No	Act Name	Year
S. 237	Electric Consumers Protection Act	1997
H.R. 655	Electric Consumers’ Power to Choose Act	1998
S. 2287	Comprehensive Electricity Competition Act	1998
H.R. 1828	Comprehensive Electricity Competition Act	1999

S. 1047	Comprehensive Electricity Competition Act	1999
S. 1369	Clean Energy Act	1999
H.R. 2050	Electric Consumers' Power to Choose Act	1999
S. 517	Energy Policy Act	2002
S. 1766	Energy Policy Act	2002
H.R. 6	Energy Policy Act	2003
S. 14	Energy Policy Act	2003
H.R. 6	Energy Policy Act	2005
H.R. 737	Renewable Energy and Energy Efficiency Act	2005
H.R. 969	Taxpayer Abuse Prevention Act	2005
H.R. 983	Federal Renewable Energy Portfolio Standard Act*	2005
S. 427	Renewable Energy Investment Act	2005
H.R. 5926	Freedom Through Renewable Energy Expansion Act	2006

Source: Alan Nogee, Jeff Deyette, and Steve Clemmer, "The Projected Impacts of a National Renewable Portfolio Standard," *Electricity Journal* 20(4) (May, 2007), pp. 33-47; Ryan Wiser, Christopher Namovicz, Mark Gielecki, an d Robert Smith, "The Experience With Renewable Portfolio Standards in the United States," *Electricity Journal* 20(4) (May, 2007), pp. 8-20; ; James W. Moeller, "Of Credits and Quotas: Federal Tax Incentives for Renewable Resources, State Renewable Portfolio Standards, and the Evolution of Proposals for a Federal Renewable Portfolio Standard," Fordham Environmental Law Journal 51 (Winter, 2004), pp. 69-189.
* This act was formally called "To amend title VI of the Public Utility Regulatory Policies Act of 1978 to establish a Federal renewable energy portfolio standard for certain retail electric utilities, and for other purposes."

Although a consensus of economic forecasts predict lower electricity prices from a national RPS, the Bush Administration has officially opposed a federal RPS on the grounds that it would create "winners" and "losers" among regions of the country and increase electricity prices in places where renewable resources are less abundant or harder to cultivate.[6]

Utilities have opposed the costs associated with "draconian" federal interventions and advocacy groups like the Union of Concerned Scientists (UCS) continue to churn out report after report demonstrating that a national RPS would lower electricity prices and save consumers money.

Which side is right?

The answer is the same as in the Minnesota dispute: Both are.

The cost of a national RPS to regulated utilities may well represent a decrease in future profits that the industry would otherwise collect from ratepayers.

A national RPS may simply shift cost savings from the electricity sector to ratepayers who would enjoy lower electricity prices. In contrast, rejecting a national RPS may subject consumers to higher energy costs in order to protect the profits of the electricity sector.

Policymakers must make a choice.

The vacuum of federal leadership on renewable portfolio standards is not without consequence. Not only does reliance on state-based action make for an uncertain regulatory environment for potential investors, it creates inherent inequities between ratepayers in some states that are paying for "free riders" in others. Indeed, the most compelling argument for federal action may be that a national RPS would help correct many of the market distortions brought about by a patchwork of inconsistent state actions.

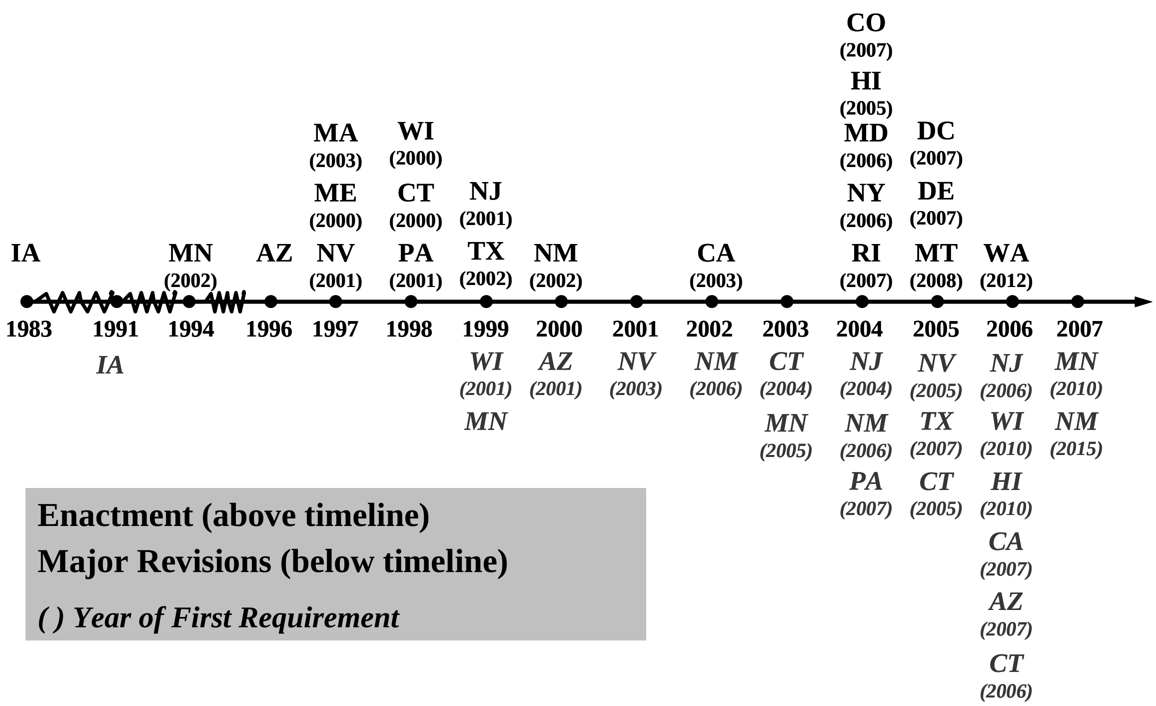
The History of State RPS

An RPS is a legislative mandate requiring electricity suppliers (often referred to as "load serving entities") to employ renewable resources to generate a certain percentage of power by a fixed date. For instance, California requires that utilities produce 20 percent of their electricity from renewable energy resources by 2010.

In 1985, Iowa passed legislation to "encourage the development of alternate energy production facilities and small hydro facilities in order to conserve our finite and expensive energy resources and to provide for their most cost effective use."[7] The law mandated that utilities enter into power purchase agreements with renewable energy producers and set the upper limit on aggregate purchases of renewable energy at 105 MW. In 1994, Minnesota passed similar legislation. The first state to actually use the term "RPS", however, was California, in legislation proposed (but ultimately defeated) in 1995.[8]

A slew of state RPS programs were implemented in the late 1990s.[9] In May, 1997, Maine passed a binding RPS mandate requiring all electric power retailers to generate 30 percent of their power from renewable resources by 2000. Around the same time, Massachusetts enacted a bill to establish an RPS for companies that provided retail power service. Nevada also included an RPS in legislation it enacted in 1997 to deregulate the sale of electric power retail markets (later modified as a stand-alone RPS law). Connecticut (1998), New Jersey (1999), Texas (1999), Wisconsin (1999), Arizona (2001), Hawaii (2001), New Mexico (2002) and, finally California (2002) quickly followed. All told, as of May, 2007, 21 states (and the District of Columbia) had adopted some form of an RPS mandate.

Figure 1.2: The Adoption and Revision of State RPS Policies[10]



Source: Union of Concerned Scientists; revised by Lawrence Berkeley National Laboratory

Originally, RPS mandates were intended to promote the development of renewable energy technologies and diversify the fuels that America relies on for generating its electricity. Policy makers intended these regulations to correct three major failures of the existing "free" market for electricity fuels:

- **Electricity prices do not reflect the social costs of generating power**.

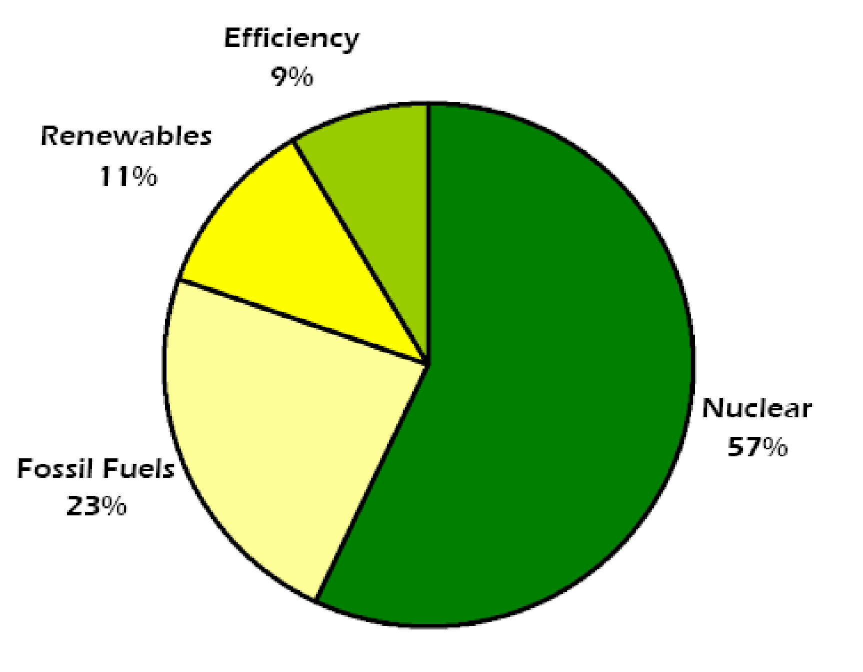
  Hidden costs (often referred to as "negative externalities")—the need to secure foreign imports of fuel, environmental damage from air and water emissions, medical expenses associated with air pollution and transportation accidents, catastrophic global climate change—are not typically reflected in the rates we pay for electricity.

- **Energy subsidies have created an unfair market advantage for fossil fuel and nuclear 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 80 percent of U.S. Department of Energy appropriations for research and development (R&D) have gone to nuclear and fossil fuel technologies.[11]

Even though the coal, gas and nuclear energy industries are relatively mature sectors (electricity has been produced from coal for over a century), federal R&D expenditures continue to favor these industries at the expense of funds for newer renewable technologies. In fiscal year (FY) 2006, for instance, the federal government allotted $580 million in R&D funds to fossil fuels and $221 million to nuclear (The FY 2008 budget calls for expanding this figure to an astonishing $547 million). But the wind industry, in contrast, received only $38.3 million.[12]

Figure 1.3: Energy Research and Development Spending by Sector, 1948-1998



Source: Public Interest Research Group (PIRG), 2005

- **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.

RPS mandates are intended to stimulate a market for renewable resources and spur additional research, development and implementation of renewable energy technologies. Government intervention helps level the playing field by neutralizing a legacy of unequal subsidies. Mandating a certain percentage of renewable penetration also helps internalize some of the environmental costs associated with dirty energy sources and provides a mechanism for early developers of cleaner resources to recover more of the value of renewable energy technologies.

The electricity market benefits as well. RPS policies create an incentive for retail utilities either to build their own renewable facilities or buy renewable energy credits (RECs) from other generators.[13] As the demand for renewable energy grows, manufacturers gain experience that lowers the cost of clean electricity production for everyone.

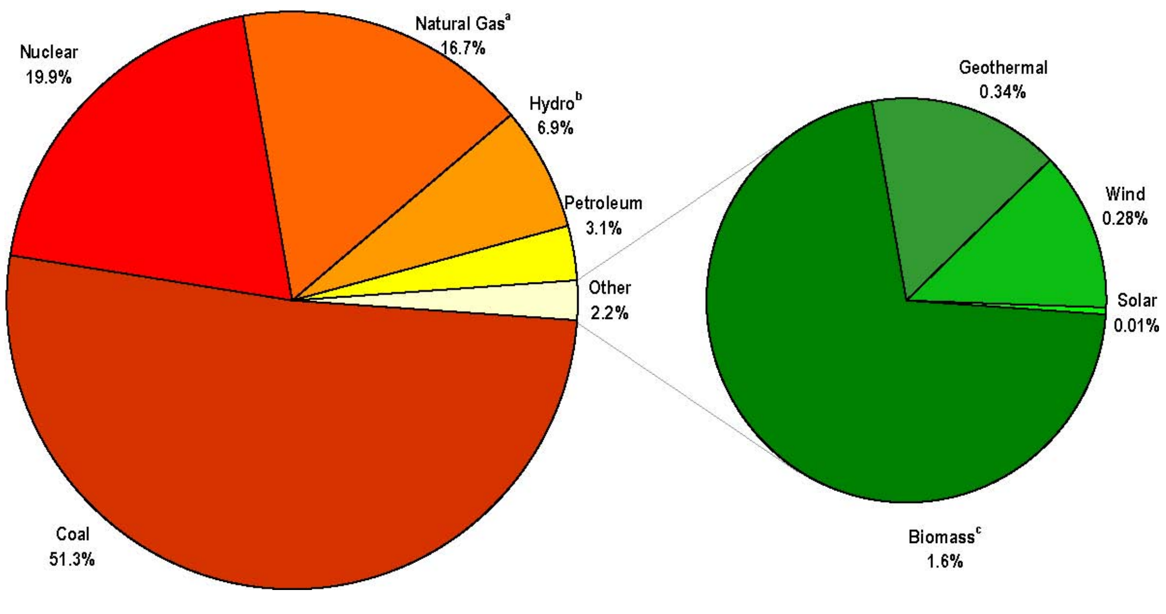
Paying Lip-Service to Renewable Energy

Throughout the energy crisis of the1970s, policy experts predicted that renewable energy systems would be in widespread use by the 1980s. President Carter even told Dr. Arthur Rosenfeld, one of the five current members of the California Energy Commission, that he expected renewable energy systems to reach 10 percent of national electricity capacity by 1985. Carter's optimism was based on estimates from Dennis Hayes, director of the Solar Energy Research Institute, who in 1977 predicted that:

> By the year 2000, renewable energy sources could provide 40 percent of the global energy budget; by 2025, humanity could obtain 75 percent of its energy from solar resources … Every essential feature of the proposed solar transition has already proven technically viable.[14]

That was over 30 years ago, and America has yet to tap even half the potential of its vast renewable resources. Excluding large hydroelectric generators, renewable resources in 2005 comprised only about 2 percent of the fuel used to generate electricity in the U.S.

Figure 1.4: U.S. Electricity Generation by Source, 2005[15]



Source: U.S. Energy Information Administration, 2005

State-Based RPS Are Not Enough

RPS proponents are fond of noting that states with RPS mandates represent 52.6 percent of the nation's electric retail revenue.[16] Indeed, with so much state-level action, one might be tempted to agree with the National Rural Electric Cooperative Association (NRECA) that "activities on a number of fronts supplant the need for a federal RPS."[17]

But, like card tricks and drag queens, looks can be deceiving.

Many states set RPS levels that provide economic rewards for existing renewable generation without inducing any new renewable energy at all.

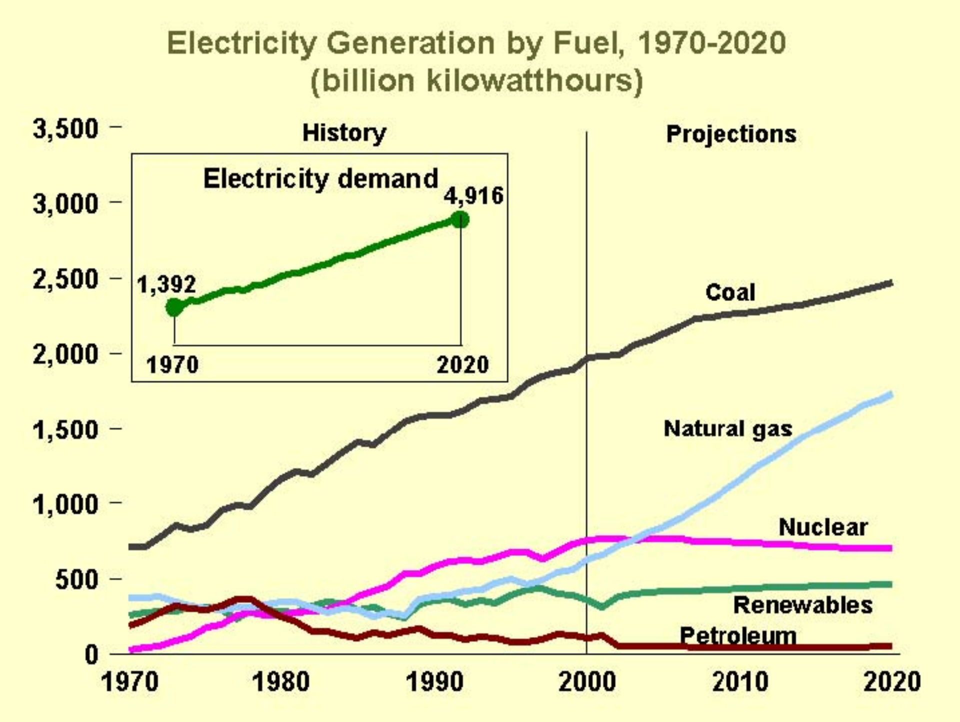
Because the accumulated demand for electricity is expected to accelerate over the next several decades, the penetration of renewable energy technologies in individual states, while noteworthy, is not likely to substantially alter the national fuel mix. For the past fifteen years, non-hydroelectric renewable energy resources have provided around 2 percent of the country's electricity supply.[18]

Even with the contribution of the existing state RPS mandates, non-hydroelectric renewable energy resources are not expected to alter substantially the nation's electricity fuel mix.[19]

The U.S. Energy Information Administration (EIA) uses one of the most rigorous methodological tools yet invented to estimate future renewable energy deployment—the National Energy Modeling System (NEMS). NEMS tracks the geographical differences in regional energy markets at sub-state levels, including specific census divisions and North American Electric Reliability Council (NERC) sub-regions. NEMS is so rigorous it is used as a benchmark for models employed by the UCS and the Tellus Institute in their own projections of renewable energy production.

In its *2006 Annual Energy Outlook*, the EIA used NEMS to estimate the contribution of renewable fuels to U.S. electricity supply given existing state-based RPS mandates. According to NEMS, electricity generation from biomass is expected to increase from 0.9 percent of total generation in 2004 to 1.7 percent in 2030. Wind is forecast to increase from 0.4 percent to just 1.1 percent of total generation. Geothermal power is projected to increase from 0.4 percent to 0.9 percent. Grid-connected solar is anticipated to remain at less than 0.1 percent of total generation.[20]

Figure 1.5: Projection of Electricity Demand and Generation by Fuel (billion kWh)



Taking into consideration the contributions of state-based RPS mandates, EIA's projection means that non-hydroelectric renewable energy deployment is expected to rise to no more than about 3 percent by 2015 and 4 percent by 2030.

When broken down by state, EIA projects that 3.7 GW of central-station renewable energy capacity will be added in Texas, 3.4 GW in California, 0.9 GW in Nevada, and 0.5 GW in Minnesota. In Arizona, Colorado, Hawaii, Illinois, Massachusetts, Maine, Montana, New Mexico, New York, New Jersey, Pennsylvania, Vermont, and Wisconsin, small projects are projected to increase the production of renewable energy by only 100 to 200 MW in each state.[21]

Why is the outlook so bleak for renewable energy in the U.S., especially given the rapid expansion of state-based RPS programs?

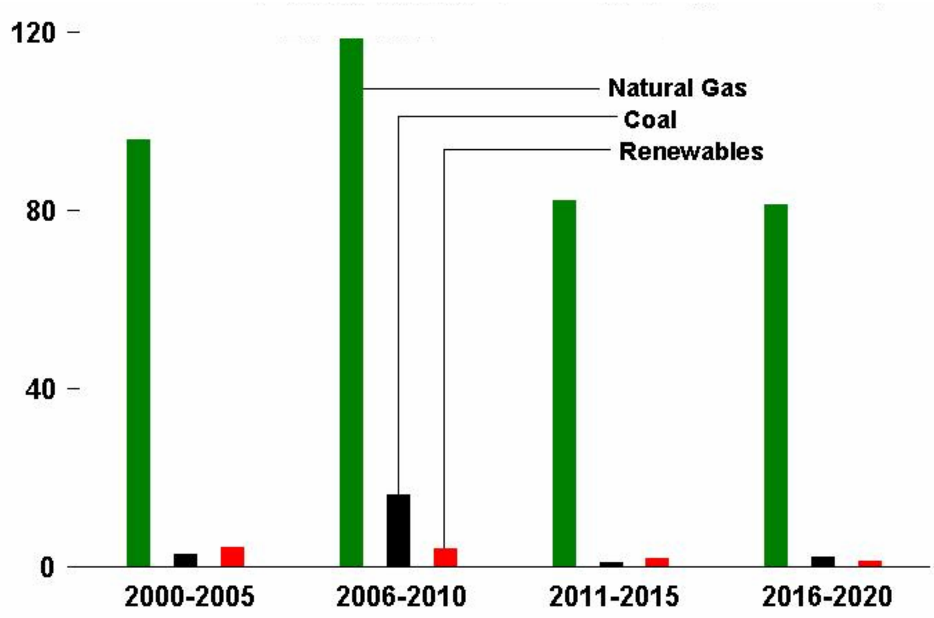
EIA notes that poor financing, comparatively higher capital costs for renewable energy, and the need to build or upgrade transmission capacity from remote resource areas will likely discourage significant investments in renewable energy. EIA also assumes that the federal production tax credit will expire on December 31, 2007, significantly deterring large-scale investments in renewable energy generation.

In an early release of its *2007 Annual Energy Outlook*, EIA's updated analysis reflects its earlier pessimism about the future of renewables:

> Despite the rapid growth projected for biofuels and other non-hydroelectric renewable energy sources … oil, coal, and natural gas still are projected to provide roughly the same 86-percent share of the total U.S. primary energy supply in 2030 that they did in 2005. [22]

Mary J. Hutzler, EIA's Director of the Office of Integrated Analysis and Forecasting, told Congress a few years earlier that she expects the American energy landscape to continue to be dominated by fossil fuels, even with the capacity additions induced by state RPS policies. She estimated that, including state-based RPS, renewable energy technologies would be lucky to achieve more than 5 GW of additional installed capacity by 2010.[23] In fact, if state RPS targets remain at their current levels, Hutzler projects that capacity additions would actually be *less* than 5 GW between 2015 and 2020.

Figure 1.6: Projected Electricity Generation Capacity Additions by Fuel Type, 2000-2020



Source: Huntzler, 2001

EIA's pessimistic projections are based partly on the expectation that base-load fossil fuel generation will continue to have low operating costs compared to current renewable technologies, making it harder for renewables to compete in state-based electricity markets without some form of regulatory intervention.[24]

State Inconsistencies Discourage Investment

"*When people understand what rules are made, life just gets better*."
- Respondent #5, Platts Survey of Utility Executives, 2006

If America's interstate highway system were structured like our renewable energy market, drivers would have to change engines, tire pressure, and fuel mixture every time they crossed state lines.

None of the existing state RPS mandates are alike. Wisconsin, for example, has set its RPS target at 2.2 percent by 2011, while Rhode Island is shooting for 16 percent by 2020. In Maine, fuel cells and high efficiency cogeneration count as "renewable", while the standard in Pennsylvania includes coal gasification and non-renewable distributed generation. Iowa, Minnesota, and Texas set purchase requirements based on installed capacity, while many other states make it a function of electricity sales. Minnesota and Iowa have voluntary standards, while Massachusetts, Connecticut, Rhode Island, and Pennsylvania all levy different noncompliance fees.[25] States vary in their targets, definitions of eligible resources, purchase requirements, renewable energy credit (REC) trading schemes, and compliance mechanisms, among other things.

Conflicts over Statutes

Amid this complex morass of regulations, stakeholders and investors must not only grapple with inconsistencies, they are forced to decipher vague and often contradictory state statutes.[26] In Connecticut, for example, the state's Department of Public Utility Control originally exempted two of the state's largest utilities from RPS obligations because the description of "electric suppliers" in the statute was unclear. These exemptions created uncertainty over whether the statute would be enforced against any utilities at all.[27] Hawaii's standard contained so much "wiggle room" that it was unclear even to its own advocates whether it applied to most of the state's utilities.[28] Such ambiguity has lead to "wide disagreements among parties in regulatory proceedings" about how to enforce some state RPS mandates.[29]

In testimony before the U.S. Senate Committee on Energy and Natural Resources, Don Furman, a senior VP at PacifiCorp, lamented how "for multi-state utilities, a series of inconsistent requirements and regulatory frameworks will make planning, building and acquiring generating capacity on a multi-state basis confusing and contradictory."[30]

Limits on Distributed Generation (DG)

The current state-by-state approach to RPS is also inhibiting the expansion of distributed generation technologies by forcing unusually prohibitive operational procedures. Inconsistent tariff structures and interconnection requirements, for example, add complexity (and therefore cost) to distributed generation projects. In fact, the Clean Energy Group, a coalition of electric generating and electric distribution companies committed to responsible environmental stewardship, forecasts that fuel cells and community-scale wind energy projects are unlikely to play a meaningful role in state RPS markets until policymakers adopt a more comprehensive and uniform approach.[31]

Uncertain Policy Duration

The complexity of state-based RPS statutes is compounded by uncertainty over the duration of many state RPS programs. Stakeholders trying to plan investments in state renewable energy markets are tormented with unknowns.[32] New Jersey, New York, and Rhode Island, for example, will review and potentially modify their RPS schemes in 2008, 2009, and 2010, respectively.

Hawaii's standard expressly allows for its requirements to be waived if they prove to be "too costly" for retail electric providers and consumers.[33] Arizona, New Mexico, and Maine may terminate their RPS programs entirely.[34]

The market disruptions created by complex and often conflicting state RPS mandates are not merely "academic" concerns voiced only by staunch renewable energy advocates. In comments to the New York State Public Service Commission, Executives from Constellation Energy – a utility serving 1.2 million customers in Baltimore and more than 10,000 commercial and industrial customers in 34 states – complained that many state RPS programs "unnecessarily burden interstate commerce, raise the cost of compliance, invite retaliatory discrimination, potentially violate the Commerce Clause, reduce the availability of imports, and are 'impractical' given the inability to track electrons."[35]

Risks Increase Costs

When renewable energy policy is predictable and stable, long-term project financing follows.

Potential investors are less likely to assume persistent risks where legislative or regulatory commitments are weak or constantly changing. Regulatory uncertainty creates substantial direct and opportunity costs for the nation's renewable energy market. Ten years ago, researchers at Lawrence Berkeley National Laboratory estimated that the uncertainties generated by inconsistent and unpredictable energy policies may increase the costs of renewable energy projects up to 50 percent compared to the probable costs under stable regulatory environments.[36] It is not an exaggeration, therefore, to suggest that the instability inherent in a state-based approach to RPS is dramatically distorting private investments in renewable energy generation nationally and prohibiting the expansion of a robust renewable energy sector in the United States.

A federal mandate is critical to correcting these market distortions and signaling a national commitment to renewable energy generation. A federal policy would promote a national renewable energy technology sector that contributes to the U.S. economy, weans the nation from foreign and polluting sources of energy and decreases the real and social costs of electricity for American consumers.

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[1] Quote from *The Minneapolis Star*, January 28, 1959.
[2] Moos, G. (2001). "'Fast Time' causes tense time at capitol," *Session Weekly*, Minnesota House Public Information Office. Available at: http://www.house.leg.state.mn.us/hinfo/swkly/1995-96/select/time.txt
[3] Downing, M. (2006). *Spring Forward: The Annual Madness of Daylight Savings Time*, Shoemaker & Hoard, February 1.
[4] Under the 2005 Energy Policy Act (EPAct) signed into law by President George W. Bush on August 18, 2005, the entire state of Indiana must now observe daylight-savings time. Prior to the law, only certain areas of the state observed the time change. Hawaii, Guam, Puerto Rico, the Virgin Islands, America Samoa and most of Arizona continue to refrain.
[5] We do not count Illinois or Vermont in our calculation because their RPS targets are voluntary, not statutorily mandated. Also, as of publication, New Hampshire's state legislature had passed an RPS of 25% by 2025. However, the mandate still awaits the Governor's signature.
[6] Garman, David K. (2005). "Electricity Generation Portfolio Standards," Testimony before the Committee on Energy and Natural Resources, United States Senate, March 8. Available at: http://www1.eere.energy.gov/office_eere/printable_versions/congressional_test_030805.html

[7] James W. Moeller, "Of Credits and Quotas: Federal Tax Incentives for Renewable Resources, State Renewable Portfolio Standards, and the Evolution of Proposals for a Federal Renewable Portfolio Standard," *Fordham Environmental Law Journal* 51 (Winter, 2004), p. 91.
[8] Volkmar Lauber, "REFIT and RPS: Options for a Harmonized Community Framework," *Energy Policy* 32 (2004), pp. 1405-1414.
[9] James W. Moeller, "Of Credits and Quotas: Federal Tax Incentives for Renewable Resources, State Renewable Portfolio Standards, and the Evolution of Proposals for a Federal Renewable Portfolio Standard," *Fordham Environmental Law Journal* 51 (Winter, 2004), pp. 69-189.
[10] Figure 1.3 shows the rate of state RPS adoption over time, presenting both the year of initial enactment and the years in which major changes to state RPS policies have been made. In addition to these mandatory policies, voluntary renewable energy standards exist in Iowa, Illinois, Vermont, and Maine.
[11] Nayak, Navin. (2005). Redirecting America's Energy: The Economic and Consumer Benefits of Clean Energy Policies. (February). Washington, DC: Public Interest Research Group, p. 11.
[12] Levesque, C. (2007). "What is the percentage of federal subsidies allotted for wind power?" *RenwableEnergyAccess*, April 10.
[13] RPS policies provide regulated utilities with choices similar to the way emissions control strategies implemented in the 1970's and 1980's worked to reduce lead pollution from refineries and chlorofluorocarbons from aerosols. The Clean Air Act amendments of 1990 also used emissions credits as a market-based strategy to stimulate cleaner energy production. Cap-and-trade policies set an upper limit for emissions for a given time period and emissions limits declined over time. Polluters could either reduce their own pollution or buy certificates that represented emissions reductions beyond mandated targets. In a similar way, an RPS allows generators to either generate their own renewable energy or buy credits. It therefore blends the benefits of a "command and control" regulatory paradigm with a free market approach to environmental protection.
[14] Quoted in Howard C. Hayden, *The Solar Fraud: Why Solar Energy Won't Run the World* (New York: Vale's Lake, 2002), pp. 1-2.
[15] Figure used with permission from the Virginia Center for Coal and Energy Research.
[16] Kent S. Knutson and Peter McMahan, "Closing the Green Gap," *Public Utilities Fortnightly* 143(4) (April, 2005), pp. 14-18.
[17] Ralls, Mary Ann. (2006). "Congress got it right: There's no need to mandate renewable portfolio standards," *Energy Law Journal*, 27:2.
[18] U.S. Energy Information Administration, *Annual Energy Outlook 2006: With Projections to 2030* (Washington, DC: U.S. Department of Energy, 2006), p. 81.
[19] See Christian B. Larsen, "Unlocking America's Energy Resources: Future of Renewable Energy," *Testimony Before the House Committee on Science*, August 2, 2006, p. 2; and Jack Barkenbus, R. Jamey Menard, Burton C. English, and Kim L. Jensen, *Resource and Employment Impact of a Renewable Portfolio Standard in the Tennessee Valley Authority Region* (Knoxville: Institute for a Secure and Stable Environment at the University of Tennessee, July, 2006), p. 4.
[20] U.S. Energy Information Administration, *Annual Energy Outlook 2006: With Projections to 2030* (Washington, DC: U.S. Department of Energy, 2006), pp.78-84.
[21] Ibid, p. 82-83.
[22] U.S. EIA, 2007 Annual Energy Outlook, http://www.eia.doe.gov/oiaf/aeo/pdf/earlyrelease.pdf, pp. 3-10.
[23] Mary J. Hutzler, "Hearing on the Effect of Federal Tax Laws on Energy," May 3, 2001, available at http://waysandmeans.house.gov/Legacy/srm/107cong/5-3-01/5-4-hutz/slide7.jpg.
[24] See EIA Assumptions to the Annual Energy Outlook 2006, http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554(2006).pdf, pp. 130-150.
[25] See Massachusetts Division of Energy Resources, "Renewable Portfolio Standard: Policy Analysis," December 16, 2002, available at http://www.mass.gov/doer/programs/renew/rps.htm; U.S. Department of Energy, "State Renewable Portfolio Standards and Purchase Requirements," *Transportation Handbook*, Updated 2006, available at http://cta.ornl.gov/bedb/biopower/State_RPS_and_**Purchase_Requirements**.xls; and National Renewable Energy Laboratory, *Power Technologies Energy Data Book*, 2003, available at http://www.nrel.gov/analysis/power_databook/chapter3.html; and Illinois Commerce Commission, "Illinois Sustainable Energy Plan," February 11, 2005, p. 1-2.
[26] For an excellent overview of state RPS programs, see John J. Fialka, "States Power Renewable-Energy Push," *Wall Street Journal*, June 14, 2006, p. B2; Thomas Petersik, *State Renewable Energy Requirements and Goals: Status Through 2003* (Washington, DC: U.S. Department of Energy, 2004), available at http://www.eia.doe.gov/oiaf/analysispaper/rps/index.html; Pew Center for Climate Change, *Race to the Top: State Experiences With Renewable Portfolio Standards* (2006); National Renewable Energy Laboratory, *Power Technologies Energy Data Book* 2006, available at http://www.nrel.gov/analysis/power_databook/, pp. 94-96.
[27] Nancy Rader, "The Hazards of Implementing Renewables Portfolio Standards," *Energy & Environment* 11(4) (2000), pp. 393.
[28] Ken Costello, "Regulatory Discretion in Implementing Renewable Portfolio Standards: The case of Hawaii," *Electricity Journal* 18(5) (June, 2005), pp. 51-58.
[29] Ken Costello, "Regulatory Discretion in Implementing Renewable Portfolio Standards: The case of Hawaii," *Electricity Journal* 18(5) (June, 2005), pp. 51-58.
[30] Furman, Donald N. (2005). Statement before the U.S. Senate Committee on Energy and Natural Resources, "Power Generation Resource Incentives and Diversity Standards," March 8.
[31] Weiss, Jurgen. (2006). "Integrating fuel cells and RPS markets," Clean Energy Group Working Paper, June.

[32] See Ryan Wiser, Kevin Porter, and Robert Grace, "Evaluating Experience With Renewables Portfolio Standards in the United States," *Mitigation and Adaptation Strategies for Global Change* 10 (2005), pp. 237-263.
[33] Charles G. Willing, "Renewable Portfolio Standards Programs," *Distributed Energy* 5 (2005), pp. 11-24.
[34] See Ryan Wiser, Kevin Porter, and Robert Grace, "Evaluating Experience With Renewables Portfolio Standards in the United States," *Mitigation and Adaptation Strategies for Global Change* 10 (2005), pp. 237-263.
[35] State of New York Public Service Commission, "Case 03-E-0188 – Proceeding on Motion of the Commission Regarding a Retail Renewable Portfolio Standard," *Order Regarding Retail Renewable Portfolio Standard*, September 24, 2004, p. 60.
[36] Wiser, Ryan and Pickle, Steven. (1997). "Financing investments in renewable energy: The role of policy design and restructuring," Ernest Orlando Lawrence Berkeley National Laboratory, March.

2. Economics: A National RPS will Decrease Electricity Prices

A. A Consensus of Models Predict Decreased Prices

Increasingly sophisticated studies conducted by the Union of Concerned Scientists (UCS), U.S. Energy Information Administration (EIA), and Lawrence Berkeley National Laboratory (LBNL) all confirm that a federal RPS would either lower electricity costs for consumers or have a negligible impact on electricity prices. Even these estimates substantially underestimate potential savings because none compare a national RPS to the expanding universe of state-based policies. None assume the cost-savings associated with passing a federal statute that is more precise, more consistent and more predictable than complying with an ever-changing patchwork of inconsistent and often competing state RPS mandates.

Union of Concerned Scientists (UCS)

The most recent (2007) economic analysis by UCS compared a range of potential economic impacts of a national RPS by examining four RPS scenarios matching proposals expected for consideration in the 110th Congress. Using more *conservative* estimates even than the Department of Energy uses to forecast the market potential for wind, geothermal and biomass resources, UCS found that a federal RPS mandate would *lower* consumer energy bills in all four cases.

UCS determined that a 20 percent by 2020 federal RPS would decrease consumer energy bills by an average of 1.5 percent per year and save consumers a total of $49.1 billion (in 2002 dollars) on their electricity and natural gas bills by 2020.[37] According to UCS, a 20 percent RPS by 2020 would lead to substantial cost-savings for four reasons:

1. A national RPS would reduce competition for fossil fuels and lower future prices.

2. Many renewable energy technologies are now less expensive than new fossil fuel plants that generate the same amount of energy.

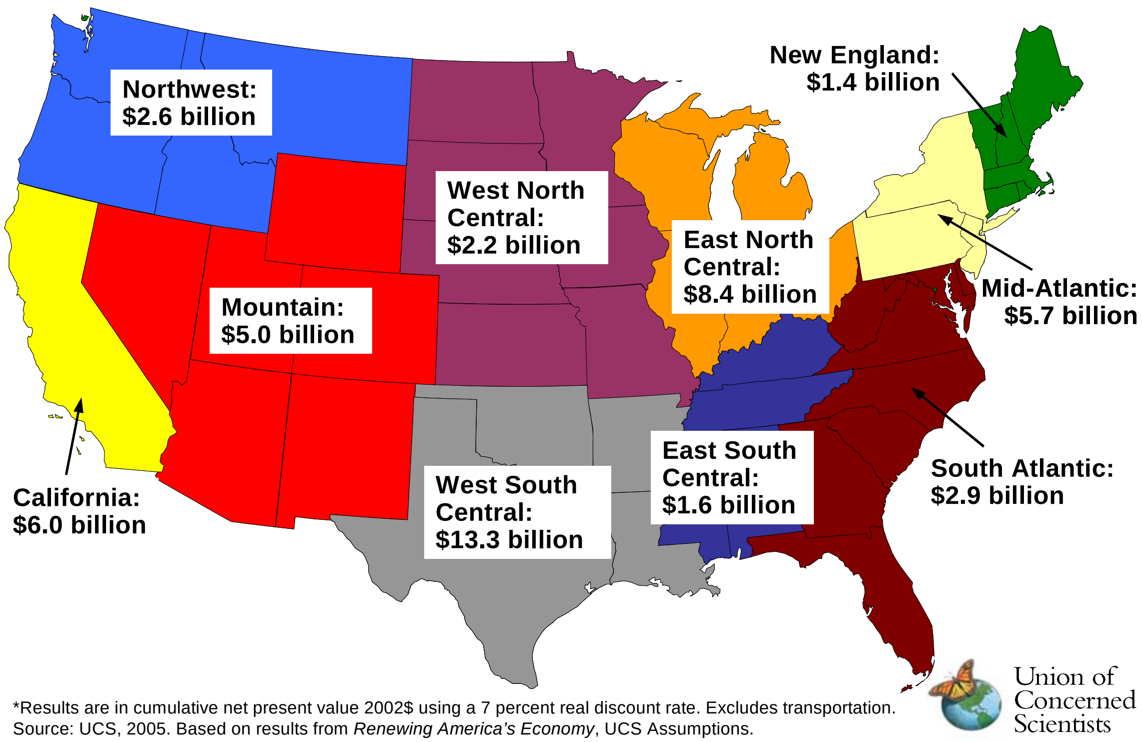
3. A national RPS would reduce the cost of renewable energy by creating economies of scale in manufacturing, installation, operations and maintenance.

4. Increased reliance on renewable energy would offset expensive natural gas-fired generation, and "hedge" against volatile natural gas prices.

All Regions Save Money

Significantly, when UCS performed the same calculations without modifying any of EIA's assumptions, the results still favored a national RPS. Using EIA forecasts, UCS showed that a 20 percent RPS would save consumers in every region of the United States more than $27 billion in electricity and gas costs.

Figure 2.1: Cumulative Energy Bill Savings from a 20% by 2020 RPS*
(by U.S. Census Region)



*Results are in cumulative net present value 2002$ using a 7 percent real discount rate. Excludes transportation.
Source: UCS, 2005. Based on results from *Renewing America's Economy*, UCS Assumptions.

A 20% RPS Saves More than a Smaller Goal

UCS found that a 10 percent RPS would save less money than a 20 percent scenario, but would still save consumers almost $28.2 billion on their electricity and natural gas bills by 2020, with savings continuing to grow to $37.7 billion by 2025. EIA's own analysis found that a 10 percent RPS would save consumers $26.6 billion by 2025.

In a 1999 study, UCS noted that a 20 percent by 2020 federal RPS would save a typical home consuming 500 kWh of electricity per month around $5.90 on their electricity bill. Because an RPS would engender lower projected growth in natural gas prices, UCS calculated that households that heat with natural gas would pay 13 cents less per month on their combined electricity and natural gas bills under a federal RPS.[38] Those numbers are likely much higher today, given inflation and the continued volatility of the natural gas market.

According to more recent UCS calculations, a 20 percent national RPS coupled with extension of the renewable energy production tax credit and widely available net metering[39] would result in annual savings of $105 billion per year (or $350 per year for a typical household).[40]

U.S. Department of Energy - Energy Information Administration (EIA)

In February, 2007, EIA researcher Andy Kydes published the results of his analysis of the market impact of a federal RPS of 20 percent by 2020.[41] Kydes found that a 20 percent national RPS would have a relatively mild affect on electricity prices, projecting rate increases of no more than 3 percent higher than the reference case.[42]

Many of Kyde's assumptions caused his analysis to underestimate the cost savings of a national RPS.

For example, Kydes assumed that the penetration of renewable energy technologies induced by a federal RPS would offset the construction of hyper-efficient integrated gasification combined cycle (IGCC) power plants rather than far less efficient conventional coal-fired plants. This assumption seems remarkably optimistic considering the immaturity of IGCC technology. For example, while defending TXU's plan to build 11 new conventional coal-fired units in Texas, one TXU VP noted:

> IGCC is a promising technology, but is not yet viable on a large-scale commercial basis for the types of coal available in Texas. There are only two IGCC units in operation today in the U.S. – both are small, were heavily subsidized, and actually have dirtier emissions profiles than the supercritical plants we have proposed. Further, both these plants continue to operate at low reliability levels more than five years after coming on line.[43]

In practice, therefore, RPS-induced renewable energy systems are for more likely to offset traditional coal-fired power plants that produce far less energy per ton of coal and generate far more pollutants and carbon emissions than the units Kyde's analysis assumed.

Utility Costs Are Exaggerated

Kydes also claimed that, while consumer electricity prices would be negligible under a 20 percent RPS by 2020, "the cost to the electricity industry over the next 18 years ranges between $35 and $60 billion (2002$)."

But this calculation is also erroneous. Kydes assumed that the marginal price of base-load generation from coal-fired power plants would increase because the plants would have to purchase renewable energy credits to comply with a national RPS. The added cost, according to Kyde's would reduce the profit-margin of coal-fired plants in a competitive market.

This assumption suffers from several flaws:

1. In 21 (and counting) states, coal-fired plants already are burdened with RPS compliance costs, creating inequities in the market for conventional base-load generation.

2. A national RPS would even the playing field. Federal regulation would not impact the ability of coal-fired power plants to compete against one another because every conventional plant would be under the same compliance obligation.

3. Under a national RPS, utilities with conventional holdings have the option of investing in renewable generation rather than buying renewable energy credits. A national RPS represents an investment opportunity for smart utilities to generate RECs to sell to other suppliers rather than buying RECs at a premium.

4. Renewable energy generated to comply with a national RPS mandate generally would offset more expensive natural gas-fired "peaking" generation, before it offsets less expensive base-load.

5. Utilities, most of which own base-load *and* peaking assets, would be required to comply with a national RPS mandate, not individual power plants. Kydes comparison of the marginal cost of electricity from each individual facility owned by a regulated utility artificially inflated the cost estimates of a national mandate by ignoring how renewable generation would offset energy production across a utility's entire portfolio.

Utility Costs Are Consumer Savings

Kydes conclusion is also misleading. The $35 billion to $60 billion in "costs" to the electricity industry really represent a decrease in future profits that the industry would otherwise collect from ratepayers as a result of business-as-usual. In other words, UCS's findings can be completely consistent with Kyde's findings. A national RPS could represent $49 billion in consumer savings that would otherwise be paid to regulated utilities. Policymakers who reject a national RPS may be protecting the future profits of the electricity industry, but those profits come out of the pockets of consumers who would otherwise see lower electricity costs.

Rejecting a national RPS in the interests of the electricity sector exacts considerable costs on American ratepayers even if it results in economic gains for regulated utilities.

Deciding whether to adopt a national RPS, therefore, is really deciding how to balance consumer interests with the interests of the electricity industry. When the real and externalized cost of electricity increases with the continued dominance of fossil fuels, it is not the American taxpayer who profits.

Earlier EIA Data Contradicts Kydes

When Kydes analysis was published, it included a disclaimer that his estimate did not represent official EIA data. Indeed, an older (2003) EIA analysis found that a 10 percent federal RPS by 2020 would have virtually no negative impact on electricity prices. EIA projected that the cost of buying renewable energy credits would be small compared to overall electricity costs, and higher renewable energy costs would be offset by lower natural gas prices. The EIA estimated that total electricity costs to consumers would increase 0.4 percent (from $351.9 billion to $353.4 billion in 2025), but expenditures on natural gas would decline 0.6 percent (from $136.0 billion to $135.2 billion). Therefore, combined total energy expenditures under a 10 percent RPS were expected to be only 0.1 percent higher in 2025.[44]

All of the studies analyzing the economic impact of a national RPS underestimate aggregate savings because none estimate the value of security benefits or system reliability derived from diversifying the nation's electricity fuel supply. Since renewable "fuels" tend to be more predictable and less interruptible than fossil and nuclear resources, supply costs are more stable than technologies that rely on conventional or nuclear fuels. In many cases, these additional benefits can result in substantial savings that are not incorporated into existing assessments of the economic impacts of a national RPS.

Lawrence Berkeley National Laboratory (LBNL)

In March 2007, the Lawrence Berkeley National Laboratory (LBNL) released the most comprehensive and rigorous analysis ever conducted of the economic impact of state-based RPS policies. Researchers analyzed the results of 28 different state or utility-level RPS cost impact projections since 1998. Together, these projections modeled proposed or adopted RPS policies in 18 different states.

LBNL concluded that the long-term rate impacts of state RPS policies were projected to be relatively modest. 19 of the 28 state cost studies predicted rate increases of no greater than 1 percent, and only two of the 28 studies projected increases of greater than 5 percent. Six of the studies, in fact, projected rate *decreases*. LBNL calculated that the median impact on a monthly residential electric bill would be 38 cents. When combined with projected natural gas savings, the overall cost impacts of state-based RPS policies are even more modest, resulting in net consumer *savings* in at least seven of the cases.[45]

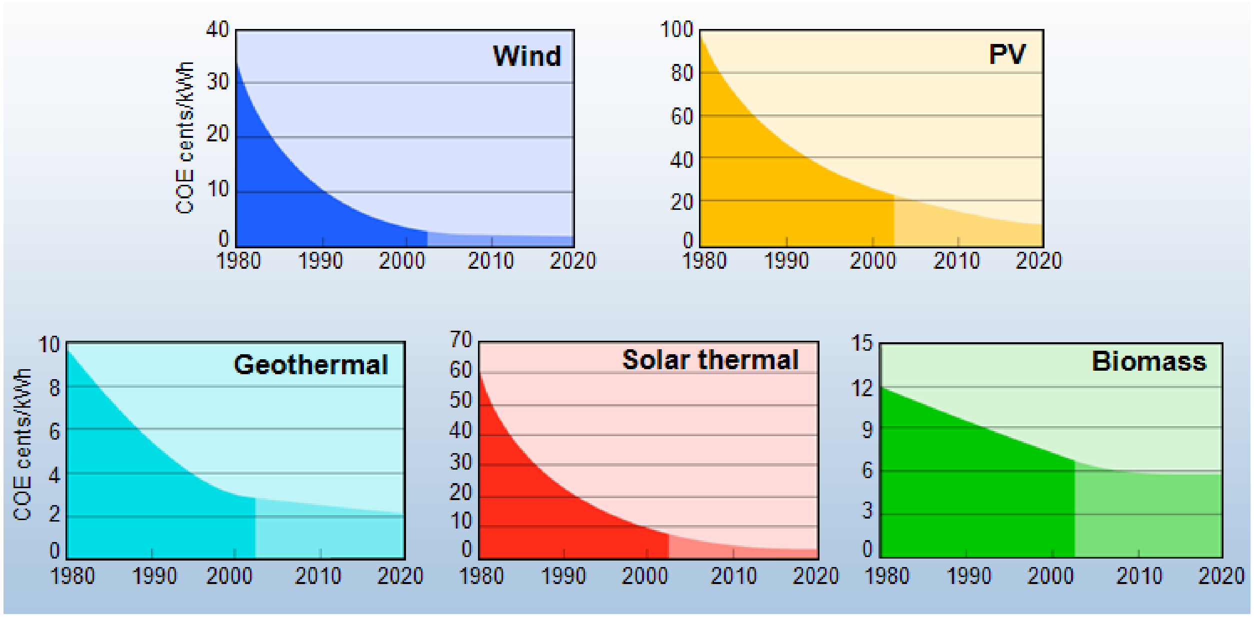
A Federal RPS will save utilities and ratepayers more than a patchwork of state mandates.

Comparing the UCS studies of national RPS proposals with LBNL's analysis of state-based RPS policies suggests that a national RPS could incur substantially higher cost savings than a patchwork of state-based policies. There are several reasons that a national mandate is more likely to reduce electricity rates than continued reliance on state-based policies:

B. Lower Costs from Economies of Scale

Technological improvements in thermal efficiency (the amount of raw energy converted to usable electricity), reductions in manufacturing cost and better construction methods have reduced the cost of renewable technologies consistently over the past thirty years.[46] New wind technologies operate at lower speeds, and newer solar technologies operate with much improved efficiency.[47]

Figure 2.2: Reduction in Cost of Renewable Energy Technologies (Levelized cents/kWh at 2000$)[48]



Source: National Renewable Energy Laboratory, 2002

In those states that have already adopted more aggressive RPS statutes, the renewable energy industry has responded by streamlining manufacturing processes and lowering the cost of technology production. For example, in 2005, the California Energy Commission (CEC) estimated that the average levelized cost (the total cost over the life of a generator divided by the numbers of kilowatt hours [kWh] produced) of wind energy in California was 3.5 cents per kWh, less than one-eighth of the price of producing wind energy just 25 years earlier (In 1980, the cost to produce wind in California was as much as 39 cents per kWh).[49]

Wind and Landfill Gas Already Beat Fossil Fuels

A similar study conducted by the Virginia Center for Coal and Energy Research (VCCER) found that renewable generators fueled by wind and landfill gases offered the *cheapest* forms of electricity—2.8 and 3.0 cents per kWh, respectively—compared to all other generators including advanced coal, natural gas, and nuclear reactors.[50]

Table 2.1: Levelized Cost of Electricity (LCOE) for Fossil, Nuclear, and Renewable Technologies (using data from California and Virginia)[51]

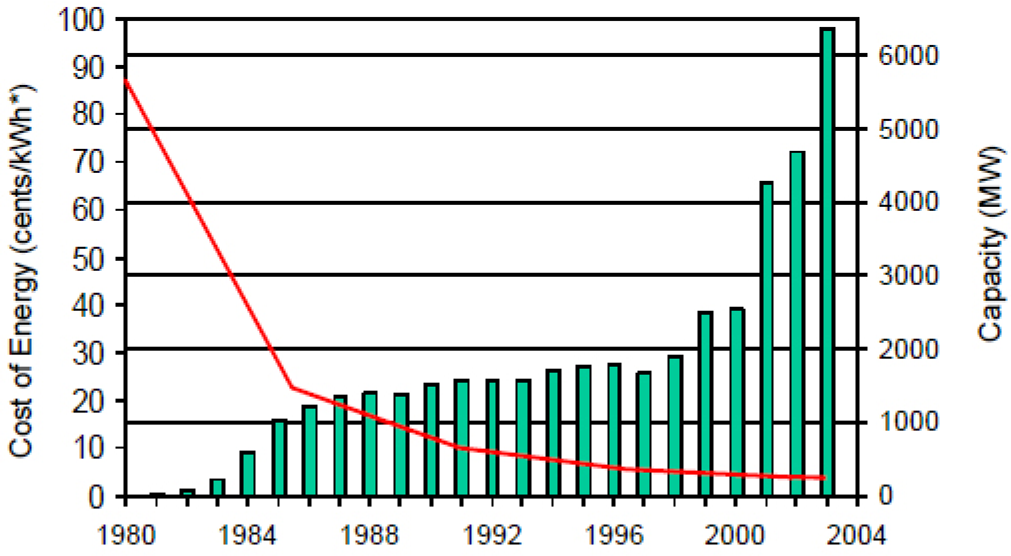
Technology	LCOE, in 2005 $/kWh
Wind	$.028
MSW-Landfill Gas	$.030
Advanced Nuclear	$.035
Scrubbed Coal	$.044
Integrated Gasification Combined Cycle (IGCC)	$.044
Geothermal	$.045
Advanced Combined Cycle Gas/Oil	$.047
Conventional Combined Cycle (CC) Gas/Oil	$.050
Biomass	$.050
IGCC with Carbon Sequestration	$.059
New Hydroelectric	$.061
Advanced Combustion Turbine	$.067
Advanced CC with Carbon Sequestration	$.069
Conventional Combustion Turbine	$.077
Natural Gas Fuel Cell	$.094
Solar Thermal	$.135
Solar, PV (30% capacity factor)	$.235
Solar, PV (10% capacity factor)	$.310

Yet even VCCER's cost estimates are artificially high, since capital in a given industry becomes more productive as the level of cumulative investment increases. The more renewable energy technologies are developed, the cheaper they become. Experience from RPS states suggests that a national RPS would bring even further reductions in the cost of manufacturing renewable technologies. Since most renewable technologies are relatively immature, the potential for cost-savings from "learning" is relatively high.

The Institute of Electrical and Electronics Engineers (IEEE), for example, estimated that a national RPS would bring large scale development of renewable energy and nationwide standards that would lower costs. Such a "learning by doing" approach was estimated to lower the expense of producing, installing, and maintaining renewable energy technologies.[52]

We are already witnessing this "learning effect" with the increased penetration of large wind. The more turbines that get deployed, the more manufacturers invest in research and development to increase turbine size and improve performance. For example, in 1980, when the DOE just started developing commercial wind turbines (and only a few MW were installed), wind energy had a levelized cost of around 81 cents per kWh (in 2000$).[53] After more than 6,000 MW had been installed by 2004, however, the levelized cost dropped sharply to around 5 cents per kWh (and is projected to decrease further as more turbines are deployed).[54]

Figure 2.3: Cost of Energy and Cumulative Domestic Capacity of Wind Energy in the U.S., 1980-2004



Source: U.S. Department of Energy

This "learning effect" was confirmed by the Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) projection of significant continued improvements in the competitiveness of wind technology over the next decade. EERE forecasted cost reductions due to discounts for large-volume purchases of materials, parts and components as well as from the "learning effects" that flow from deploying wind technology to meet greater cumulative electricity volumes.[55] In fact, researchers from Resources for the Future estimate that a 15 percent federal RPS by 2020, could further lower the construction costs for wind turbines by more than 20 percent and decrease the cost of biomass generators by nearly 60 percent.[56]

C. Reduced Fossil Fuel Prices

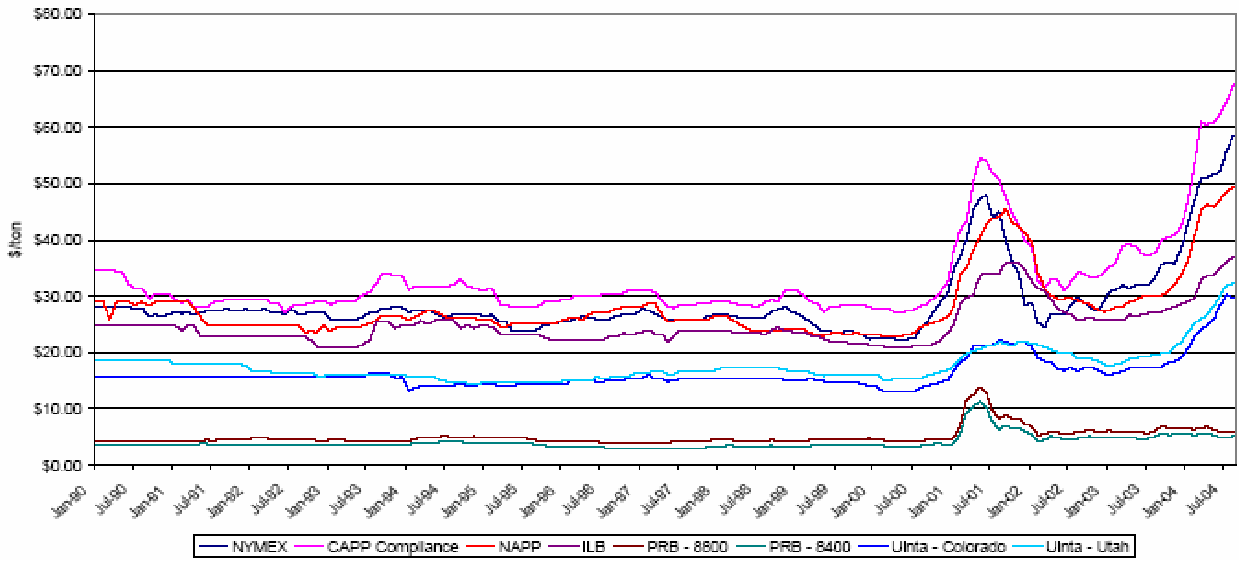
Because fossil fuels inherently involve competition over a limited commodity, supply and demand impacts create a vicious cycle that increases the value of the fuel and adds additional costs that must be absorbed by ratepayers. Since renewable energy technologies utilize domestic and widely available fuels to produce electricity, they decrease demand on fossil fuels and, therefore, lower prices.

Fossil Fuel Prices Have Doubled

From 2002 to 2005, for example, operation and maintenance expenses for utilities rose by nearly $26 billion ($2002). Ninety-six percent of this increase was driven by rising fossil fuel prices, not because parts or labor had gotten more expensive.[57] Aggregate fossil fuel costs nearly doubled in the four years between 2000 and 2004, from $0.023 per kWh, to $0.0437 per kWh.

The overbuilding of gas-fired peaking plants in the 1990's resulted in skyrocketing demand for natural gas, which, in turn caused prices to surge. Between 1995 and 2005, natural gas prices rose by an average of 15 percent *per year*. As a result, many electricity generators switched back to coal-fired peaking units. But the switch only increased demand for coal, driving the price up. In 2003, for example, the cost of coal in Central Appalachia was $35 per ton. The price increased nearly 7 percent *each year* until, by 2006, a ton of coal in the same region cost close to $60 a ton.[58] In some regions of the U.S., coal prices actually doubled between 2002 and 2004.

Figure 2.4: U.S. Domestic Coal Price History, 1990-2004



Source: Modified from Pincock Perspectives, "Trends in U.S. Domestic Coal Markets," September, 2004, p. 2.

Natural Gas Prices Will Increase

"There is a risk in investment in nuclear and coal. Coal has got the carbon unknown mostly in terms of draconian impositions by the Feds. Nuclear has got safety and liability concerns. So I think people will still go gas because they have less money invested in it, with the idea they can pass it on to retail customers, particularly in market-oriented areas."

- Respondent #15, Platts Survey of Utility Executives, 2006

Many of the electricity generating units used for intermediate and "peaking" purposes (for example, to meet increased demand for air conditioning on hot, summer days) use natural gas for fuel. This is because natural gas generating units usually require a lower capital investment than nuclear or coal-fired plants, have shorter construction and lead-times, and tend to produce lower emissions than coal plants. Natural gas-fired units also can be turned on or off quickly, giving them operational flexibility to meet short-term peak electricity demands.

The electricity sector's demand for natural gas has increased from 24 percent of total natural gas consumption in 2000 to 29 percent in 2005.[59] And consumption of natural gas is likely to increase even further for two reasons:

Lower Reserve Margins

First, increased electricity demand in many areas has shrunk reserve margins to historically low levels. By 2005, reserve margins across the contiguous United States had dropped to 15 percent and, in some large states (like Texas and Florida), as low as 9 percent. Shrinking reserve margins coupled with increased electricity demands have forced many utilities to restart "mothballed" natural gas-fired generating units. And plans for new peaking units in large consumer states like Texas and Florida rely overwhelmingly on natural gas.[60]

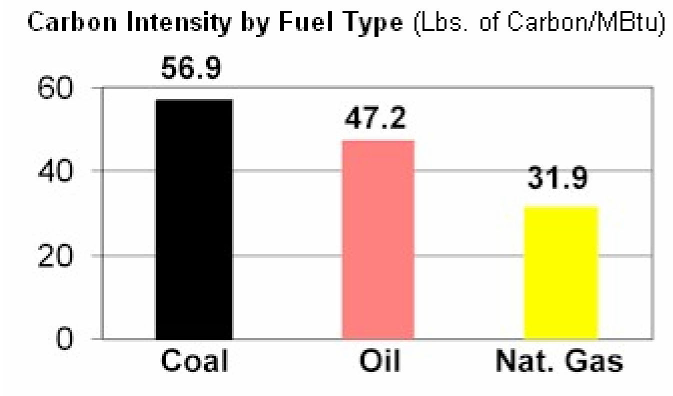
Prospects for New Sources

Second, because U.S. utilities have over-invested in gas-fired generating units, they hunger for new supplies of natural gas. Congress responded recently by authorizing greater drilling rights in the Gulf of Mexico and has hinted at granting greater access to federal lands where natural gas drilling is currently off-limits.[61] Whether new drilling rights are granted or not, the tantalizing prospect of vast new sources of natural gas may lead utilities to believe that gas-fired units are safer investments than they really are.

Future Carbon Controls

Third, as pressure builds for the United States to adopt some form of binding greenhouse gas reduction targets, more generators will turn to natural gas because its carbon intensity is about half that of coal.[62]

Figure 2.5: Natural Gas Less Carbon-Intensive than Coal or Oil



Source: Treepower.org

Roger Garrett, Director of Puget Sound Energy's Resource Acquisition Group, for example, recently told industry executives that PSE had plans to invest in a significant number of new natural-gas fired combined cycle facilities partly because the company anticipates future binding carbon constraints.[63]

In its most recent energy outlook (AEO 2007), EIA projects natural gas wellhead prices to average $5.06 per million cubic feet (2002$) from 2007 to 2030. If there are delays in the construction of the nearly 45,000 miles of new gas pipelines that industry analysts say are required to ensure adequate supply, the base-case price grows to $6.43 per million cubic feet.[64] Since 1997, however, the U.S. Department of Energy's Energy Information Administration (EIA) has had to increase its projections for natural gas prices each year to conform to new data showing that the price was higher than expected.[65] The year 2007 was no exception. In its report on short-term energy and summer 2007 fuels outlook, the DOE said it expected natural gas prices over the summer season to be 18 percent above its predictions a year earlier.[66]

While natural gas has enjoyed a recent period of depressed prices, substantial long-term price increases are virtually inevitable.

Recent evidence suggests that EIA's long-term projections – as in its short-term forecasts – make optimistic assumptions about growth in domestic natural gas production. In October 2006, for example, Chesapeake Energy stunned the gas industry by announcing that it would shut off 100,000 cubic feet per day of unhedged gas production until natural gas prices rebounded. A week later, Questar Exploration & Production curtailed its output for the same reason.[67] These unusual moves repudiated government (and industry) optimism about domestic natural gas output and reminded analysts that the gas market can be far more volatile and easily manipulated than forecasts predict.

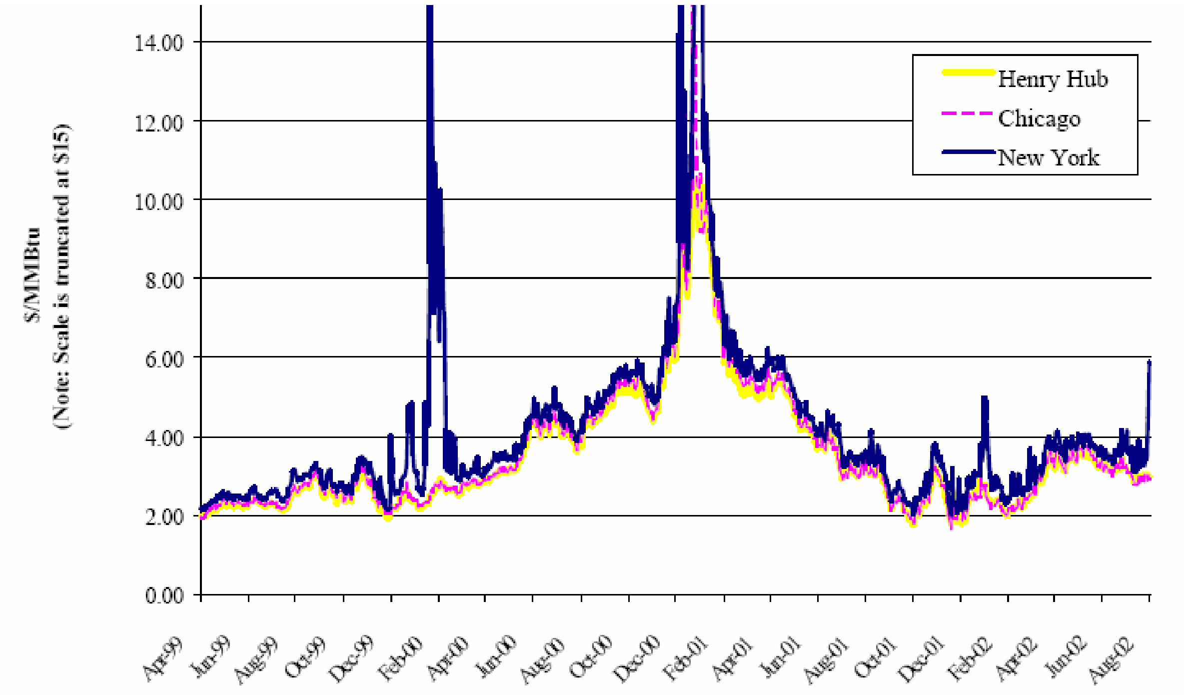
As early as 2003, then Federal Reserve Chairman Alan Greenspan predicted continued strain in the long-term market for natural gas:

> Today's tight natural gas markets have been a long time in coming, and futures prices suggest that we are not apt to return to earlier periods of relative abundance and low prices anytime soon.[68]

Rising Natural Gas Costs Will Increase Electricity Rates

Short-term deflation in natural gas prices obfuscates the costs associated with natural gas price volatility. In hearings before the House Committee on Natural Resources in 2003, the CEO of one large chemical company told Congress, "the recent history of natural gas prices is a study in commodity price volatility."[69] For example, the price of natural gas jumped from $6.20 per million BTUs (MMBtu) in 1998 to $14.50 per MMBtu in 2001, then dropped precipitously for almost a year and then rebounded steadily from around $2.10 per MMBtu in 2002 to more than $14.00 per MMBtu near the end of 2005.[70]

Figure 2.6: Natural Gas Prices for Henry Hub, Chicago, and New York, 1999-2002[71]



Source: Adelman & Watkins, 2005

When natural gas prices swing wildly, utilities find it difficult to plan prudent investments or contract for bulk supplies. The enormous price spikes for natural gas seen over the last few years have made natural-gas fired plants uneconomic to operate, and have resulted in significant increases in electricity prices in several areas, much to the consternation of utility executives.[72]

From April through June of 2006, Platts conducted surveys of utility executives to analyze perceptions of important issues facing the electricity industry and to identify issues that may cause concern in the future. Natural gas supply shocks were mentioned repeatedly as a justification for significant rate increases:

> The issue for utility executives is how best to deal with the increases and volatility in natural gas prices. The added costs to produce electricity or provide natural gas cannot be absorbed by local distribution companies (LDCs) and many are facing the need to file for rate relief and pass those costs through to end-users. The added issue for many is timing. Rising natural gas prices are occurring simultaneously with the end of rate caps, causing end-users to potentially see rate increases of more than 70 percent in some regions. Managing these rate shocks and the backlash, which is often directed towards deregulation, is a serious issue.[73]

Indeed, in fall of 2006 ratepayers in Illinois waged a modern-day version of the Boston Tea Party, sending teabags to the state's utilities in protest of projected rate increases of 22 percent to 55 percent in 2007. In Boston, homeowners and small businesses have seen electricity prices rise by 78 percent since 2002, from 6.4 cents a kilowatt hour to 11.4 cents a kilowatt hour.[74]

Across the U.S., average retail electricity prices rose by 9.2 percent in 2006 alone, a trend likely to continue for the next several years.[75]

Natural-gas induced price spikes have been devastating to the U.S. economy. Because natural gas accounts for nearly 90 percent of the cost of fertilizer, escalating natural gas prices in 2005 created significant economic hardships for U.S. farmers. As well, some manufacturing and industrial consumers that relied heavily on natural gas moved their facilities overseas. The U.S. petrochemical industry, for example, relies on natural gas as a primary feedstock as well as for fuel. On February 17, 2004, the *Wall Street Journal* reported that the petrochemical sector had lost approximately 78,000 jobs to foreign plants where natural gas was much cheaper.[76]

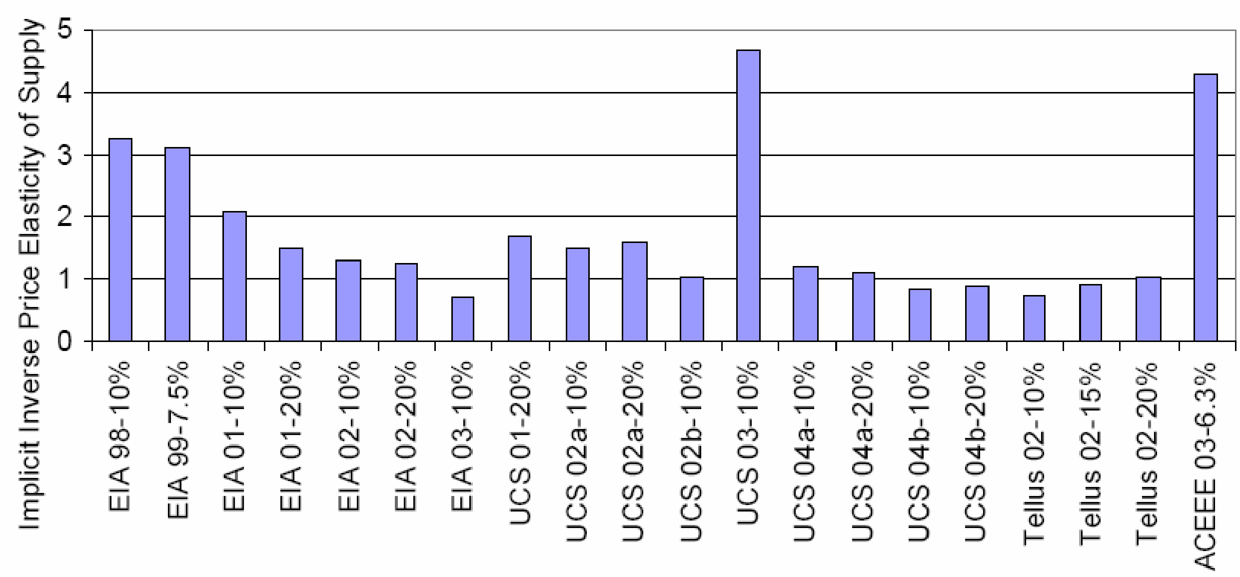
A National RPS Reduces Natural Gas Prices

A national RPS can save consumers money by reducing demand for natural gas. Several studies have documented that an increase in renewable energy production would decrease costs for electricity generation by offsetting the combustion of natural gas.[77] Because some renewable resources generate the most electricity during periods of peak demand, they can help offset electricity otherwise derived from natural gas-fired "peaking" or reserve generation units. Photovoltaics, for example, have great value as a reliable source of power during extreme peak loads. Substantial evidence from many peer-reviewed studies demonstrates an excellent correlation between available solar resources and periods of peak demand. In California, for example, an installed PV array with a capacity of 5,000 MW reduces the peak load for that day by about 3,000 MW, cutting in half the number of natural-gas "peakers" needed to ensure reserve capacity.[78]

The value of renewable energy to offset natural gas combustion varies with the projected supply (and thus the price) of natural gas. When demand for natural gas increases (or supply decreases), its price increases and so does the value of the renewable resources used to displace it. Researchers at Resources for the Future calculated that, given the historic volatility of the natural gas market, a 1 percent reduction in natural gas demand can reduce the price of natural gas by up to 2.5 percent in the long term.[79] This inverse relationship between renewable generation and natural gas prices was confirmed by researchers at the Lawrence Berkeley National Laboratory (LBNL) who reviewed the projected affect of 20 different RPS scenarios on future natural gas prices:

> Each 1 percent reduction in natural gas demand could lead to long-term average wellhead price reductions of 0.8 percent to 2 percent, with some of the models predicting more aggressive reductions. Reductions in the wellhead price will not only have the effect of reducing wholesale and retail electricity rates but will also reduce residential, commercial, and industrial gas bills.[80]

Figure 2.7: Average Inverse Price Elasticity of Natural Gas by Study and RPS Target



Source: Lawrence Berkeley National Laboratory, 2005

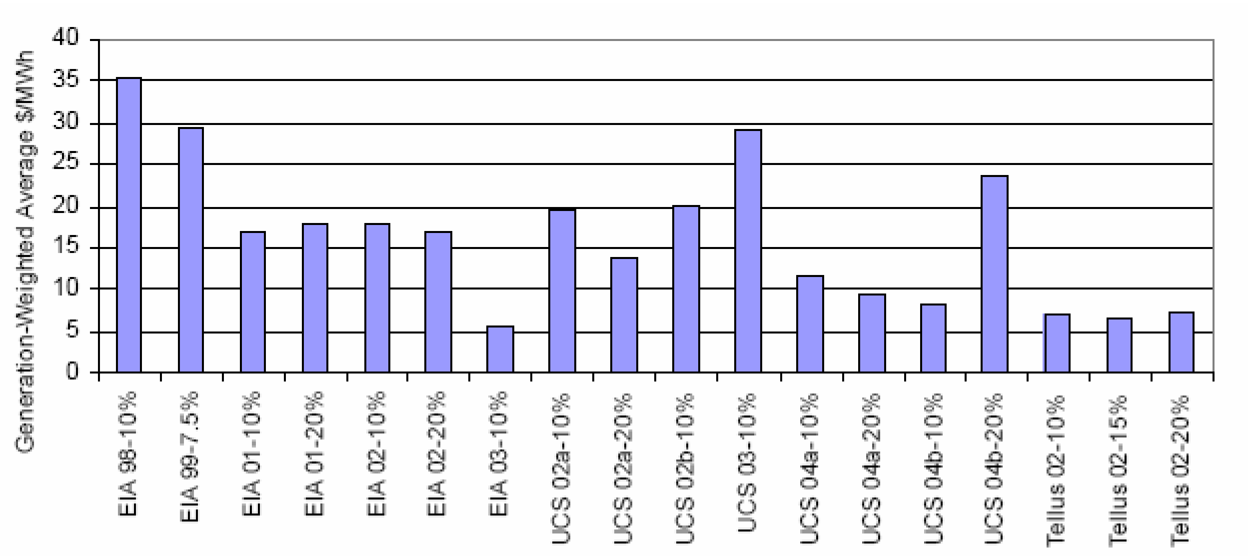
In a 2007 study, the Union of Concerned Scientists assessed the cumulative affect of a 20 percent national RPS on average annual electricity prices and found that an RPS would save consumers more than $49 billion largely by depressing the price of natural gas used for electricity production and home heating:

> Average consumer natural gas prices would be lower than business as usual in nearly every year of the forecast under the 20 percent RPS, with an average annual reduction of 1.5 percent. In addition, average consumer electricity prices would be lower than business as usual in every year of the forecast, with average annual reduction of 1.8 percent. As a result, the 20 percent RPS would save consumers $49.1 billion on their electricity and natural gas bills by 2020.[81]

UCS is not alone in their findings. LBNL researchers reviewed 13 studies and 20 specific analyses all confirming that the higher the level of renewable energy penetration, the more gas is saved and the more gas prices are reduced.

Nine of fifteen studies evaluating national RPS proposals of 10 to 20 percent found that consumers would save from $10 to $40 billion from decreased natural gas prices.[82]

Figure 2.8: Consumer Natural Gas Savings by Study and RPS Target



Source: Lawrence Berkeley National Laboratory, 2005

Some studies have also begun to document how RPS policies depress the price of *other* fossil fuels, such as oil and coal. In Pennsylvania, for example, where more than 90 percent of electricity comes from coal and nuclear resources, a study conducted by Black & Veatch concluded an aggressive RPS would result in a substantial reduction in fossil fuel consumption, lowering the price of coal and oil and ultimately providing cost savings to ratepayers. The study noted that even a 1 percent reduction in fossil fuel prices would lead to a $140 million reduction in fossil fuel expenditures for the state.[83]

A National RPS Reduces Fuel Transportation Costs

By developing indigenous renewable resources, all regions also can enjoy substantial cost savings from decreased fossil fuel transportation costs. The University of Wyoming estimates that up to 80 percent of the cost of coal for ratepayers in Illinois is to cover railway costs. Coal at the mouth of a mine in Wyoming, for example, costs about $5 per ton. By the time it reaches a power plant outside of Chicago, that same coal costs about $30 a ton.[84]

The cumulative costs to transport natural gas may be even higher. Natural gas transportation and distribution already account for 41 percent of the residential price of natural gas. Since the construction of natural gas pipelines can cost as much as $420,000 per mile[85], fully constructing the natural gas infrastructure recommended by the Administration's National Energy Plan (which calls for over 301,000 miles of new natural gas transmission and distribution pipelines) could cost ratepayers as much as $126.4 billion. [86]

Utility Comparisons are Skewed Against Renewables

Why do some utilities claim that a national RPS would substantially increase electricity prices, given the overwhelming consensus that investment in renewable energy could offset rising natural gas prices?

Increasingly, investors are exploring how renewable resources can serve as a hedge against electricity sector risks[87], especially the financial risks associated with natural gas price volatility and the risk of future environmental regulations.[88] Utilities trying to hedge against the volatility of natural gas prices attempt to forecast future costs. Historically, utility analyses have tended to rely on uncertain long-term forecasts of spot natural gas prices rather than on prices that can be locked-in through futures, or fixed-priced supply contracts (called "forward" prices). On first glance, it would appear that comparing fixed-priced renewable resources to volatile natural gas prices would favor renewable technologies. However, LBNL researchers compared forward gas prices from 2000 to 2003 to utility forecasts of natural gas prices (based on the EIA reference case over this same period) and found that the methodology used by most utilities to compare the projected cost of renewable energy to the projected cost of natural gas created a bias in favor of the gas:

> Utilities and others who have conducted resource acquisition, planning and modeling studies based on EIA reference case (as well as other) gas price forecasts…have arguably produced "biased" results that favor variable-price gas-fired over fixed-price renewable generation, potentially to the tune of ~0.4-0.6 cents/kWh levelized. This is because if consumers are rational and value price stability, then the cost of fixed-price renewable generation should be compared to the *hedged* or *guaranteed* cost of natural gas-fired generation, rather than to *projected* costs based on *uncertain* gas price forecasts.[89]

According to LBNL's findings, there is a premium associated with purchasing large volumes of natural gas at a guaranteed price that most utilities do not account for when comparing the cost of natural gas-fired generation to the cost of renewable generation. If utilities accounted for this "hedging" cost, renewable energy would be substantially cheaper in many cases. Since the supply of renewable resources is, by definition, inexhaustible, the cost of fueling a renewable energy system is "fixed". By underestimating the hedging costs associated with fossil fuels and overlooking the cost-savings of fixed-price renewable fuels, most utility estimates are skewed against renewable generation.

D. Higher RPS Increases "Hedge" Value of Renewables

Any renewable fuel with stable (or decreasing) prices that can displace significant volumes of fossil fuel at a competitive cost can be used as a price hedge. However, the potential hedge benefits of renewable technologies are not fully realized until renewables constitute a larger portion of a utility's generation portfolio. At lower generation levels, renewable resources simply do not offset enough fossil fuel to hedge against price fluctuations.

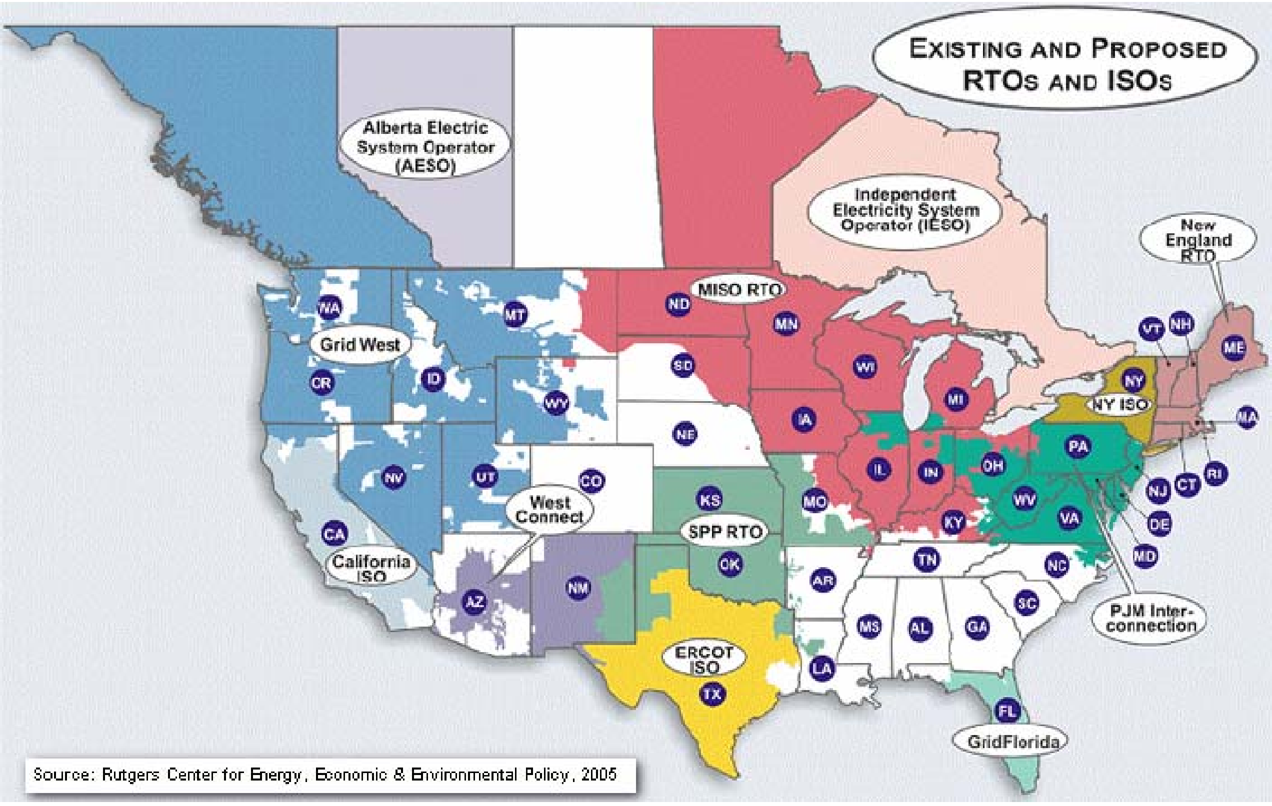
When researchers for Western Resource Advocates assessed the ability of wind power to operate as a natural gas price hedge, they found that wind energy had a hedge value *only* when it was a substantial portion of a generation portfolio. A 1 MW wind project in a 5000 MW generation portfolio had a negligible hedge value. However, larger wind projects had a better chance of realizing potential hedge benefits, especially during periods of high natural gas prices.[90] These results suggest that utilities could benefit more from an aggressive national RPS mandate that compels significant renewable energy investments than from direct incentives for projects that are small relative to a utility's entire generation portfolio.

E. Uniform REC Trading Market

Contradictory and imprecise definitions of "renewable energy" in state RPS mandates and other inconsistent restrictions have splintered the national renewable energy market into regional and state markets with conflicting rules on the treatment and value of renewable energy credits (RECs).

Consider just the Northeast region of the United States, where the electricity wholesale market is controlled by three independent system operators – ISO-NE (New England), NYISO (New York) and PJM (13 Mid-Atlantic states).

Figure 2.9: Existing and Proposed U.S. Independent System Operators (2005)



In August 2005, PJM launched its Generation Attribute Tracking System (GATS), a procedure to monitor REC trading between PJM member-states. While GATS may succeed in creating a robust REC market *within* PJM, its convoluted rules hamper REC trading *outside* of its geographically-defined service area. According to the GATS rules, renewable energy generators external to PJM, for instance, are allowed to trade RECs in the GATS market, but only if they qualify under one of the RPS policies of a PJM member-state. The rules also require generators to be physically located adjacent to PJM geographical boundaries.

In addition to these restrictions, some PJM member-states (Delaware, Maryland and Washington, DC) impose the added requirement that the electricity from renewable generators *outside* of PJM be imported into the territory in order for external generators to freely trade RECs within their states.[91]

For renewable generators *within* PJM, member-states also impose wildly different restrictions. In Maryland and Pennsylvania, for example, generators are allowed to bank all of their RECs for up to two years after the year of generation. But in Rhode Island, generators may only bank up to 30 percent of their compliance total (and then only if the banked RECs are in excess of the compliance total required in the year the energy was actually generated).

ISO-NE has its own REC trading market supported by its own REC tracking system, called the Generation Information System (GIS). GIS sets stringent limits on who can trade within the ISO-NE region, regardless of the individual state RPS policies. GIS also requires that generators operate in control areas that are directly adjacent to the service area. This geographical restriction creates irrational distortions in the REC trading market. Generators in NYISO, for example, can trade RECs in Massachusetts, but generators in PJM cannot simply because they are located a few dozen miles away. Connecticut further restricts REC trading to generators actually within ISO-NE, but, to complicate matters even more, that restriction may expire in 2010.

One need not understand all of the intricacies of inter-state REC trading to get the point: the complex, contradictory and often irrational rules for trading RECs between states and between system operators creates substantial inequalities between states and impedes potential investors.

Two factors are essential for the success of renewable energy investments: a trusted exchange and a sufficient trading volume. Currently, state and regional REC trading markets lack both of these elements. Inconsistent and limited REC markets prevent investors from guaranteeing a predictable return on renewable energy investments. In 2006, Christopher Berendt, who directs clean energy investments for Pace Global Energy Services, noted that:

> While state systems share similarities, there is a critical lack of consistent fungibility between RECs issued in different states and control areas … Thus, there are no real REC markets among or even within the states, only individual state regulatory compliance systems. The lack of a real national REC market for state RPS compliance creates an absence of liquidity for RECs and thus for investment capital as well.[92]

An expanded interstate renewable energy market established under a national RPS would drive down the costs of RECs since supply would be pegged to demand organically rather than resulting from inconsistent, artificial geographical restrictions. By eliminating geographical barriers to REC exchange, a national RPS would provide the necessary market volume to create predictable rates of return for bulk investors. Standardized trading practices would validate RECs as fungible currency and be far more cost effective for investors than trying to negotiate discreet investments in small or regionalized systems. [93]

Utilities Benefit from Uniform Market

A national REC trading market would also benefit regulated utilities. By allowing renewable generators to sell their RECs to retail suppliers anywhere, a national RPS gives regulated utilities the option of investing in their own renewable generation or purchasing RECs from suppliers at the most competitive cost.[94]

By establishing a uniform REC trading market, a national RPS can:

1. Provide flexibility for utilities that may not own renewable generators to more easily meet their portfolio requirements

2. Provide a safety value for utilities that own renewable generators, should they suffer from unexpected shortfalls

3. Provide regulated utilities time to plan investments, defer short term investments that may be unfavorable, or acquire the time needed to purchase equipment or negotiate contracts

4. Lower compliance costs, since a national market would allow utilities to buy credits from the cheapest suppliers

5. Help overcome the physical inability to transmit energy from eligible resources (such as solar hot water heaters)[95]

Two recent studies document the cost-savings associated with a national RPS that establishes a uniform REC trading market. Kent S. Knutson and Peter McMahan analyzed two national RPS scenarios, one without a nationwide REC system, and one with. They found that a national REC trading scheme would save utilities $14 billion compared to a RPS without uniform trading rules.[96]

Another study from the European Union assessed the costs of renewable energy in the EU under a scenario with and without uniform rules for trading renewable energy credits (In Europe, RECs are called “tradable green certificates”). The study found that, with an EU-wide credit trading scheme, the cost of renewable energy was approximately 12 percent less (around 9.2 eurocents per kWh) than without a uniform market. Moreover, the study concluded that strategic deployment of renewable energy technologies under an EU-wide REC trading scheme could reduce costs for individual countries by up to 47 percent.[97]

F. More Manufacturing Jobs

Renewable technologies create far more jobs than fossil fuel or nuclear generation facilities. The United Nations Environment Program (UNEP) assessed the employment impact of various electricity generation technologies and found that renewable energy technologies renewable energy technologies generate three times as many jobs per megawatt of installed capacity as fossil fuel-based generation.

The wind industry demonstrates the disparity quite clearly. According to a survey by Danish wind energy manufacturers, 17 worker-years are created for every megawatt of wind energy manufactured, and five worker-years for every megawatt installed:

> Renewable energy technologies are up to three times more employment-intensive than fossil fuel power options: 188 worker-years are created locally for every megawatt of small solar electric systems. In Germany, wind power accounted for 1.2 percent of electricity generation in 1998 and the industry employed 15,000 people, compared to nuclear with 33 percent share and about 40,000 jobs, and coal with a 26 percent share and 80,000 jobs. Based on a market share comparison, the potential to create jobs is far greater for wind then for coal and nuclear options.

In the year 2000, the wind energy industry provided more than 85,000 jobs worldwide and UNEP projects that the sector could provide up to 1.8 million jobs by 2020.

Job creation potential is not limited to the wind industry alone. The U.N. reviewed several studies demonstrating that up to 188 worker-years are created locally for every megawatt of small solar electric systems installed (these jobs come primarily from local retailing, installation and maintenance).

Figure 2.10: Roof integrated PVs and Solar Thermal Panels on a Maine Residence

Source: Solar Design Associates.

UNEP also found that local production of solar modules can contribute substantially to a country's manufacturing infrastructure.[98]

Researchers at the University of California at Berkeley found an even larger job creation ratio in the United States. In 2004, Professor Daniel Kammen, head of UC Berkeley's Renewable and Appropriate Energy Laboratory (RAEL), directed a team that reviewed 13 reports all confirming that investments in renewable energy technologies would produce as much as 10 times as many American jobs than comparable investments in fossil fuel or nuclear technologies.[99]

> Across a broad range of scenarios, the renewable energy sector generates more jobs per average megawatt of power installed, and per unit of energy produced, than the fossil fuel-based energy sector. All states of the Union stand to gain in terms of net employment from the implementation of a portfolio of clean energy policies at the federal level.[100]

The UC Berkeley team calculated that a national RPS of 20 percent by 2020 could create as many as 240,000 new jobs versus only 75,000 jobs if the same energy were provided by fossil fuels. Kammen suggested that the large disparity partly lies in the fact that the employment rate in fossil fuel-related industries in the U.S. has been declining steadily for several years, while the renewable energy sector enjoys the potential of vast expansions in manufacturing, delivery, construction, installation and maintenance.

Regions with Job Losses Benefit Most

Because a substantial percentage of a national RPS would be met with wind power, some opponents have argued that a federal mandate would disproportionately benefit the upper Great Plains region where the best resources are located. That conclusion neglects the broad economic impacts related to the manufacturing of turbine components. Every 1000 MW of wind energy requires roughly $1 billion in rotors, generators, towers and related investments.[101] A national RPS mandate that induced the development of, say, 50GW of new wind power would generate up to $77 billion in manufacturing activity related to all the components required to build this substantial number of new wind generators.

The Renewable Energy Policy Project used North American Industrial Classification Codes to map the dispersion of manufacturing activity related to the development of wind energy and found that the 20 states that would receive the most investment and most new manufacturing jobs account for 75% of the total U.S. population, and 76% of the manufacturing jobs lost in the U.S. between 2001 and 2004.

Table 2.2: Wind Energy Job Creation Potential in Top 20 States by Average Investment

State	Employees at Potential Companies	Rotor	Nacelle and Controls	Gearbox & Drive Train	Generator & Power Electronics	Tower	Number of New FTE Jobs	Average Investment ($ Billions)
California	102,255	25226	52490	1380	14889	8270	12,717	4.24
Ohio	80,511	30578	33367	6360	3372	6834	11,688	3.90
Texas	60,229	15191	28339	1678	3006	12015	8,943	2.98
Michigan	66,550	27719	30241	2466	926	5198	8,549	2.85
Illinois	57,304	20001	24193	5520	3143	4447	8,530	2.84
Indiana	53,064	18962	20359	4783	2633	6326	8,317	2.77
Pennsylvania	50,304	16647	20844	2565	1997	8251	7,622	2.54
Wisconsin	48,164	17795	21317	3796	567	4689	6,956	2.32
New York	47,375	10855	24188	4020	5966	2347	6,549	2.18
South Carolina	20,532	4398	4510	6780	1765	3079	4,964	1.65
North Carolina	30,229	9431	12814	3142	2036	2806	4,661	1.55
Tennessee	28,407	9761	12513	2128	381	3624	4,233	1.41
Alabama	21,213	6607	7686	927	620	5374	3,571	1.19
Georgia	20,898	6610	8245	2335	253	3456	3,532	1.18
Virginia	20,201	6692	7372	1549	567	4021	3,386	1.13
Florida	24,008	5138	12197	254	1923	4497	3,371	1.12
Missouri	23,634	8389	11031	1202	537	2475	3,234	1.08
Massachusetts	27,955	6956	15952	659	3331	1057	3,210	1.07
Minnesota	26,131	8364	14427	711	1142	1488	3,064	1.02
New Jersey	22,535	8552	10191	819	1299	1675	2,920	0.97

Source: Renewable Energy Policy Project, 2004

However, the regional dispersion of economic benefits is not limited to the wind manufacturing sector or to the states of the upper Great Plains, where the most substantial wind resources are located. In the Southeast, for example, researchers at the University of Tennessee estimated that renewable energy technologies (including biomass generators and incremental hydropower) could create more jobs per MWh for the region than any other type of electricity generation.[102]

The American Society of Mechanical Engineers (ASME) projected even better job creation estimates for renewable energy technologies deployed nationwide. In a 2004 study, ASME estimated that coal and gas facilities provide only 11 job-years per MWh, while renewable technologies can provide as many as 121 job-years per MWh.[103]

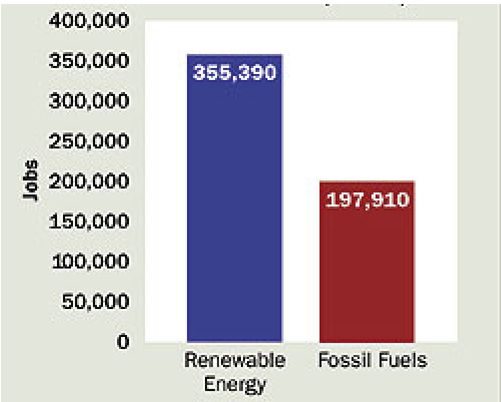
Table 2.3: Job Estimates for Conventional and Renewable Energy Technologies

Technology	*Jobs per MWh*
Coal	11
Natural Gas	11
Biomass	33
Wind	100
Solar Photovoltaics	121

Source: Greico, 2004

When researchers at UCS examined the cumulative economic impact of a 20 percent national RPS by 2020, they found that the mandate would create almost 80% as many jobs as continued reliance on fossil fuels - more than 355,000 new jobs in domestic manufacturing, construction, operations, maintenance, shipping, sales, and finance.[104]

Figure 2.1: Jobs Created by Renewable Energy vs. Fossil Fuels (by 2020)



Source: Union of Concerned Scientists, 2005

By UCS estimates, the difference in the number of jobs created compared to fossil fuels (157,480 net jobs created by a national RPS) would generate an additional $8.2 billion in income and $10.2 billion in gross domestic product ($2002).[105]

G. Decreased Construction Cost Over-Runs

Classic electricity generation systems are typically "lumpy systems" in the sense that additions to capacity are made primarily in large lumps (mammoth power plants, gargantuan transmission networks). Large facilities are extremely capital intense. A typical 1,100 MW light water reactor, for example, can cost as much as $3 billion when licensing and construction expenses are included.[106] Moreover, planning and financing large facilities is fraught with uncertainties, especially when the balance of supply and demand can change rapidly and unexpectedly.[107]

Generally, the larger the project, the longer it takes to complete and the more the project is at risk to unforeseen changes in interest rates, labor expenses, and regulatory compliance costs. Because of these risks, utilities base resource acquisition decisions on long-term forecasts of future customer demand. But even these forecasts are fraught with uncertainty. We have a hard enough time predicting the weather or the outcome of political elections; imagine the difficulty of projecting how an entire industry will be five, ten, or even twenty years from now.

In the 1970s and 1980s, excessively high forecasts of growth in demand for electricity led to overbuilding of generating plants and massive electric system cost over-runs in many states. One infamous example was in Washington State, where the Washington Public Power System (WPPS) began a construction program for as many as seven new nuclear power plants in the early 1970s.[108]

After large cost overruns and collapsing electricity demand growth in the late 1970s and early 1980s, the power system faced financial disaster and all but one of the plants was cancelled, leading to, at the time, the country's largest municipal bond default. The entire experience came to be called the "WHOOPS" fiasco (as a play off of the WPPS acronym) and is "an enduring illustration of the risk associated with large electric system supply-side investments."[109] Consumers across the Northwest are still paying for WHOOPS in their monthly electricity bills.

Figure 2.12: Washington Public Power Supply System Unfinished Nuclear Reactor near Satsop, Washington (1978)

Photo: Waymarking.com

While WHOOPS is perhaps the most spectacular example, similar "boom and bust" cycles in power plant construction and cost-overruns occurred in many states during the 1980s, and directly produced the high electricity rates that spurred the "electric restructuring" movement of the mid-1990s.[110]

Unfortunately construction cost over-runs for conventional power plants are not relegated to history, nor are they limited to nuclear reactors. In November, 2006 Duke Energy announced that the price tag for the company's proposed coal-fired power plants near Charlotte, North Carolina had soared to $3 billion. Just two months prior, the company had reported to state utility regulators that the two plants would cost only $2 billion. Charlotte's daily newspaper speculated that such a substantial cost discrepancy raised the possibility that the total expense for the plants could continue ballooning during the five years that the utility estimated it would take the company to build the facilities. The likely outcome is a substantial increase in electricity rates for North Carolina residents:

> The surprisingly high cost of coal plants signals that North Carolina's electricity costs, among the lowest in the nation, are not immune to broader economic trends and are destined to increase.[111]

A national RPS can help minimize construction cost overruns by deploying technologies that are smaller, more modular and less capital intense. Renewable energy technologies have lead times of 2 to 5 years (or less) compared with conventional coal and nuclear plants that can take 5 to 15 years to plan, permit, and construct. Florida Power and Light (FPL) boasts that it can take a wind farm from groundbreaking to commercial operation in as little as 3-6 months.[112] In 2005, Puget Sound Energy (PSE) proved that FPL's boast was achievable in practice when it brought 83 1.8MW wind turbines at its Hopkins Ridge Wind Project from foundation pour to commercial operation in exactly 6 months and 9 days.[113]

Solar installations may require even less construction time since the materials generally are pre-fabricated and modular. John Ravis, a project finance manager for TD BankNorth, recently told industry analysts that utility-level PV systems can come online in as little as two months, if the panels are available.[114]

Quicker lead times enable a more accurate response to load growth, and minimize the financial risk associated with borrowing hundreds of millions of dollars to finance plants for 10 or more years before they start producing a single kilowatt of electricity.

Figure 2.13: Florida Power and Light Wind Farm Near Weatherford, Oklahoma

Photo: Roger J. Wendell

Modular Systems Decrease Risk

Because renewable energy technologies can be produced at smaller scale, they can be located nearer to loads, enhancing their ability to match smaller increments of demand. Photovoltaic (solar) panels can be built in various sizes, placed in arrays ranging from watts to megawatts, and used in a wide variety of applications, including centralized plants, distributed sub-station plants, grid connected systems for home and business use, and off-grid systems for remote power use. PV systems have long been used to power remote data relaying stations critical to the operation of supervisory control and data acquisition systems used by electric and gas utilities and government agencies.

Because renewable technologies are faster to build and easier to deploy, they also limit financial risk and capital exposure. Modular plants can be cancelled easier, so that stopping a project is not a complete financial loss. And the portability of most renewable energy systems means utilities can still recover value should the systems need to be resold as commodities in a secondary market.

Smaller units with shorter lead times also reduce the risk of purchasing a technology that becomes obsolete before it is installed. Quick installations can better exploit rapid learning, as many generations of a renewable energy technology can be developed in the same time it takes to build one giant conventional power plant.[115]

[37] Alan Nogee, Jeff Deyette, and Steve Clemmer, "The Projected Impacts of a National Renewable Portfolio Standard," *Electricity Journal* 20(4) (May, 2007), pp. 33-47.
[38] Steve L. Clemmer, Alan Nogee, Michael C. Brower, and Paul Jefferiss, *A Powerful Opportunity: Making Renewable Electricity the Standard* (Union of Concerned Scientists, January 1999).
[39] As of May 2007, 37 states had enacted statewide net metering programs and federal legislation (The Solar Opportunity and Local Access Rights (SOLAR) Act) had been proposed. See Cooper, C & Rose, J. (2006). *Freeing the Grid: How Effective State Net Metering Laws Can Revolutionize U.S. Energy Policy*, Network for New Energy Choices: New York, NY.
[40] Steve Clemmer, Deborah Donovan, Alan Nogee, and Jeff Deyette, *Clean Energy Blueprint: A Smarter National Energy Policy for Today and the Future* (Washington, DC: Union of Concerned Scientists, October, 2001).
[41] Kydes article included a disclaimer that his results did not represent official data reported by the EIA.
[42] Kydes, S. (2007). "Impacts of a renewable portfolio generation standard on U.S. energy markets," Energy Policy 35(2), February.
[43] See Brian Tulloh, TXU Vice President for Corporate Affairs, (2007). "Letters from Readers," EnergyBiz Insider, February 8, available at: http://www.energycentral.com/site/newsletters/ebi.cfm?id=276
[44] Energy Information Administration, Analysis of a 10-percent Renewable Portfolio Standard, May, 2003.
[45] Chen, C., et.al. (2007). "Weighing the costs and benefits of state renewable portfolio standards: A comparative analysis of state-level policy impact projections," Ernest Orlando Lawrence Berkeley National Laboratory, LBNL-61580, March.
[46] Donald K. Klass, "A Critical Assessment of Renewable Energy Usage in the USA," *Energy Policy* 31(2003), pp. 353-367.
[47] See U.S. House of Representatives Committee on Science, "Renewable Energy Technologies—Research Directions, Investment Opportunities, and Challenges to Commercial Applications in the United States and Developing World," Hearing Charter, August 2, 2006, 9pp; Arno Penzias, "Renewable Energy Technologies: Research Directions, Investment Opportunities, and Challenges to Deployment in the Developing World," *Testimony Before the House Subcommittee on Energy*, August 2, 2006, pp. 1-2; and David B. Pearce, "Renewable Energy: The Future," *Testimony Before the U.S. House Science Committee*, August 2, 2006, pp. 2-3.
[48] National Renewable Energy Laboratory. (2002). *Renewable Energy Cost Trends*, October. Available at: http://www.nrel.gov/analysis/docs/cost_curves_2002.ppt
[49] Yuri Makarov et al, "California ISO Wind Generation Forecasting Service Design and Experience," *Report from the California ISO* (December, 2005), p. 3-4.
[50] Michael Karmis, Jason Abiecunas, Jeffrey Alwang, Stephen Aultman, Lori Bird, Paul Denholm, Donna Heimiller, Richard F. Hirsh, Anelia Milbrandt, Ryan Pletka, Gian Porro and Benjamin K. Sovacool. *A Study of Increased Use of Renewable Energy Resources in Virginia* (Blacksburg, VA: Virginia Center for Coal and Energy Research, November 11, 2005), accessed July 2006 at http://www.energy.vt.edu/Publications/Incr_Use_Renew_Energy_VA_rev1.pdf.
[51] Source; Based on Karmis *et al.*, 2005; California Energy Commission, Comparative Cost of California Central station Electricity Generation Technologies, Staff Report, publication # 100-03-001, August 2003, pgs. 3 & 11.
[52] Sam Schoofs, *A Federal Renewable Portfolio Standard: Policy Analysis and Proposal* (Institute of Electrical and Electronic Engineers, August 6, 2004).
[53] U.S. Department of Energy, available at http://www.eere.energy.gov/windandhydro/windpoweringamerica/images/newengland/economics_cost.jpg.
[54] U.S. Department of Energy, available at http://www.eere.energy.gov/windandhydro/windpoweringamerica/images/newengland/economics_cost.jpg.
[55] Office of Energy Efficiency and Renewable Energy (EERE), (2007). "Projected benefits of federal energy efficiency and renewable energy programs (FY2007-FY2050)," Department of Energy, Appendix E, Wind Technologies Program, p.E-6.
[56] Karen Palmer and Dallas Burtraw, "Cost-Effectiveness of Renewable Energy Policies," *Energy Economics* 27 (2005), pp. 873-894.
[57] Hathaway, A. (2006). "The impact of renewable/ee portfolio standard on future rate hikes in Virginia," Power-Point Presentation to the Energy Virginia Conference, October 17, p.13.
[58] Ibid. p.14.
[59] Ibid, p.3.
[60] Michot-Foss, M. (2007). "United States natural gas prices to 2015," Oxford Institute for Energy Studies, February, p. 12.
[61] Silverstein, K. (2007). "Rockies Project: Laying the Groundwork," EnergyBiz Insider, April 30.
[62] See www.treepower.org/outreach.html
[63] Comments at the EUCI 3rd Annual Renewable Portfolio Standards (RPS) Conference, April 23-24, 2007. Westminster, CO.
[64] Silverstein, K. (2007). "Rockies Project: Laying the Groundwork," EnergyBiz Insider, April 30.
[65] Alan Nogee, Jeff Deyette, and Steve Clemmer, "The Projected Impacts of a National Renewable Portfolio Standard," *Electricity Journal* 20(4) (May, 2007), pp. 33-47..
[66] Lesova, P. (2007). "Crude, natural gas rise as demand to stay strong," *MarketWatch*, April 10.
[67] Davidson, M. (2006). "Natural gas spikes keep market guessing," *Platts Insight*, December.
[68] Greenspan, A. (2003). "Natural gas supply and demand issues," Testimony before the House Committee on Energy and Commerce, June 10.

[69] Gupta, R. (2003, March 19). Enhancing energy security. *Hearing Before the House Committee on Natural Resources*.
[70] See M. A. Adelman and G. C. Watkins, "U.S. Oil and Natural Gas Reserve Prices, 1982-2003," *Energy Economics* 27 (2005), pp. 553-571; Robert S. Pindyck, "Volatility in Natural Gas and Oil Markets," *The Journal of Energy and Development* 30(1) (2004), pp. 1-19; and U.S. Energy Information Administration, *Annual Energy Outlook 2006*.
[71] Source: Modified from Bruce B. Henning, "Natural Gas Supply: Understanding Gas Price Volatility," *NASEO Winter Fuels Outlook*, October 7, 2002, p. 4.
[72] Ed Vine, Marty Kushler, and Dan York, "Energy Myth Ten—Energy Efficiency Measures are Unreliable, Unpredictable, and Unenforceable," In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007).
[73] Henlser, T. & Ipock, K. (2006). Platts/Capgemini Utitlities Executive Study, Phase I: Qualitative Research, June, p.25.
[74] Smith, R. (2006). "Emboldened states take charge of energy issues," Wall Street Journal, October 12, p. A6.
[75] Kopecky, D. (2007). "The trend toward on-site power generation," Energy Pulse, March 19. Available at: http://www.energypulse.net/centers/article/article_display.cfm?a_id=1445
[76] Nogee, A. (2005). "Renewable energy and electricity: Creating jobs, saving consumers money, and increasing our energy security," Testimony before the House Committee on Energy and Commerce, Subcommittee on Energy and Air Quality, February 16, p.4.
[77] See Chen, C., Wiser, R., and Bolinger, M. (2007). "Weighing the costs and benefits of renewable portfolio standards: a comparative analysis of state-level policy impact projections," Lawrence Berkeley National Laboratory, January.
[78] Herig, C. (2002). "Using photovoltaics to preserve California's electricity capacity reserves," National Renewable Energy Laboratory, p.2.
[79] Fischer, Carolyn. (2006). "How can renewable portfolio standards lower electricity prices?" Resources for the Future Discussion Paper, May.
[80] Wiser, R., et. al (2005). "Easing the natural gas crisis: Reducing natural gas prices through increased deployment of renewable energy and energy efficiency," Ernest Orlando Lawrence Berkeley National Laboraroy, LBNL-56756, p.40.
[81] Alan Nogee, Jeff Deyette, and Steve Clemmer, "The Projected Impacts of a National Renewable Portfolio Standard," *Electricity Journal* 20(4) (May, 2007), p. 7.
[82] Wiser, R., et. al (2005), p.ix.
[83] Ryan Pletka, "Economic Impact of Renewable Energy in Pennsylvania," *Black & Veatch Project 135401*, March, 2004, 56pp.
[84] http://smtc.uwyo.edu/coal/trains/unit.asp
[85] Sovacool, B. (2007). "Distributed generation and the American electric utility system: A review of sociotechnical benefits and barriers," *Journal of Energy Resources Technology*, 129(4), forthcoming.
[86] Clemmer, S., et.al. (2001). "Clean energy blueprint: A smarter national energy policy for today and the future," Union of Concerned Scientists with American Council for an Energy-Efficient Economy Tellus Institute, October, p.31.
[87] Wiser, R. & Bolinger, M. (2005). "Balancing cost and risk: The treatment of renewable energy in western utility resource plans," Ernest Orlando Lawrence Berkeley National Laboratory, LBNL-58450.
[88] From 2002 to 2005, the electric utility industry spent more than $21 billion on unexpected regulatory costs, and is projected to spend another $47 billion by 2025, depending on whether the U.S. Environmental Protection Agency (EPA) issues new rules concerning interstate pollution of mercury. See Rebecca Smith, "Court Decisions May Aid Some Utility Profits in Long Term," *Wall Street Journal*, April 3, 2007, p. A10.
[89] Bolinger, M., et. al. (2004). "Accounting for fuel price risk when comparing renewable to gas-fired generation: the role of forward natural gas prices," *Energy Policy* 34:719.
[90] Berry, D. (2003). "Renewable energy as a natural gas price hedge: The case of wind," *Energy Policy* 33:805.
[91] Center for Energy, Economic & Environmental Policy. (2005). "Northeast RPS Compliance Markets: An examination of opportunities to advance REC trading," Rutgers University, October 12.
[92] Christopher B. Berendt, "A State-Based Approach to Building a Liquid National Market for Renewable Energy Certificates: The REC-EX Model," *Electricity Journal* 19(5) (June, 2006), p. 57.
[93] Jan Hermrin and Meredith Wingate, *Developing a Framework for Tradable Renewable Certificates* (Washington, DC: Center for Resource Solutions, August, 2002), pp. 36-38.
[94] See Cooper, C and Sovacool, B. (2006). "Green Means 'Go?' – A Colorful Approach to a U.S. National Renewable Portfolio Standard," *Electricity Journal,19:7,* August/September.
[95] David Berry, "The Market for Tradable Renewable Energy Credits," *Ecological Economics* 42 (2002), pp. 369-379.
[96] Kent S. Knutson and Peter McMahan, "Closing the Green Gap," *Public Utilities Fortnightly* 143(4) (April, 2005), p. 14.
[97] M.H. Voogt and M.A. Uyterlinde, "Cost Effective of International Trade in Meeting EU Renewable Electricity Targets," *Energy Policy* 34 (2006), pp. 352-364.
[98] United Nations Environment Program, (2000). "Natural selection: Evolving choices for renewable energy technology and policy," UN Publications, p.6-7. Available at: http://www.uneptie.org/energy/publications/pdfs/naturalselection.pdf.
[99] Kammen, D., et. al. (2004). "Putting Renewables to Work: How Many Jobs can the Clean Energy Industry Create?," *Rael Report*, January. Available at: http://rael.berkeley.edu/files/2004/Kammen-Renewable-Jobs-2004.pdf
[100] See Sanders, R. (2004). "Investment in renewable energy better for jobs as well as environment," *UC Berkeley Press Release*, April 13.

[101] Sterzinger, G. and Svrcek, M. (2004). *Wind Turbine Development: Location of Manufacturing Activity*, Renewable Energy Policy Project (REPP) Technical Report, September, p.4.
[102] Barkenbus, J. et. al (2006). *Resource and Employment Impact of a Renewable Portfolio Standard in the Tennessee Valley Authority Region* (Knoxville: Institute for a Secure and Stable Environment at the University of Tennessee, July, 2006)
[103] John Grieco, "How Much in Job Years?" *Power & Energy* 1(3) (October, 2004), available at http://www.memagazine.org/supparch/peoct04/letters/letters.html.
[104] Jeff Deyette and David Friedman, *Made in the U.S.A: Clean Energy, Clean Cars are Patriotic* (Union of Concerned Scientists, 2005), available at http://www.ucsusa.org/publications/catalyst/page.jsp?itemID=27226049.
[105] Jeff Deyette and David Friedman, *Made in the U.S.A: Clean Energy, Clean Cars are Patriotic* (Union of Concerned Scientists, 2005), available at http://www.ucsusa.org/publications/catalyst/page.jsp?itemID=27226049.
[106] Fertel, M. S. (2004, March 4). The future of nuclear power. *Hearing Before the Senate Subcommittee on Energy and Natural Resources*.
[107] Jane Summerton and Ted K. Bradshaw, "Towards a Dispersed Electrical System: Challenges to the Grid," *Energy Policy* (January/February 1991), p. 29.
[108] Ed Vine, Marty Kushler, and Dan York, "Energy Myth Ten—Energy Efficiency Measures are Unreliable, Unpredictable, and Unenforceable," In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007).
[109] Ed Vine, Marty Kushler, and Dan York, "Energy Myth Ten—Energy Efficiency Measures are Unreliable, Unpredictable, and Unenforceable," In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007).
[110] Ed Vine, Marty Kushler, and Dan York, "Energy Myth Ten—Energy Efficiency Measures are Unreliable, Unpredictable, and Unenforceable," In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007).
[111] Murawski, J. (2006). "Cost of power plant jumps," *The News & Observer* (Charlotte, NC), November 17.
[112] Christopher Flavin, Janet L. Sawin, John Podesta, Ana Unruh Cohen, and Bracken Hendricks, *American Energy: The Renewable Path to Energy Security* (Washington, DC: Worldwatch Institute & the Center for American Progress, September, 2006), p. 16.
[113] According to PSE's Director of Resource Acquisition, Roger Garratt, PSE poured the first foundation on May 18, 2005 and the Hopkins Ridge Wind Project began commercial operations on November 27, 2005. See Garratt (2007). "Utility Resource Acquisition in an RPS Environment," Presentation to the EUCI 3rd Annual RPS Conference, April 23, slide 7.
[114] Comments at the EUCI 3rd Annual Renewable Portfolio Standards (RPS) Conference, April 23-24, 2007. Westminster, CO.
[115]See Lovins, A. et al. (2001). *Small is profitable: The hidden benefits of making electrical resources the right size.* Snowmass, Colorado: Rocky Mountain Institute.

3. Transmission: A National RPS Speeds Infrastructure Investment

Some utilities object to aggressive RPS mandates on the grounds that greater penetration of renewables will require costly transmission system upgrades. New wind projects, for example, will need to be located in windy areas that are often far from the cities where the most electricity is consumed.[116] Mandating that utilities invest in new renewable generation, therefore, is also mandating investment in new and expensive transmission upgrades.

Creating incentives for utilities to invest in much needed transmission system upgrades actually may be one of the hidden benefits of a national RPS.

Utilities can overcome public opposition to new transmission infrastructure by arguing for the need to access renewable resources. While public reaction to renewable energy is far from uniform, using access to renewable resources as a justification for new transmission wins local support for projects and speeds their development.

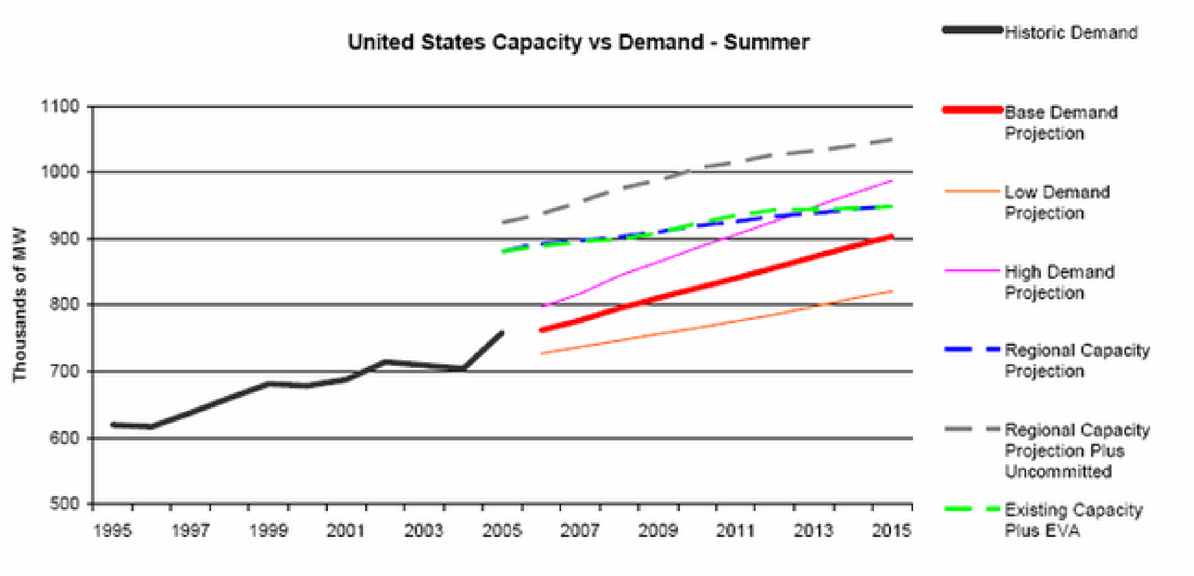
In addition, because renewable energy technologies have much shorter lead-times than conventional power plants, utilities can start getting use out of new power lines even as they wait to bring large conventional projects online. Quicker use of new transmission capacity benefits ratepayers because new rules allow utilities to start recovering the full cost of transmission investments even before utilities have built new capacity to fill them.

A. Transmission Congestion Raises Prices

Ever since the blackout of 2003, analysts have engaged in heated discussion about the under-investment in the U.S. transmission grid relative to the increased demand placed on the system. From 1975 to 1998, for example, transmission investment in the U.S. actually *declined* by about 1.5 percent per year, even while electricity demand more than doubled.[117]

The 2003 blackout prompted calls for up to $100 billion in new transmission investments to prevent bottlenecks and relieve strained power lines. But investment continues to lag woefully. While electricity demand is forecast to grow by 20 percent between 1998 and 2008, transmission capacity is set to grow by only 5 percent.[118] As a result, congestion expenses in some areas costs more than $1 billion each year. [119]

Figure 3.1: U.S. Summer Electricity Demand vs. Capacity (projected to 2015)

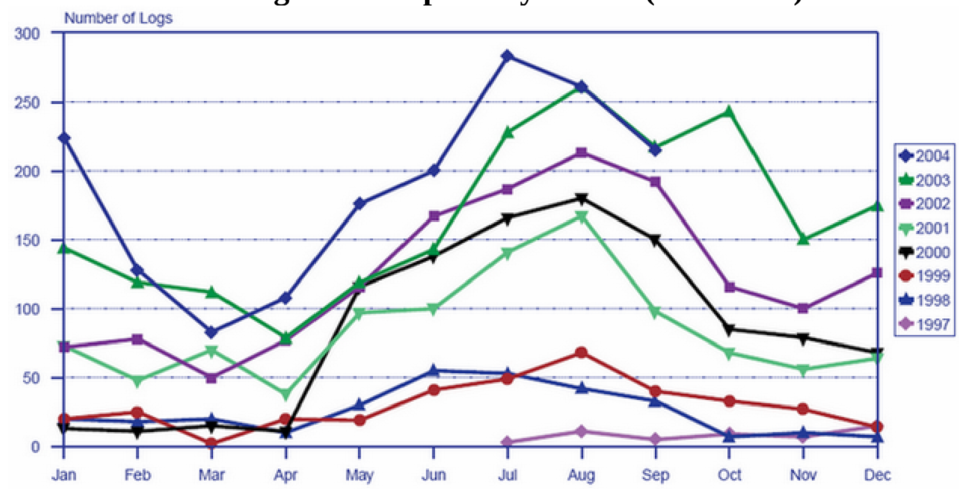


Source: NERC Long-Term Liability Assessment, 2006

Some analysts estimate that just to maintain the current ratio of available transmission capacity per MW of electricity demand will require the construction of 26,600 miles of new transmission over the next decade. Compare this staggering figure with estimated planned construction of only 6,200 miles and the investment shortfall becomes almost stupefying.[120] According to an informal association of electric utilities in 35 states, maintaining transmission adequacy at year 2000 levels will require quadrupling planned expenditures to $56 billion by 2011 (in 2004 dollars).[121] Ensuring increased reliability will require even more investment.

As consumers demand more electricity than the system can deliver, U.S. ratepayers could soon face serious congestion-driven rate increases. The National Electric Reliability Council (NERC) warns that grid congestion will continue to increase and in some situations "lead to supply shortages and involuntary customer interruptions."[122]

Figure 3.2: Transmission Congestion Measured as the Number of Level 2 or Higher Loading Relief Reports by Month (1997-2004)



Source: DOE/Energy Information Administration, 2004

There is a growing consensus that federal leadership is needed to address an impending electricity transmission crisis. Citing NERC concerns that increased volumes of power flowing across the transmission system could overwhelm bulk transmission capacity, FERC proposed transmission pricing reforms in 2006 designed to encourage utility investments in the nation's transmission infrastructure.[123]

In testimony before the House Government Reform Subcommittee on Energy and Resources, FERC Chairman Pat Wood defended the proposed federal intervention, noting that market-driven transmission investment "was not keeping up with load growth, and that "*in every area of the country*" FERC needed to "accelerate investment in transmission infrastructure."[124]

B. Utilities Benefit from Congestion

Like prisons, transmission lines would almost certainly be inadequately funded if left to individual market participants. Under normal market conditions, some utilities benefit from limited transmission resources. When the transmission system is saturated, less supply is available to meet existing demand, and prices increase. Market forces create perverse incentives for some utilities to delay transmission upgrades unless or until they risk catastrophic system failure. Even FERC has observed:

> Market participants also complain that companies that own both transmission and generation under-invest in transmission because the resulting competitive entry often decreases the value of their generation assets.[125]

Market dynamics can create situations where congestion prices benefit some electricity generators at the expense of customers, who not only pay higher prices, but suffer costs from the increased risk of blackouts. [126]

The current structure of the U.S. transmission system also encourages some utilities to intentionally flood limited transmission lines to crowd out other generators.

In a 2007 letter to the Public Utility Commission (PUC) of Texas, for example, Florida Power & Light (FPL) accused TXU of intentionally flooding West Texas transmission lines with high-cost power to prevent FPL's wind power from reaching customers across the state. While TXU has denied the allegations, the state's independent electricity market monitor found TXU guilty of similar market manipulations during the summer of 2005 and the PUC recommended that TXU be fined $210 million for that offense.[127]

C. FERC Pricing Rules Cost Consumers

FERC established new transmission pricing rules, in part, to address the market distortion brought about by transmission congestion. Under the new rules, FERC allows rate increases that permit utilities to recover higher than normal rates of return on transmission investments. The rules also provide accelerated depreciation of transmission investments and allow utilities to recover from consumers 100% of the stranded costs for transmission projects that may ultimately be abandoned.

Allowing utilities to recover the cost of transmission investments through rate increases and tax incentives, in theory, provides an economic incentive for utilities to make transmission investments that they otherwise would not. However, these incentives come at a cost to electricity consumers and American taxpayers. For example, prior to FERC's transmission incentives, the costs of abandoned transmission projects typically were split evenly between the investor and the electricity customers within the service area. Under the new rules, utilities are allowed to recover all of the costs of the failed investment from consumers.[128]

Under normal circumstances, utilities can not begin to recover much of the capital invested in new transmission until generation facilities designed to fill the new capacity are in operation. Long lead-times and unforeseen construction overruns often delay returns on investment for several years. Under FERC's new transmission pricing incentives, regulated utilities may start collecting 100% of the cost of the transmission expansions from ratepayers even before new generating capacity comes online.

The added cost to consumers can be substantial. The National Association of State Utility Consumer Advocates characterized FERC's transmission pricing scheme as "an unjustified multi-billion dollar giveaway of consumer money and conservatively calculated the total consumer cost of FERC's transmission pricing rules at more than $13 billion.[129]

D. Renewables Overcome Objections to Renewables

A national RPS may not only compel some utilities to invest in transmission upgrades sooner rather than later, it may actually help them to do so. Often, utilities face public opposition when trying to win regulatory approval for new transmission lines. Environmental groups may argue that the utility is overbuilding the system or that alternative solutions were overlooked. Local landowners may object to transmission line rights-of-way or oppose substations located too close to their property. In Faquier County, Virginia, one county Supervisor recently rallied local opposition to Dominion Power's preferred route for a 500 kV line, declaring, "This is a fight to the death!"[130]

"Transmission is the most difficult infrastructure project to site and more so than generation," according to Ron Poff of American Electric Power (AEP). "You can get support from politicians. But when the not-in-my-backyard factor weighs in, the politicians will pull the rip cord."[131] Poff should know. In 1990 AEP sought permission to build an 89-mile transmission line through parts of West Virginia and Virginia. After major concessions to objectors (including rerouting the line to avoid the area's rivers and wildlife), the project finally began transmitting power some 16 years later.

Figure 3.3: Pennsylvania Power & Light Electrical Substation in Columbia, PA

Source: Network for New Energy Choices, 2007

Delays in transmission siting and development add substantially to the cost of infrastructure projects. To site transmission, utilities often incur significant pre-certification expenses and risk stranded costs should a permit be denied or public opposition halt the project. In most cases the costs of project delays are capitalized as the project moves forward, creating investor uncertainty and adding to construction costs which are eventually passed on to ratepayers.[132] The longer a transmission project is delayed, the more it costs to finance and the more utilities must raise rates to recover those costs.

Recent experiences suggest that opposition to transmission projects turns to broad public support if it is justified by the need to interconnect new renewable generation.

In 2003, for example, Xcel Energy received approval from the Minnesota Public Utilities Commission (PUC) to site 178 miles of new transmission lines and four new substations to facilitate a tripling in size of its Buffalo Ridge wind farm. Early in the process, Xcel justified the new transmission as critical to expanding wind power generation at Buffalo Ridge, whose transmission lines were already fully subscribed.

In a remarkable reversal of norms, local stakeholders accused the company of not proposing an adequate amount of new transmission and not working to build it fast enough. One senior environmental consultant noted how local landowners and advocates perceived environmental and economic benefits from renewable energy and that perception translated into overwhelming support for Xcel's transmission upgrades:

> The combination of expanded use of renewable energy and the associated influx of potential economic gain in rural, primarily agricultural, regions have led to unprecedented support of the transmission line projects. Environmental groups view the increased use of a renewable energy source as a positive step and recognize the need for additional transmission capacity to support siting of renewable generation facilities.[133]

Xcel's experience with Buffalo Ridge is a case study for how other utilities can win public approval for network upgrades that ultimately benefit all generators. By justifying transmission expansions through RPS-induced renewable generation, utilities can overcome opposition that would delay or stop transmission upgrades under normal circumstances. The cost-savings associated with quicker project approvals result in lower rates for consumers who would otherwise pay for the delays.

And because modern transmission systems are required to respect FERC's Open Access requirements, line owners are not allowed to discriminate on the basis of generation source in the distribution of transmission resources. Therefore, transmission built initially to access renewable resources can facilitate infrastructure expansions that benefit the entire portfolio of generation sources. Transmission upgrades justified by substantial new renewable generation can buy time for zero-emissions coal and carbon sequestration technologies to become commercially viable.[134]

E. A National RPS Speeds Cost Recovery

"Cash flow is critical to determination of a project's expected return…What would investors like to see? A national RPS – projects that are competitive across the board."

- John Ravis, TD Banknorth, 2007[135]

Under FERC's new rules, utilities may begin to recover the costs of transmission projects before the projects are completed and new generating capacity is available to use the infrastructure. In theory, this policy change decreases the cost to ratepayers by allowing utilities to begin paying down the financing of a project sooner rather than later. However, such an arrangement raises the obvious question: how do utilities know what a transmission project will cost prior to the project's completion?

FERC allows utilities to calculate a rate of return based on a hypothetical case that may be different from the actual capitalization of the project.[136] This "hypothetical capital structure" estimates how much debt a project will incur relative to its equity. In theory, this calculation would require utilities to assess future revenues derived from the transmission costs of electricity that runs through the new infrastructure.

However, FERC's rules create an incentive for utilities to craft a hypothetical structure with the goal of achieving excessive rates of return on transmission investments. While such gaming may benefit investors, it is consumers who pay.[137] Indeed, the American Public Power Association warns that hypothetical capital structures "can result in an investor windfall that could substantially increase actual levels to far in excess of the Commission's allowed return on equity."[138] The only check against such abuse is FERC's review of rate structures on a case-by-case basis.

Because renewable energy projects have construction lead-times that are years (or even decades) faster than the lead-times for conventional or nuclear facilities, they can start generating electricity to be sold over new transmission lines much faster. Renewable energy systems, therefore, can start providing revenue to help pay down debt on transmission investments while conventional plants are waiting to come online. If this expedited debt repayment is calculated in hypothetical capital structures, it may depress the projected capital costs of transmission expansions and provide a natural check to excessive rate increases. A national RPS mandate may therefore have the added benefit of decreasing the financing costs of new transmission and protecting ratepayers from excessive price increases.

F. A National RPS Improves Reliability

New studies reveal that a national RPS would contribute to overall transmission system reliability substantially more than a state-by-state RPS approach. This is because, contrary to what some opponents of renewable energy assert, the variability of renewable resources becomes *easier* to manage the more they are deployed.

Greater Geographical Dispersion

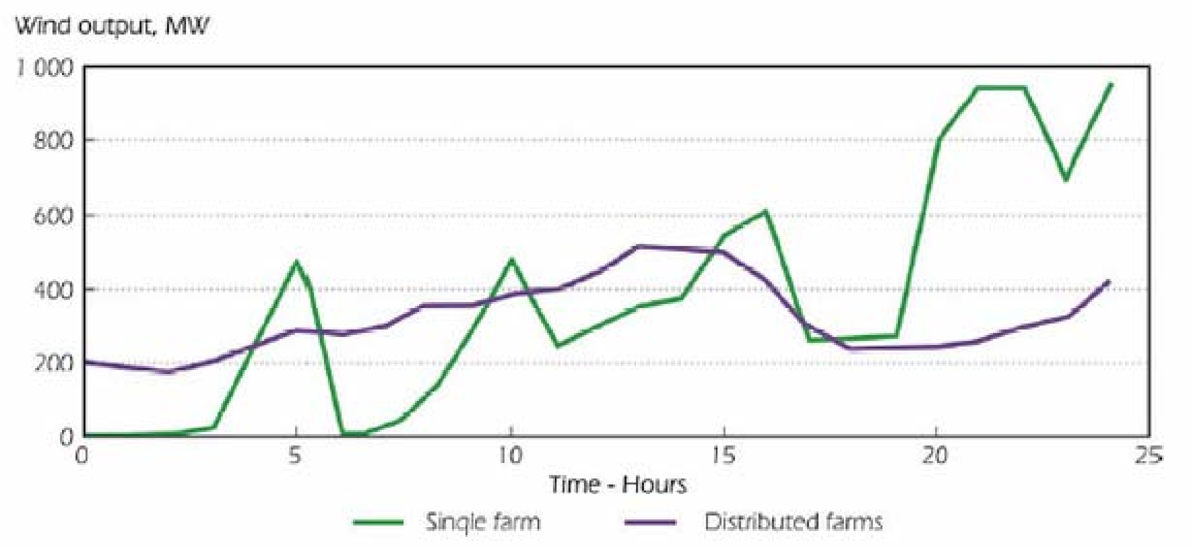
Electrical and power systems engineers have long held the principle that the larger a system becomes, the less reserve capacity it needs. Demand variations between individual consumers are mitigated by grid interconnection in exactly this manner. When a single electricity consumer, for example, starts drawing more electricity than the system has 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.[139] So when the wind is not blowing through one wind farm, it is likely blowing harder through another.

The European Wind Energy Association explains how the smaller unit size and larger geographical dispersion of wind turbines actually turns the variability of wind power into an advantage over large, conventional systems:

> Variations in wind energy are smoother, because there are hundreds or thousands of units rather than a few large power stations, making it easier for the system operator to predict and manage changes in supply as they appear within the overall system. The system will not notice the shut-down of a 2 MW wind turbine. It will have to respond to the shut-down of a 500 MW coal fired plant or a 1,000 MW nuclear plant instantly.[140]

According to data from the International Energy Agency (IEA), the greater geographical distribution of wind turbines in Europe is already reducing the volatility of renewable energy output. IEA has concluded, therefore, that the extent to which intermittency of renewable resources will become a barrier to even greater renewable energy generation is, "mainly a question of economics and market organization," *not* technology.[141]

Figure 3.3: Smoothing Effects of Distributed Wind Farms versus Single Wind Farm (levelized nameplate capacity of 1000MW)



Source: International Energy Agency, 2004

A study assessing the wind portfolios of all major European power providers concluded the same way, noting that:

> A large contribution from wind energy … is technically and economically feasible, in the same order of magnitude as the individual contributions from the conventional technologies developed over the past century. These large shares can be realized while maintaining a high degree of system security.[142]

Greater Technical Availability

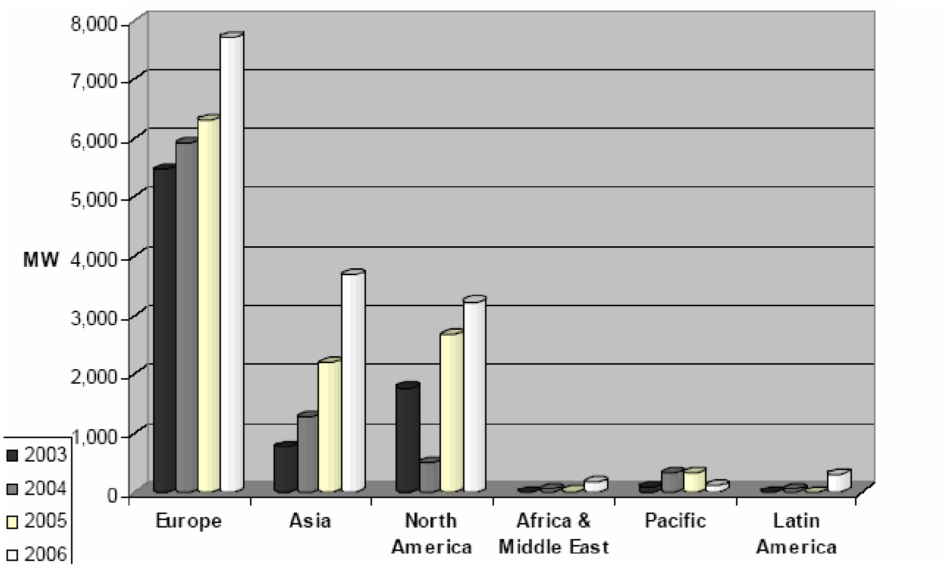
Any given hour there is a 10 percent risk that electricity from conventional power plants will be unavailable or limited due to forced outages and mechanical failures.[143] A national RPS can help respond to such failures by promoting technologies that have a higher rated technical reliability. Modern wind turbines, for example, have technical reliability above 97.5 percent, compared to coal and natural gas power plants with technical reliabilities that rarely exceed 85 to 90 percent.[144]

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 (since it is very unlikely that all turbines would be down at the same time). And even 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 all arranged in complex circuits prone to mechanical failure.[145] In fact, the International Energy Agency recently concluded that:

> Bigger units of power plants bring with them the need for both greater operational and capacity reserve since outages cause greater disturbances to the system. The higher the technical availability, the lower the probability of unexpected outages and thus the lower the requirements of short-term operational reserve. Wind power plants actually score favorable against both criteria, since they normally employ small individual units (currently up to 5 MW) and have a record of high technical availability.[146]

In Europe, utilities and system operators have heavily promoted renewable energy for precisely this reason. The American Wind Energy Association, for example, estimates that by 2005 Europe had installed almost three times as much wind energy as the U.S.—48,500 MW of installed capacity, 9,000 MW of which had been installed in 2005 alone.[147]

Figure 3.4: Annual Global Installed Wind Capacity by Region, 2005



Source: American Wind Energy Association (AWEA), 2006

Analysts have 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.[148]

The U.S. government has already acknowledged the ability of renewable energy systems to deter major power outages and provide consistent power supply. A recent assessment from the U.S. Department of Defense, for instance, found that increased deployment of renewable energy resources significantly improved overall system reliability.[149] The study, which focused on the deployment of wind, solar, and geothermal electricity generators on and near military installations, found that:

1. Renewable energy facilities contribute to energy security by enabling military facilities to operate during simulated outages

2. Renewable energy generators enable the possibility of storing excess energy when power output is high

3. Renewable energy resources help "segregate" a service area from outside influences, creating "self-sustaining regional islands" that can provide "critical installation functions"

4. Renewable power may be more reliable during routine or prolonged power outages than conventional generators, which may have restricted hours of operation

Improved reliability of supply is important, as blackouts and brownouts exact a considerable toll on the American economy. The U.S. Department of Energy, for example, estimates that while power interruptions often last only seconds or minutes, they cost consumers an average of $150 to 400 billion every year.[150] The Electric Power Research Institute projects the annual costs of poor power reliability at $119 billion, or 44 percent of all electricity sales in 1995.[151]

No Need for Back-up Power

Researchers also continue to improve upon the technical performance of renewable energy generators every day. New wind technologies operating at lower wind speeds and employing stronger materials and solar technologies utilizing plastics, nanostructured materials, and thinner modules have greatly improved efficiency, lowered cost, and enhanced performance.[152] In Germany, for instance, the Wind Power Management Systems are so accurate that they predict hourly wind capacity within a 2 percent margin of error.[153] According to the German Energy Agency (DENA), the improved quality of forecasting tools has eliminated the need for construction of additional conventional power stations to balance increasing amounts of wind power on the nation's transmission grid.[154]

Evidence from recent history also proves false the accusation that large wind systems risk power outages from the abrupt loss of wind. In an analysis of the effects of integrating wind power in New York State, for example, researchers for General Electric analyzed the actual output records of wind farms in use for over 5 years and found no evidence that wind power output changed so abruptly as to require contingency plans and back-up generation:

> Analysis of historical statewide wind data indicates that loss of wind generation due to abrupt loss of wind is not a credible contingency. Short-term changes in wind are stochastic (as are short-term changes in load). A review of wind plant data revealed no sudden change in wind output in three years that would be sufficiently rapid to qualify as a loss-of-generation contingency for the purpose of stability analysis. While the wind can vary rapidly at a given location, turbines are spread out in a project, and the projects are spread throughout the state, making such an abrupt drop in total output an extremely unlikely event.[155]

Pumped hydro and compressed air energy storage systems can also be coupled to renewable energy technologies to smooth out intermittency. Bonneville Power Administration (BPA), a large federal utility in the Pacific Northwest, for example, uses its existing 7,000 MW hydroelectric and pumped hydro storage network to store renewable energy. Starting in 2005, BPA offered a new business service to "soak up" any amount of intermittent renewable output, and sell it as firm output from its hydropower network one week later.[156] Such storage technologies can have greater than 1,000 MW of capacity (depending on location), and operate according to fast response times and relatively low operating costs. Storage systems like BPA's are already commercially available and provide a combined 22.1 GW of installed capacity in the U.S.[157]

Technological Diversity

Under a national RPS, intermittent generators are not only likely to be geographically dispersed, but also technologically dispersed. That is, a national RPS would expand the diversity of technologies used to access renewable resources. Technological dispersion increases system reliability by decreasing dependence on any one intermittent source of energy. Utilities can harness wind on windy days, sun on sunny days, hydropower on rainy days, etc.

In one study, assessing the impact of renewable technologies at large penetration rates (for example, above 20 percent) in the United Kingdom, researchers found that "intermittent generation need not compromise electricity system reliability at any level of penetration foreseeable in Britain over the next 20 years … overall [any negative costs] are much smaller than the savings in fuel and emissions that renewables can deliver.[158] Put simply, the benefits of renewable energy technologies, in technological diversification, grid stability and system reliability more than outweigh their costs.

G. A National RPS Improves the Efficiency of Renewables

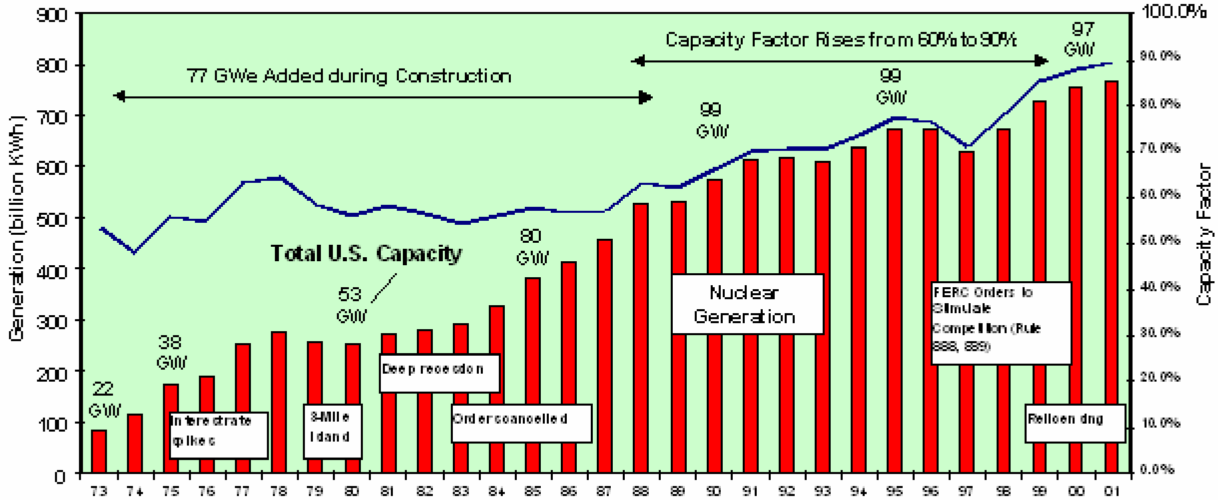
A capacity factor is the ratio of a generating facilities' actual output over time compared to its theoretical output if it were operating at maximum efficiency. In 2000, the EIA estimated that the average capacity factor for all power plants in the U.S. was approximately 55 percent.[159] (That is, over a long period of time, an average power plant actually contributes to the electricity grid only 55 percent of its theoretical maximum output.) Nuclear and hydroelectric generators have boasted the highest capacity factors, occasionally exceeding 90 percent. Coal ranks near the middle, with a capacity factor of around 60 percent.[160] Less reliable natural gas generators have much lower capacity factors of around 29 percent. (This low percentage is, in part, because gas-fired unites are generally used as "peaking" units).

Citing capacity factors for technologies that have been around for decades obscures the historical fact that nuclear, hydro, and other conventional generators did not start out with such high capacity factors. Historically, all forms of electricity generation have followed the same general trend: the more the technologies get deployed, the higher their capacity factor and the lower their costs. When coal and steam boilers were generating just a few GW of electricity in the early 1930s, they had capacity factors in the low 20s. But by 1997, when the deployment of coal-fired units reached thousands of GWs of capacity, their capacity factor had jumped to 61 percent.[161]

The relative maturity of a technology does not appear to affect the tendency for capacity factors to improve the more the technology is deployed.. System operators and utilities, for example, have announced plans to build more than 150 coal-burning electricity plants in 42 states (representing 85 GW of capacity) by 2025. During the same period, the National Energy Technology Laboratory expects the capacity factor for coal generators to grow to above 80 percent.[162]

Nuclear reactors also prove the concept. The World Nuclear Association notes that nuclear generators had a capacity factor of around 10 percent when just 22 GW were deployed. Yet their capacity factor rose to 30 percent with the deployment of 53 GW and close to 90 percent once installed capacity reached 97 GW. [163]

Figure 3.5: Capacity Factor and Nuclear Generation, 1973 to 2001



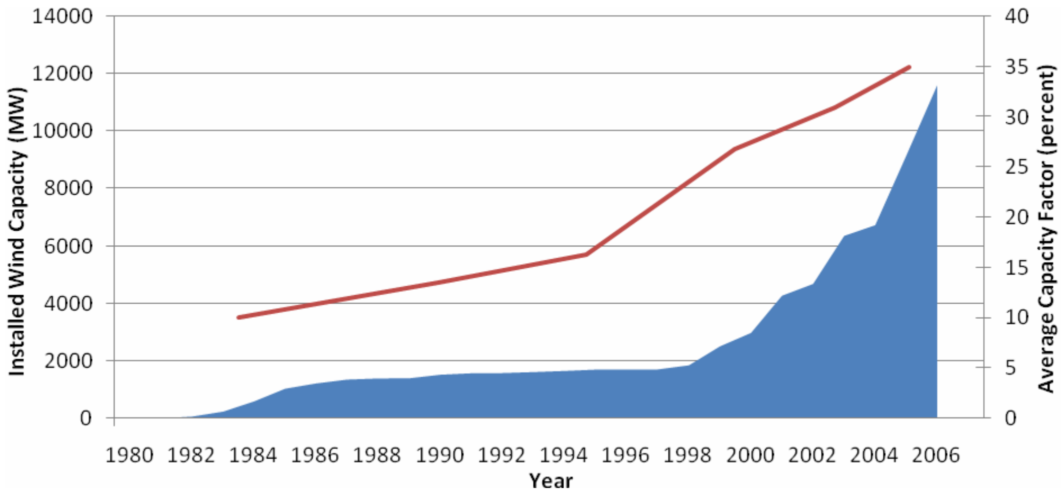
Source: World Nuclear Association.

Similarly, the capacity factor for hydroelectric generators and geothermal plants rose in direct correlation with the amount of total installed capacity. [164]

By forcing a greater amount of installed renewable capacity, a national RPS will significantly improve the capacity factors of renewable energy technologies.

Recent experience with wind energy seems to confirm this rule. In 2000, for example, wind turbines reported capacity factors in the low teens. But by 2006, when installed wind energy had more than tripled in the U.S., wind turbines registered capacity factors in the mid 30s. Capacity factors for wind turbines started off in the low teens before rising to the high 20s in 2000 and the mid 30s in 2006.

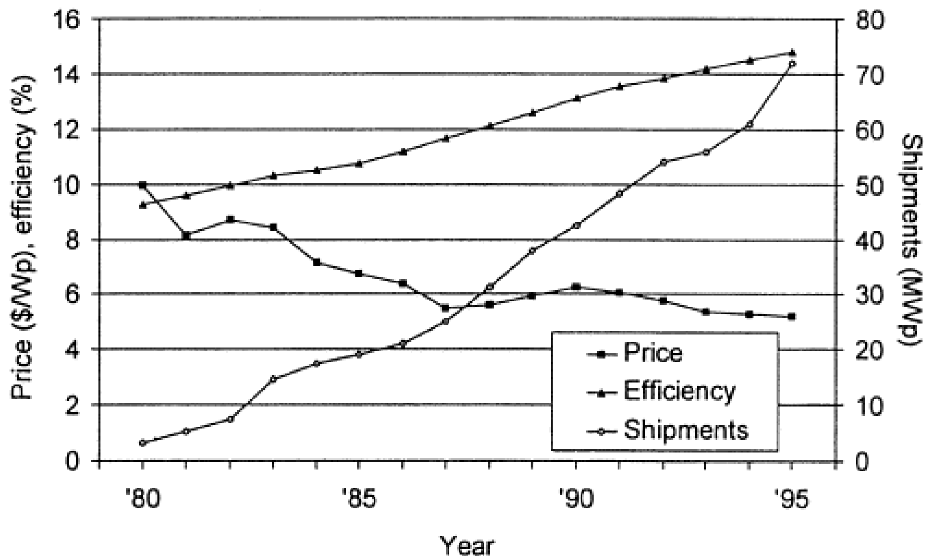
Figure 3.6: Average Wind Capacity Factors and Installed Capacity, 1980-2006



Newer wind projects in Oahu, Hawaii, and San Gorgonio, California, have even achieved capacity factors of 36 and 38 percent (respectively).[165] In a 2006 analysis, the EIA observed that wind turbine capacity factors appeared to be improving over time and concluded that "capacity factor grows as a function of capacity growth."[166]

Solar energy appears to follow this same pattern. In the early 1980s, when just 10 MW of solar photovoltaics had been installed globally, the average capacity factor for solar panels was around 9 percent. By 1995, however, after more than 70 MW had been installed, the average capacity factor of panels jumped to almost 15 percent.[167]

Figure 3.7: Sales and Capacity Factor (Module Efficiency) for Solar Photovoltaics, 1980-1995



Source: Philippe Menanteau, 2000

In 2000, Researchers from the Institute for Energy Policy and Economics found that "over the last 10 years 'learning by doing' has led to a simplification of industrial manufacturing processes … As a result, costs have fallen considerably [and] efficiency levels on the order of 18 percent for cells are expected in the near future at a competitive cost."[168]

Given the historical trend recorded by almost every electricity generating technology, it is likely that a national RPS will not only improve the stability of the electricity grid, but will also accelerate the capacity factors of renewable energy technologies—further lowering their cost and enhancing their technical reliability.

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[116] Kelly, D. (2007). "Commentary," draft submitted to *Electricity Journal*, February, 26.
[117] Associated Press. (2007). "Future of nation's power grid sparking an energetic debate," *Electricity Forum*, December 5.
[118] Reutter, M. (2006). "Transmission congestion threatens to clog nation's power grid," News Bureau, University of Illinois at Champagne-Urbana, July 26. Available at: www.news.uiuc.edu/news/06/0727power.html
[119] Gray, E. (2006). "Electric transmission one year after the Energy Bill," Electricity Journal, 19:7, August/September.
[120] Datta, E.K. & Gabaldon, D. (2003). "Energy technology: Winner take all," Public Utilities Report, October 15. Available at: http://www.pur.com/pubs/4273.cfm.
[121] Transmission Access Policy Study Group (TAPS). (2004). Effective Solutions for Getting Needed Transmission Built at Reasonable Cost, June. Available at: http://www.electricitydeliveryforum.org/pdfs/Effective_Solutions_TAPS6-2004.pdf
[122] Freeman, M. (2006). "NERC forecast: 22 actions required to save U.S. electric grid," *Executive Intelligence Review*, October 27.
[123] Renner, S. (2005). "Transmission investment: Nourishing a gnarly tree," *Electricity Journal*, 18:7, August/September, p.26.
[124] Ibid, p.27.
[125] See FERC (2003). *Proposed Pricing Policy for Efficient Operation and Expansion of the Transmission Grid*, Notice of Proposed Policy Statement, Docket Number PL03-1-000, 102 FERC 61.032, p.15
[126] Deb, R. & White, K. (2005), "Valuing transmission investments: The big picture *and* the details matter – and benefits might exceed expectations," *Electricity Journal*, 18:7, August/September, p. 42.
[127] Fuquay, J. (2007). "TXU facing power fight," *Fort-Worth Star Telegram*, April 25.
[128] Java, J. (2005). "Rule would encourage transmission investment & membership in transcos and transmission organizations," *Energy Legal Blog*, November 28. Available at: http://energylegalblog.com/archive/2005/11/28/135.aspx
[129] National Association of State Utiluty Consumer Advocates, (2006). Comments to the Federal Energy Regulatory Commission (FERC), Docket Number RM06-4-000, January 11. Available at: http://www.opc-dc.gov/pdf/NASUCAComments1.pdf
[130] Johnston, D. (2007). "Dominion line plan draws opposition," The Free Lance-Star (Fredericksburg, VA), February 28.
[131] Quoted in Silverstein, K. (2006). "Cracking the Bottlenecks: Act Spurs Buildup of Transmission Corridors," *EnergyBiz Magazine*, November/December, p.9
[132] TAPS, (2004). p.15-16
[133] Bisonnette, M., et. al. (2007). "Getting the crop to market: Siting and permitting transmission lines on Buffalo Ridge, Minnesota," Presentation at the 2007 Power-Gen Renewable Energy & Fuels Conference, March 7. Email: michelle.bissonette@hdrinc.com
[134] Olsen, D. (2007). "Renewables-first generation/transmission projects," Presentation at the 2007 Power-Gen Renewable Energy & Fuels Conference, March 7.
[135] At the EUCI 3rd Annual Renewable Portfolio Standards (RPS) Conference, April 23-24, 2007. Westminster, CO.
[136] Wyoming Office of Consumer Advocate. (2006). Comments to FERC on Promoting Transmission Investment Through Pricing Reform, Docket Number RM06-4-000, January 9, p.2.
[137] National Rural Electric Cooperative Association. (2006). Comments to FERC on Promoting Transmission Investment Through Pricing Reform, Docket Number RM06-4-000, January 9, p.29.
[138] American Public Power Association. (2006).). Comments to FERC on Promoting Transmission Investment Through Pricing Reform, Docket Number RM06-4-000, January 11, p.21.
[139] International Energy Agency, *Variability of Wind Power and Other Renewables: Management Options and Strategies* (Paris: International Energy Agency, 2005), p. 20.
[140] European Wind Energy Association, *Large Scale Integration of Wind Energy in the European Power Supply: Analysis, Issues and Recommendations* (Paris: EWEA, December, 2005), pp. 7-9.
[141] International Energy Agency. (2004). *Variability of Wind Power and Other Renewables*, p20. Available at: http://www.iea.org/Textbase/Papers/2005/variability.pdf
[142] European Wind Energy Association, *Large Scale Integration of Wind Energy in the European Power Supply: Analysis, Issues and Recommendations* (Paris: EWEA, December, 2005), p. 13.

[143] Robert Gross et al., *The costs and Impacts of Intermittency: An Assessment of the Evidence on the Costs and Impacts of Intermittent Generation on the British Electricity Network* (London: Imperial College London, March, 2006), p. iv.
[144] International Energy Agency, *Variability of Wind Power and Other Renewables: Management Options and Strategies* (Paris: International Energy Agency, 2005).
[145] International Energy Agency, *Variability of Wind Power and Other Renewables: Management Options and Strategies* (Paris: International Energy Agency, 2005).
[146] International Energy Agency, *Variability of Wind Power and Other Renewables: Management Options and Strategies* (Paris: International Energy Agency, 2005), p. 8, 43-44.
[147] American Wind Energy Association, "Global Wind Markets," 2006, available at http://www.awea.org/newsroom/pdf/070202__GWEC_Global_Market_Annual_Statistics.pdf.
[148] EnerNex Corporation and the Midwest Independent System Operator. *Final Report—2006 Minnesota Wind Integration Study* (Knoxville, TN: EnerNex Corporation, November 30, 2006).
[149] U.S. Department of Defense, *DOD Renewable Energy Assessment* (Washington, DC: March 14, 2005, DOD Report to Congress), available at http://www.acq.osd.mil/ie/irm/irm_library/Final%20Renewable%20Assessment%20Report.pdf.
[150] Swaminathan S, SenRD. Review of power quality applications of energy storage systems. Report no. SAND98-1513. Albuquesque, NM and Livermore, CA, Sandia National Laboratories, 1998.
[151] Primen. The cost of power distrubances to industrial and digital economy companies. Report. No. TR-1006274 (Available through EPRI). Madison, Wisconsin, Primen. 2001.
[152] See U.S. House of Representatives Committee on Science, "Renewable Energy Technologies—Research Directions, Investment Opportunities, and Challenges to Commercial Applications in the United States and Developing World," Hearing Charter, August 2, 2006, 9pp; Arno Penzias, "Renewable Energy Technologies: Research Directions, Investment Opportunities, and Challenges to Deployment in the Developing World," *Testimony Before the House Subcommittee on Energy*, August 2, 2006, pp. 1-2; and David B. Pearce, "Renewable Energy: The Future," *Testimony Before the U.S. House Science Committee*, August 2, 2006, pp. 2-3.
[153] International Energy Agency, *Variability of Wind Power and Other Renewables: Management Options and Strategies* (Paris: International Energy Agency, 2005), p. 23.
[154] European Wind Energy Association. (2005). "German Energy Agency Dena study demonstrates that large scale integration of wind energy in the electricity system is technically and economically feasible," *Briefing*, May 10. Available at: http://www.ewea.org/documents/0510_ewea_bwe_vdma_dena_briefing.pdf
[155] Piwko, R. et.al. (2005). *The Effects of Integrating Wind Power on Transmission System Planning, Reliability, and Operations*, Report on Phase 2: System Performance Evaluation, New York State Energy Research and Development Authority (NYSERDA), March 4, p.8.3
[156] International Energy Agency, *Variability of Wind Power and Other Renewables: Management Options and Strategies* (Paris: International Energy Agency, 2005), p. 37.
[157] See University of Oregon, "Overview of Energy Storage Technologies," 2001, available at zebu.uoregon.edu/2001/ph162/append_overview.pdf; and W. Leonhard et al., "Sustainable Electrical Energy Supply With Wind, Biomass, and Pumped Hydro Storage—A Realistic Long Term Strategy or Utopia?" *Paper Presented at the General Meeting of the IEEE Powering Engineering Society*, Denver, Colorado, June, 2004.
[158] Robert Gross et al., *The costs and Impacts of Intermittency: An Assessment of the Evidence on the Costs and Impacts of Intermittent Generation on the British Electricity Network* (London: Imperial College London, March, 2006), p. iii.
[159] U.S. EIA, "Capacity Factor by Energy Source," http://www.eia.doe.gov/cneaf/electricity/epav1/fig4.html.
[160] Bob Bellemare, "What is a Megawatt?" 2007, available at http://www.utilipoint.com/issuealert/print.asp?id=1728.
[161] J. Alan Beamon and Thomas J. Leckey, *Trends in Power Plant Operating Costs* (Washington, DC: U.S. EIA, 1999), available at http://www.eia.doe.gov/oiaf/issues/power_plant.html.
[162] National Energy Technology Laboratory, "Tipping Point or Opportunity for Clean Coal Technologies?" February 10, 2004, available at http://www.netl.doe.gov/technologies/coalpower/cctc/ccpi/pubs/presentations/eastman_021004.pdf.
[163] World Nuclear Association, "Early Orders for New Reactors," 2003, available at http://www.world-nuclear.org/sym/2003/paterson.htm.
[164] U.S. EPA, 2006, available at http://www.epa.gov/climatechange/emissions/downloads06/07Energy.pdf; U.S. EIA, "Annual Steam Production and Injection at the Geysers," http://www.eia.doe.gov/cneaf/electricity/epav1/fig4.html.
[165] Paul Gipe, "California Updates Wind Stats," 2002, available at **http://www.wind-works.org/articles/lg_ws0202.html.**
[166] Chris Namovicz, "Issues in Wind Resource Supply Data and Modeling," Presentation at the ASA Committee on Energy Statistics, Fall 2006 Meeting, October 5, 2006, available at http://www.eia.doe.gov/smg/asa_meeting_2006/fall/files/nemmodel.pdf.
[167] Modified from Philippe Menanteau, "Learning from Variety and Competition Between Technological Options for Generating Photovoltaic Electricity," *Technological Forecasting and Social Change* 63 (2000), p. 68.
[168] Philippe Menanteau, "Learning from Variety and Competition Between Technological Options for Generating Photovoltaic Electricity," *Technological Forecasting and Social Change* 63 (2000), pp. 63-80.

4. Fairness: A National RPS Creates a Level Playing Field for States

When Congress took up the massive Energy Policy Act of 2005 (EPAct), the Senate engaged in heated debate over whether to include a national RPS. Department of Energy Assistant Secretary David K. Garman articulated the Administration's opposition to the proposed RPS in hearings before the Senate Committee on Energy and Natural Resources:

> A national RPS … could create "winners" and losers" among regions of the country – winners generally being the regions with ample renewable resources, and the losers being the regions without. Moreover, a national RPS could lead to higher energy bills and opposition to renewable energy in areas where these resources are less abundant and harder to cultivate or distribute.[169]

The Administration did not, however, oppose efforts by the states to adopt their own RPS programs. Indeed, in his testimony, Secretary Garman asserted that state efforts were likely to "double" the nation's non-hydro renewable electricity capacity by 2017.[170] Of course, a closer examination of Garman's claim reveals that a "doubling" of renewable energy capacity would mean that the U.S. would continue to depend on fossil fuels and nuclear power for more than 95 percent of the nation's electricity generation.

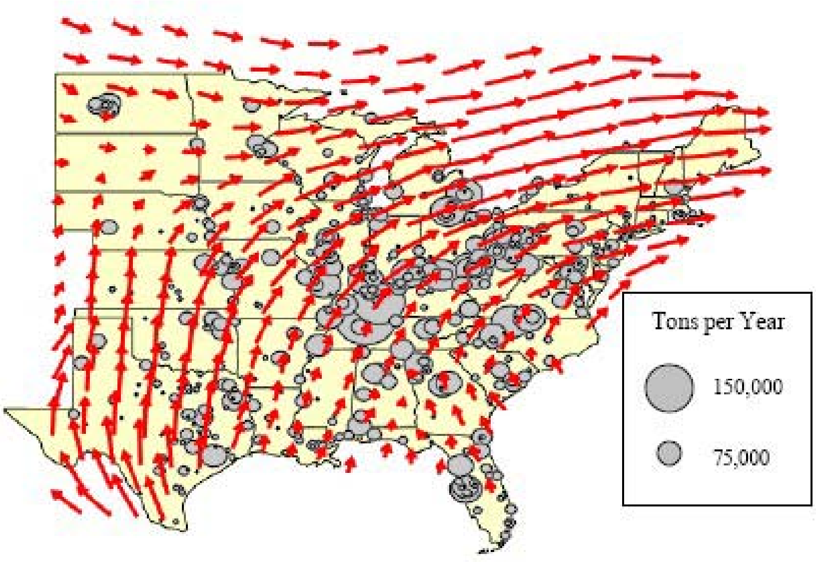
A. A National Mandate Avoids "Free Riders"

The irony of the Bush Administration's argument for rejecting a national RPS is that the current system of state-based RPS mandates itself is fostering significant inequalities between states.

While ratepayers in RPS states pick up the tab for cleaning the air and water, other states enjoy artificially deflated electricity prices as they tap cheap sources of energy, which pollute the environments of neighboring states.

In economics, those consuming more than their fair share of a resource while shouldering less than their share of the costs of producing it are called "free riders".[171] Relying on states alone to adopt RPS programs creates a classic free rider problem because environmental damage from conventional power plants does not stop at state borders. SO_2 and NO_x emissions from coal-fired plants in Midwestern states drift across borders and cause acid rain to damage watersheds in the Northeast.[172] Mercury from power plants in the Ohio Valley is deposited in Maine's forests and New Hampshire's lakes.[173] The resulting environmental problems provide powerful incentives for affected states to adopt more aggressive renewable energy policies while non-affected states (that are often the source of the pollution) get a "free ride".

Figure 4.1: Ozone and NO_x Transport Across States in the Northeast



Source: New Hampshire Department of Environmental Services, 2004.[174] Arrows show air flow when high ozone levels are present in the Northeast. Circles show locations and magnitude of NO_x emissions from electric generating plants.

Upwind and upstream states that do not suffer the full burdens of their pollution have little incentive to adopt policy reforms to address it.[175] Historically, some of these upwind states have rejected RPS mandates when they believed that such policies would raise compliance costs and encourage industries to flee to less stringent states.

In 2003, for example, the Ohio General Assembly considered a pair of bills that would have gradually increased the percent of renewable energy resources in Ohio's energy sector from 3 percent to 20 percent by 2020.[176] But the proposals went nowhere. Outgoing state Rep. Lynn Olman, Chair of the state house's Public Utilities Committee, would not call for hearings on the RPS proposal because he feared it was too ambitious and could drive up energy prices. "If you drive the cost of energy higher," Olman argued, "then you make it less likely that industries will locate in Ohio."

What Olman did not realize is that Ohio is able to exploit cheap and polluting fuels only because their environmental costs have been subsidized by ratepayers in downwind states like New Hampshire and Massachusetts. If Ohio enjoys cleaner air, more reliable energy and lower electricity prices it is because the costs are borne by utilities and ratepayers in other states.[177] Since state lawmakers have a political incentive to protect in-state interests without regard to out-of-state consequences, this free rider problem will continue to create "winners" and "losers" among the states so long as federal policymakers rely on the states to combat an energy crisis that affects the whole nation.

B. Consistency Prevents Unfair "Gaming"

Ironically, inconsistencies between what constitutes eligible renewable resources under state RPS mandates foster situations where states rich in cheap renewable resources end up paying to import more expensive renewable energy from neighboring states.

This "gaming" of inconsistencies between state RPS policies produces inequities between states and discourages the development of the most cost-competitive forms of renewable energy.

In an attempt to oppose calls for a national RPS, NRECA has argued, for example, that state-RPS mandates are likely to raise electricity rates where renewable energy substitutes for lower-cost products, as in Washington State, where I-937 (an RPS mandate passed by voter initiative in 2006) may force some forms of expensive renewable energy to displace lower-cost hydropower.[178]

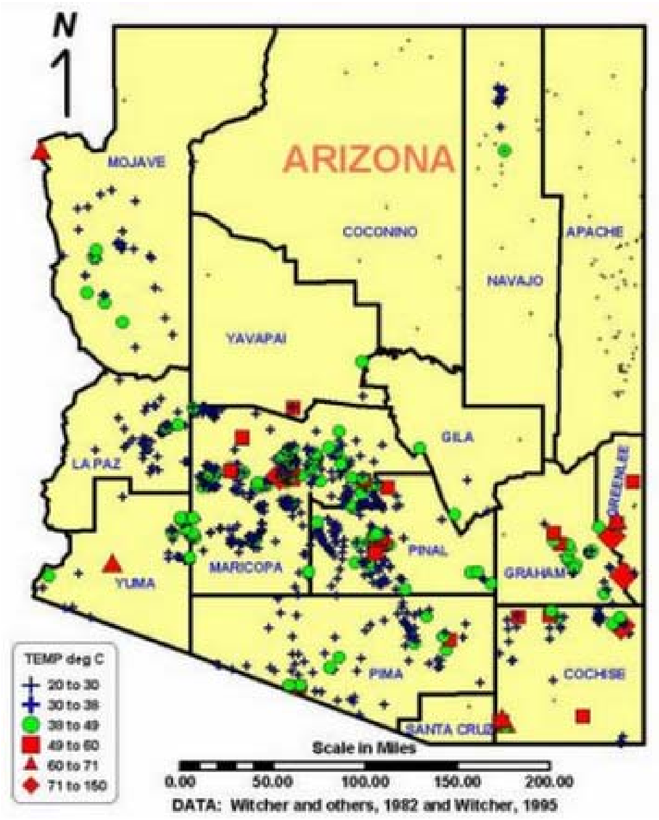
During debate over I-937, the non-partisan Washington Research Council claimed that the inconsistencies between state RPS mandates within the region created opportunities to shift energy between states to meet different requirements. Because I-937 excluded hydro-power as a "renewable energy", but other state RPS mandates included it, Washington's low-cost hydro power would be sold to ratepayers in neighboring states, while Washington consumers would be forced to buy higher-cost renewable energy (or RECs) from generators outside the state:

> Currently, [many] states have some sort of renewable energy portfolio requirement. The standards for what counts as "renewable" varies among them. The difference in those standards, and between states with energy quotas and those without, increases the likelihood that states will shift energy around to meet targets in states with renewable portfolios. In short, states without energy portfolios will sell their high-cost renewable energy to Washington State and will receive, in exchange, low-cost hydro or other energy for their own purposes. This amounts to a subsidy of energy prices in other states. That subsidy would be paid by all Washington residents, meaning that low- and middle-class families in Washington would pay to reduce energy costs for wealthier families in other states.[179]

Tony Usibelli, Director of the Energy Policy Division of Washington's Department of Community, Trade and Economic Development, confirmed that there was nothing in the state's new regulations that would prevent RECs derived from Washington State hydropower from being exported out of the state to meet RPS requirements in any of the 14 states and 2 Canadian provinces in the Western Interconnection's GIS system (including Alberta, Arizona, British Columbia, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, Oregon, South Dakota, Texas, Utah, and Wyoming.)[180]

In other regions of the United States, inconsistencies in the eligibility of low-cost geothermal power create a similar situation. Nevada and New Mexico's RPS mandates, for example, permit geothermal power.[181] But Arizona's RPS mandate excludes it.[182] This inconsistency gives rise to a scenario in which Arizona's geothermal generation can be exported to neighboring states, while Arizona's regulated utilities must either purchase more expensive solar, wind and biomass to meet the state's mandate or accept non-attainment of the RPS goal. Indeed, Arizona's Cost Evaluation Working Group (CEWG), a committee mandated by the legislation to assess the cost-benefits of the state's RPS, concluded that the goal of 1.1% of retail sales would not be met with RPS-eligible technologies, despite the declining cost of solar installations.[183]

Figure 4.2: Geothermal Resources (Wells and Springs) in Arizona



Source: Geothermal Energy Association, 2006

Even in states with consistent eligibility criteria, geographical limitations and restrictions on "unbundled" renewable energy credits create incentives for low-cost renewable energy to be exported to states whose utilities face more difficult and expensive RPS compliance burdens. Joseph Visalli, of the New York State Energy and Research Development Authority (NYSERDA), for example, recently asserted that generators in New York were in the process of installing over 300MW of new wind capacity upstate solely for the purpose of exporting it to Massachusetts, where utilities pay top dollar to meet that state's aggressive RPS goals.[184]

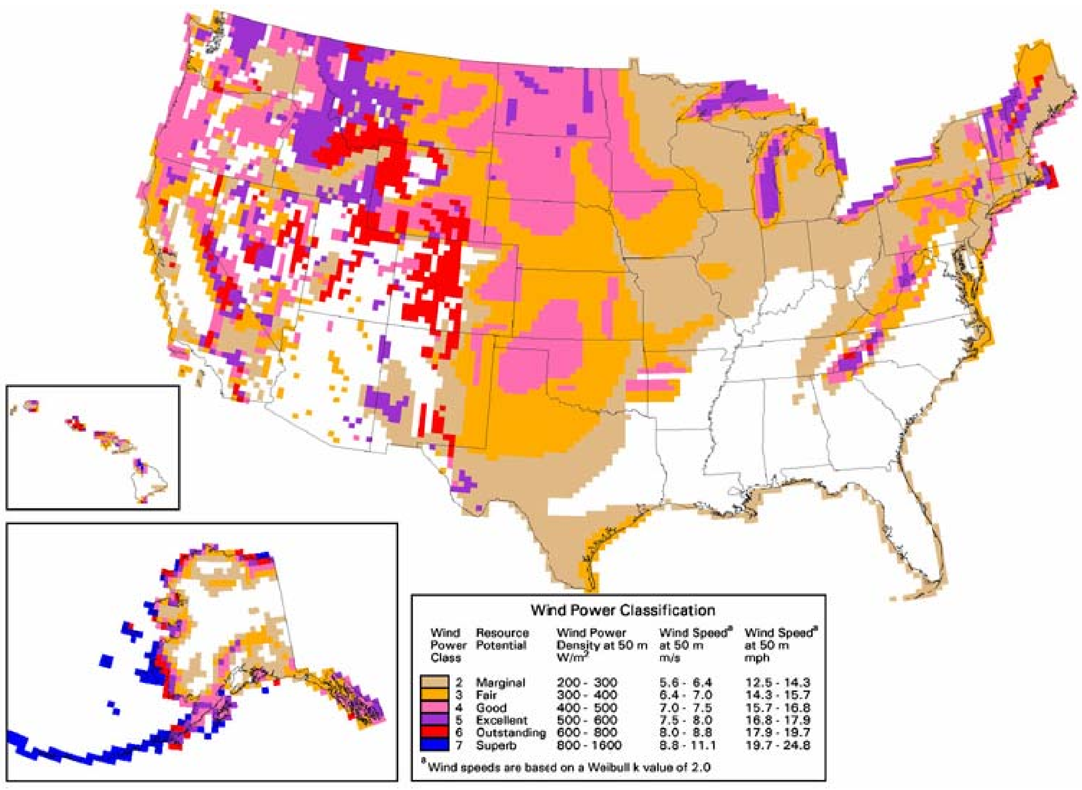
A national RPS would prevent these kinds of predatory trade-offs by creating a uniform definition of eligible renewable fuels and fostering consistent regulatory criteria. A federal mandate would allow renewable resources in every state to compete fairly with higher-cost electricity wherever its generation is most expensive and diminish the market distortions wrought by state regulatory interventions

By expanding the renewable energy market to mirror the interstate nature of the wholesale electricity market, a national RPS promotes fairer competition *among* renewable generators as well as between renewable generators and *other* technologies. Low-cost geothermal energy in Arizona, for example, would compete with solar generation in Nevada. Inexpensive hydropower in Washington State would compete freely with natural gas- fired generation in Wyoming. Ratepayers in states with low-cost renewable resources would directly benefit and price signals would flow unencumbered by the barricades erected at state lines.

C. All States Benefit

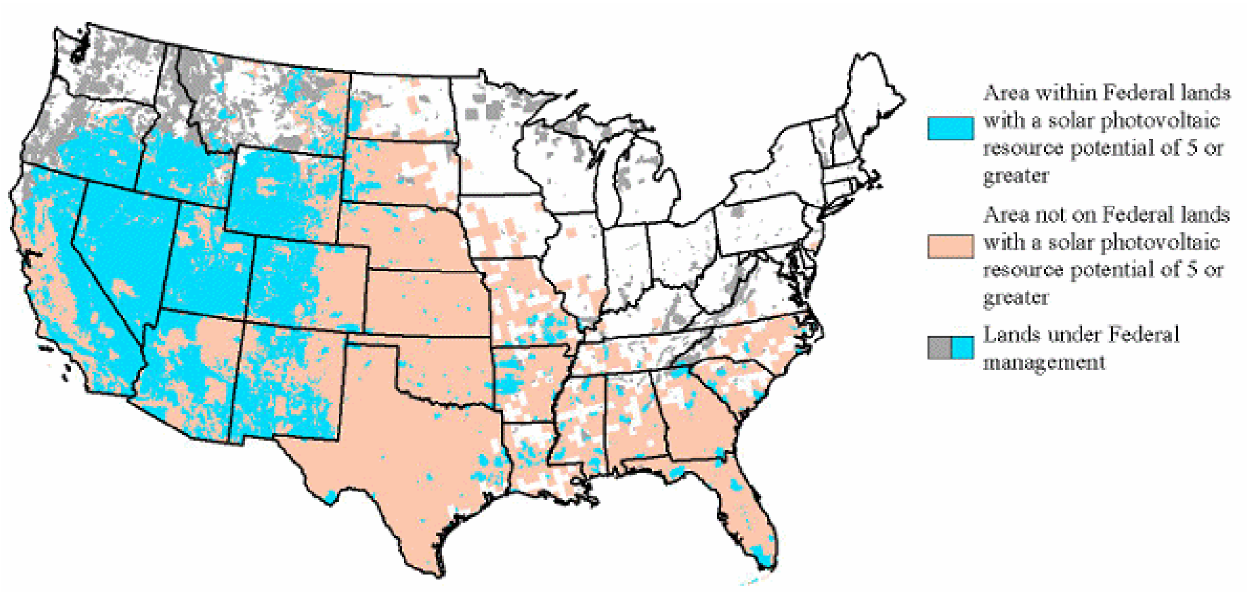
Using conservative economic assumptions, the Union of Concerned Scientists (UCS) has consistently found that all regions of the United States would benefit from a national RPS because commercially viable renewable resources are located in every state. In a 2007 economic impact analysis, UCS concluded that "all regions do have some renewable energy resources, and would likely see an increase in using local resources for generation that would often displace the need for importing fossil fuels."[185]

Figure 4.2: United States Wind Potential, 2003[186]



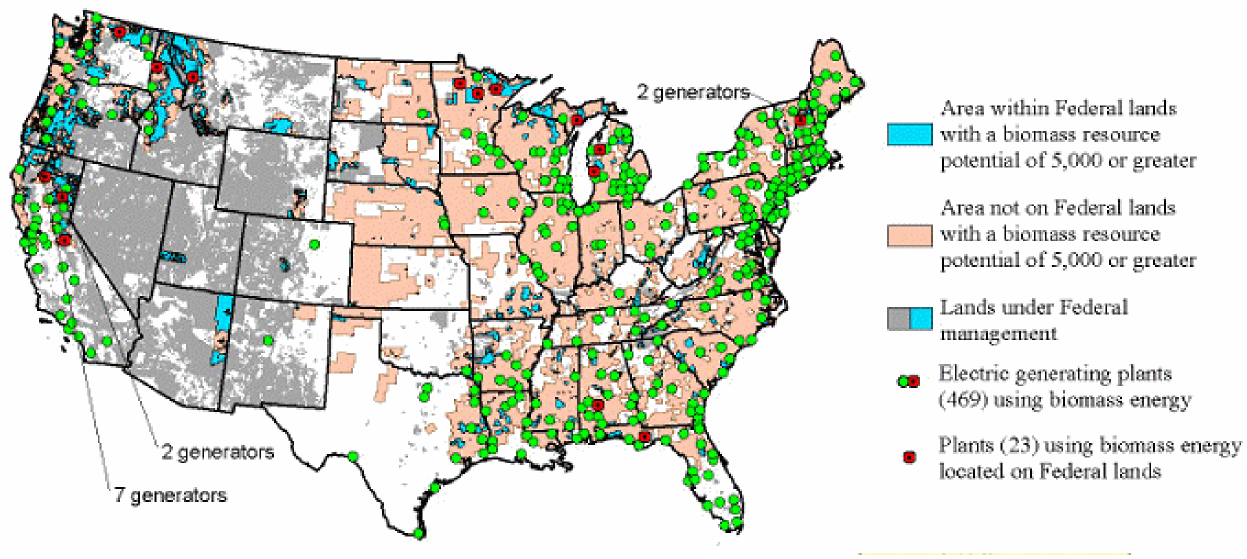
Source: National Renewable Energy Laboratory, 2003

Figure 4.3: United States Solar Photovoltaic Potential, 2003 (lower 48 states)[187]



Source: U.S. Department of Energy, Energy Information Administration

Figure 4.4: United States Biomass Potential, 2003[188]
(by cities in lower 48 states with greater than 5,000 annual tons of sustainable fuel)



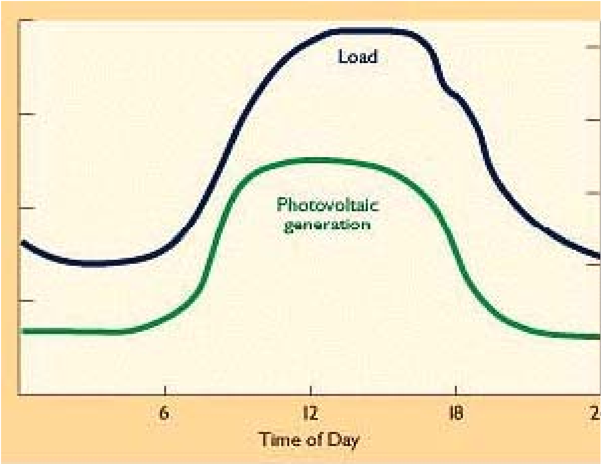
Source: U.S. Department of Energy, Energy Information Administration

Renewables Can Meet Capacities in All States

The raw amount of potential renewable resources in a region provides only a crude idea of the geographical dispersion of renewable energy in the United States. But not all electricity is created equal. A better metric for determining the availability of renewable resources in any given region is the "effective load carrying capacity," or ELCC. The ELCC refers to the difference between the amount of energy a generating unit produces and the amount of energy that can actually be used by consumers at any given time. For example, nuclear and hydropower units have relatively low ELCCs because they are producing about the same amount of electricity 24 hours a day. In times of low demand, these units continue to produce energy, even if no one is using it. The excess energy must be stored, fed into the grid as reserve capacity or wasted.

Because solar generators tend to produce the greatest amount of energy during the same times as consumer demand is highest, solar PV has an incredibly high ELCC relative to other technologies.[189]

Figure 4.5: Relationship Between Solar PV and Electricity Load

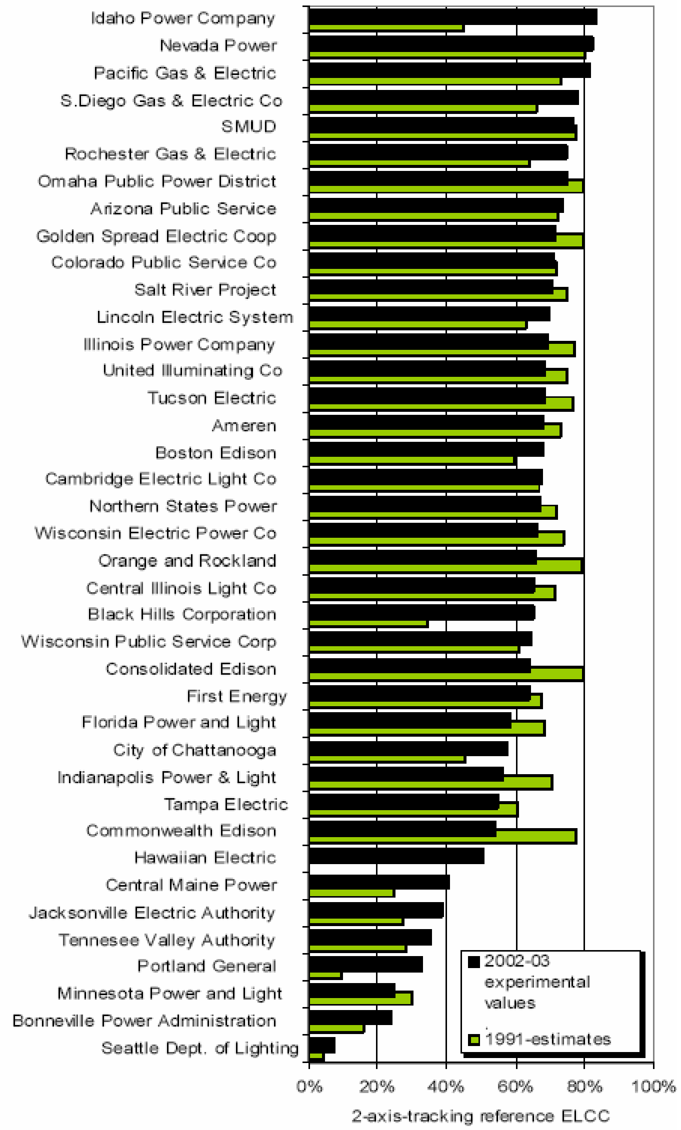


Source: Richard Perez., 1996

In many parts of the country, solar PV has an ELCC above 70 percent. In many parts of the Southeast, solar's ELCC exceeds 60 percent.[190] Researchers in Sacramento, California, estimated that the ELCC for solar PV within the city was so high that the actual value of solar energy was more than $6,000 per kW.[191] That is, because solar PV generated electricity at periods of high demand, its value was greater than electricity generated by other units throughout the day.

The National Renewable Energy Laboratory (NREL) compared the recorded ELCC of solar PV deployed by utilities in nearly every region of the country to earlier theoretical estimates of ELCC. Not only did NREL find that actual ELCC closely matched expectations, its analysis demonstrates that *valuable* amounts of solar PV are available in every region of the United States.

Figure 4.6: Effective Load Carrying Capacity for Solar PV for Major Utilities, 1991 to 2003



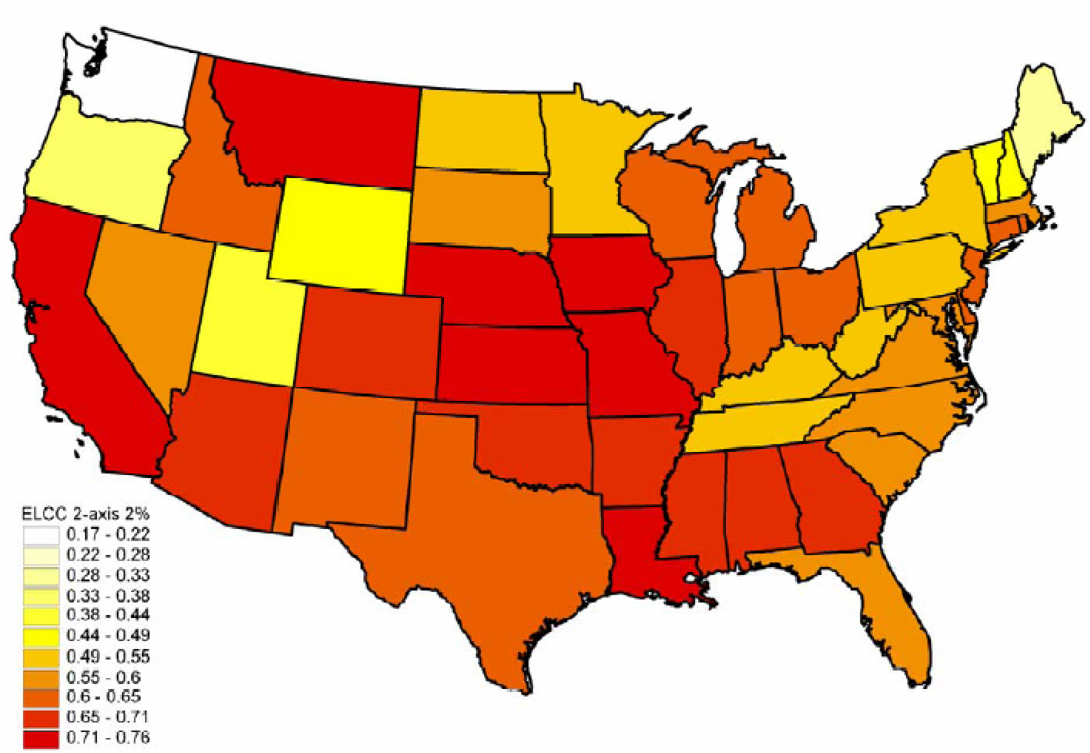
Source: National Renewable Energy Laboratory

New Resources in the Southeast

Utilities opposing a national RPS often claim there is a dearth of available renewable resources in some regions of the U.S., especially the Southeast. But new research proves that the Southeast may actually be among the nation's greatest sources of renewable energy. In fact, in a 2001 report analyzing affordable energy options for the South (Alabama, Florida, Georgia, North & South Carolina, and Tennessee), the Renewable Energy Policy Project, calculated that solar power systems covering just 0.1 percent of the region's land area could generate as much energy as thirty-five 1,000MW power plants.[192]

But when ELCC is used as a metric rather than a calculation of raw potential resources, the Southeast is revealed as one of the nation's best areas for *valuable* solar energy. Because solar generation in the Southeast more accurately tracks consumer demand, it is more valuable as a capacity asset than solar energy generated in sunny areas like Nevada and New Mexico.

Figure 4.7: Effective Load Carrying Capacity for Solar PV, 2006



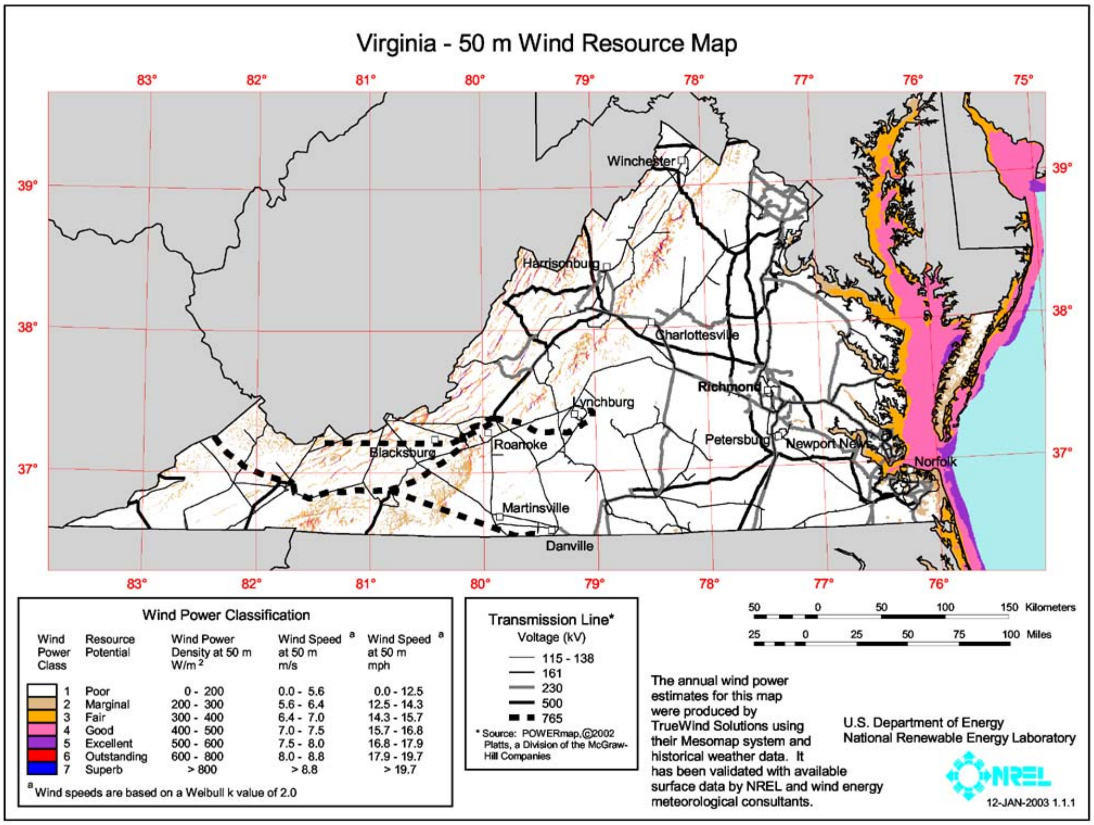
Source: National Renewable Energy Laboratory.

In 2003, researchers documented commercially significant wind resources off-shore in the Gulf of Mexico and the South Atlantic.[193] The Texas General Land Office, for example, recently reached an agreement with Superior Renewable Energy granting nearly 40,000 acres of submerged land off the coast of Padre Island for the development of the largest offshore wind farm in the United States. Texas estimates that it will collect between $34 million and $100 million in royalty payments in the first 30 years of the farm's operation.[194]

The U.S. Department of Energy (DOE) estimates that more than 900,000 megawatts (MW) of wind generation capacity—roughly equivalent to the current amount of total installed electricity capacity for the country—exists within 50 miles of the country's coasts.[195] Much of this potential is located in waters under the territorial control of states in the Southeast. Since June 1999, for instance, researchers with the University of Georgia have been monitoring the winds off the Georgia and South Carolina coasts using eight offshore platforms originally built by the Navy to monitor tactical aircrew training. A 2006 compilation of their data concluded that "wind energy resources and offshore conditions could make this region a potential area for development of offshore wind power."[196]

Similarly, a recent study from the Virginia Center for Coal and Energy Research found that the state of Virginia possesses offshore wind potential almost sixteen times greater than the amount of wind potential on land (as much as 32,000 MW offshore compared to 1,960 MW onshore).[197]

Figure 4.8: Offshore Wind Resources Map for Virginia



Source: National Renewable Energy Laboratory, 2003

Moreover, according to the National Hydro Association, the Southeast also has the potential to add 2,941 MW of additional generating capacity achieved from increased efficiency or additions to existing hydroelectric facilities, an amount second only to the hydroelectric output of the Pacific Northwest/Rocky Mountain region.[198]

A preliminary study undertaken by the Tennessee Valley Authority (TVA) has also found approximately 900 MW of energy available from wind, biomass, solar and incremental hydroelectric that could be "cost competitively" developed in the Southeast.[199] And a study by the University of Tennessee suggests that forest and agricultural by-products alone could generate up to 22.2 billion kWh of additional renewable electricity at competitive prices in TVA's service area.[200]

D. A National RPS Allows Utilities to Develop Resources Nationwide

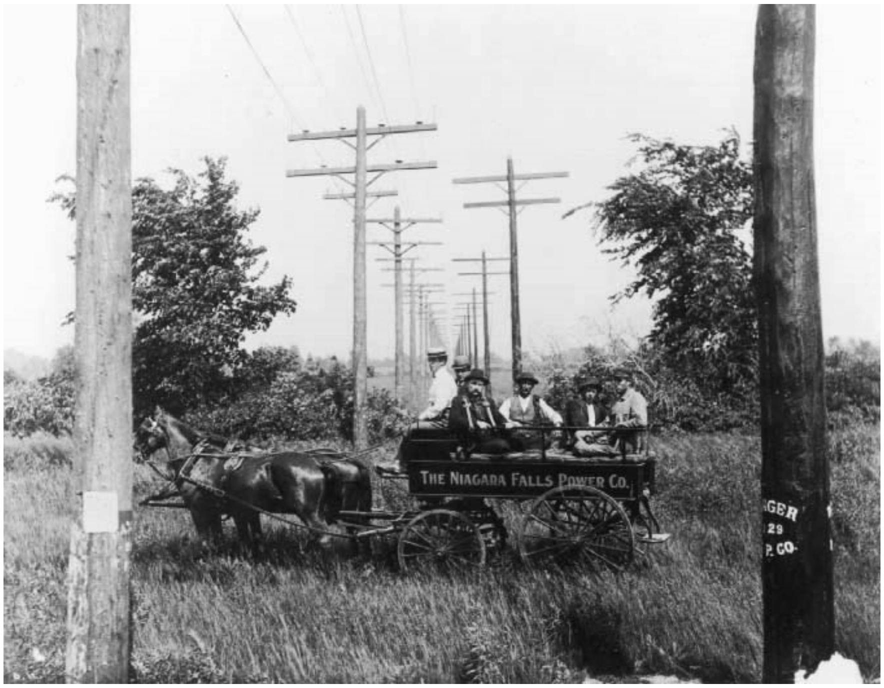
The argument that a national RPS would hurt states without abundant renewable resources misunderstands the modern electricity market. Since its inception nearly a century ago, the electricity sector has become increasingly interstate in nature. And now that Congress has lifted regulatory restrictions on electricity holdings companies, utilities that would be subject to a national RPS are not limited to developing renewable resources within the states they are headquartered.

Under a national RPS, utilities can invest in renewable generation wherever renewable resources are most abundant.

PUCHA and the Evolution of a National Market

At its infancy, the electricity market operated quite differently than it does today. During the 1910s and 1920s, the electricity market became dominated by holding companies – financial shells that exercised management control over one or more utilities through ownership of stock. Holding companies provided much needed early capital to support the rapid growth of the electricity industry. However, by 1935, the industry had so consolidated that almost half the nation's electricity was under the control of three holding companies.[201]

Figure 4.9: Line Crew of Niagara Falls Power Company, c.1895[202]



Source: Smithsonian Institution

To address abuses brought about by this monopolization, Congress passed the Public Utilities Holding Company Act (PUCHA) in 1935. PUCHA made utility holding companies subject to Security and Exchange Commission (SEC) regulations and mandated that any entity owning more than 10 percent of a utility had to divest all of its non-utility assets. PUCHA also placed geographical restrictions on the integration of electricity markets. Holding companies were restricted from owning utilities in non-contiguous service areas without meeting a number of additional regulatory burdens. Because of PUCHA, the U.S. electricity market was constrained to vertically-integrated public utilities where supply, generation, transmission and distribution was provided by a single entity overseen by state regulators and servicing a specified franchise area.[203]

The world of electricity has changed dramatically since 1935. Investor-owned utilities have faced increased pressure from stockholders to produce per-share profit beyond what they have been able to wring from organic growth alone. In turn, these utilities have pressured lawmakers to allow greater industry consolidation to take advantage of economies of scale.

Market Consolidation

The pressure paid off. In 2005, Congress finally repealed PUCHA. With its demise came a flurry of announced mergers. North Carolina's Duke Power merged with Cincinnati Gas & Electric in Ohio, Union Light Heat & Power in Kentucky and PSI Energy in Indiana. In the Pacific Northwest, MidAmerican Holding Company (with operations in Iowa, Illinois and South Dakota) merged with PacifiCorp, a subsidiary of ScottishPower servicing customers in Oregon, Utah, Idaho, Washington, Wyoming and California.[204]

Repeal of PUCHA Allows a National Market

PUCHA's repeal signaled the emergence of an interstate electricity market increasingly at odds with the anachronism of state-based regulation. There are two reasons why this interstate market supports the case for federal leadership on a national RPS:

1. Since a properly-designed national RPS would require *all* retail utilities (including publicly owned utilities, municipal utilities, and electric cooperatives) - not individual states - to meet RPS mandates, the burdens and benefits of a national program are likely to reflect the emerging interstate nature of the U.S. electricity market. Regulated utilities are not limited to developing the renewable resources within the state where they are headquartered. They may invest in renewable resources wherever their development is most cost competitive.

   By eliminating PUCHA, Congress opened the door to "area hopping." As utilities begin to consider long-term consolidation strategies that include the acquisition of relatively far-flung companies, PUCHA's repeal creates merger options not previously available. One investment fund analyst noted that PUCHA's repeal "changes the planning dynamic … a utility's possible map is no longer just three states; it's the whole country."[205]

2. With increased consolidation of the electricity market, a federal mandate is far *less* likely to create inequities than requiring companies to be subject to competing regulations of any state in which they have holdings. For example, many state utility commissions have reacted to PUCHA's repeal by increasing their scrutiny of proposed utility mergers. In 2006, Maryland's Public Service Commission rejected the merger of Constellation Energy with Florida Power and Light and New Jersey's Board of Public Utilities scuttled attempts by Illinois-based Exelon Corporation to acquire New Jersey-based PSE&G.

While the failure of these transactions may slow the wave of mergers sparked by PUCHA's repeal, they risk engendering a type of "forum shopping" where utility holding companies flock to states more likely to allow their consolidation. In fact, some analysts have warned of a possible "balkanization of industry standards that increase the costs of maintaining a holding company or, even worse, subject a holding company to conflicting standards."[206]

Interstate Conflicts

"One of the more difficult things for someone in my position, the president of an integrated, regulated utility, is that…every state has a different set of priorities and a different set of issues that we talked about and working them through the state public service commissions and state legislators and with state elected officials becomes a pretty critical issue."

- Respondent #8, Platts Survey of Utility Executives, 2006

Without federal leadership, consolidated utilities increasingly will find themselves caught in the middle of conflicts between state commissions.

In January 2007, for example, the Oregon Public Utilities Commission rejected plans by PacifiCorp (a utility serving customers in multiple states in the Pacific Northwest) to build one coal-fired power plant in Utah by 2012 and another in Wyoming by 2013. Oregon regulators claimed that the utility had exaggerated projected demand by not properly considering conservation efforts and renewable resources when calculating future capacity needs. The decision to reject the plants was heralded by the Oregon Citizens' Utility Board, a consumer group that argued that Oregon ratepayers should not have to pay for "Utah's dirty power."[207]

But in Utah, where 95 percent of the state's electricity is already generated by coal, the state's largest electricity consumers strongly supported PacifiCorp's new plants. So much so that Utah's Commissioners accused PacifiCorp of not moving fast enough and warned that delaying the construction of new coal-fired plants could leave Utah ratepayers exposed to high prices for short-term purchases needed to make up for demand shortfalls.

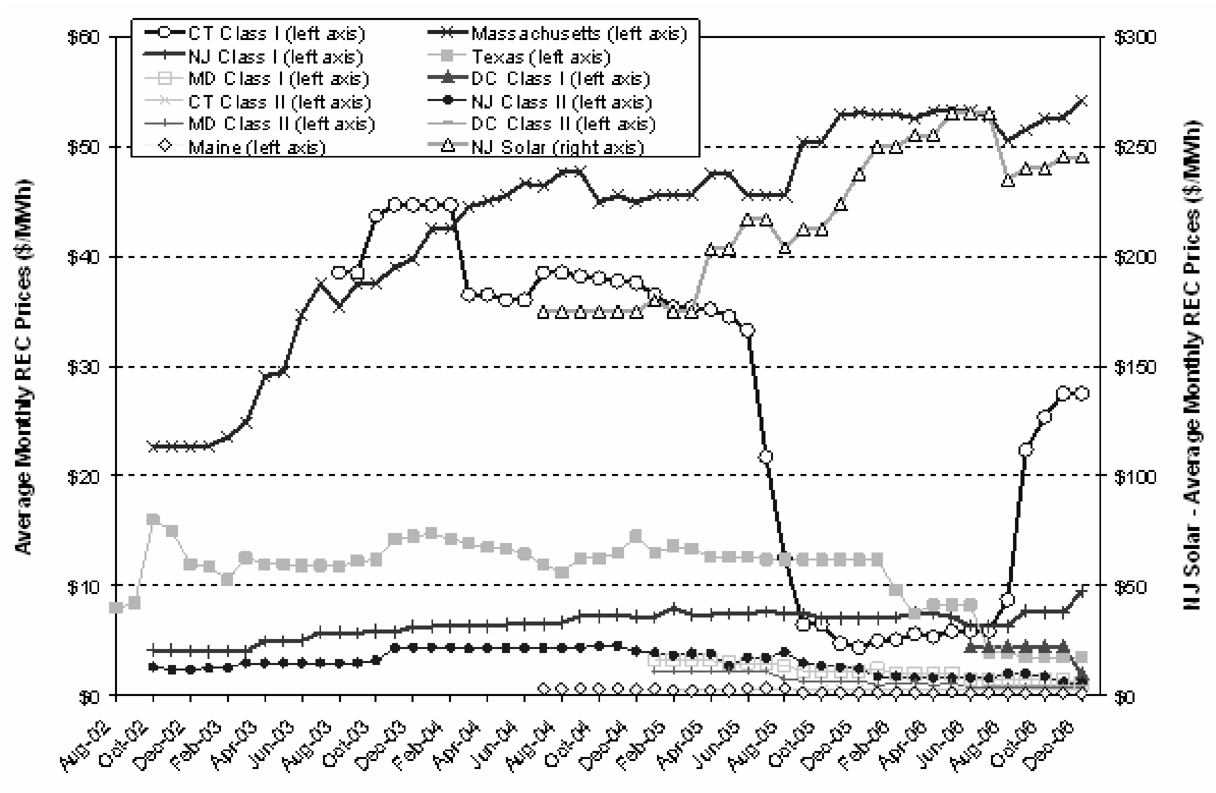
The specter of Oregon regulators deciding the fate of electricity generation in Utah and Wyoming highlights an emerging disconnect between the structure of the U.S. electricity market and the regulations to which it is subject. In the absence of federal action, U.S. utilities must answer to the whims of state regulators with multiple, often contradictory perspectives on how and where companies should invest in new generation. Federal leadership in establishing a national RPS would create uniform regulations on utilities and signal a national commitment to renewable energy generation. By leveling the playing field between states (and between utilities operating across states) a national RPS protects the interests of ratepayers while ensuring a level of regulatory predictability that benefits all utilities.

E. A National RPS Creates a Uniform Price for RECs

The inconsistencies between state RPS mandates and their compliance mechanisms have caused spot REC prices to vary substantially across regions and across renewable technologies. Because some states allow out-of-state RECs to apply to in-state mandates, significant price fluctuations are possible even within a single service area.

For example, the wholesale price for wind-derived RECs ranges anywhere from $1.75 per MWh in California up to $35 per MWh in the Northeast. For biomass RECs, the price can range from $1.50 per MWh in Western states to $45 per MWh in New England. For solar-derived RECs, the wholesale prices *in one service area* (WECC) range anywhere from $30 to $150 per MWh depending on the state.[208]

Figure 4.10: Price of Renewable Energy Credits in the U.S. (2002-2006)



Source: Lawrence Berkeley National Laboratory, 2007

In many cases, REC price fluctuations are the direct result of annual RPS-driven demand exceeding available renewable supply. To meet Massachusetts' RPS requirement, for example, utilities had to purchase 265,000 MWh of renewable credits from outside the state, pushing the

REC price within the state to $51.48 per MWh.[209] The result is that the current patchwork of state RPS compliance schemes is already creating winners and losers among regulated utilities solely on the basis of their geographical location.

Christopher Berendt, of Pace Global Energy Services, has noted how the volatility of REC prices limits the investment capital available for new renewable energy projects.

> While state systems share similarities, there is a critical lack of consistent fungibility between RECs issued in different states and control areas…Thus, there are no real REC "markets" among or even within the states, only individual state regulatory compliance "systems." The lack of a real national REC market for state RPS compliance creates an absence of liquidity for RECs and thus for investment capital.[210]

Renewable energy investors require reliable information and predictable rates of return from the start of the financing process. Researchers at the Lawrence Berkeley National Laboratory (LBL) have tracked the wild fluctuation of REC prices and found them to be a significant deterrent to renewable energy investment:

> Whatever the cause, these fluctuating prices have, in some cases, impeded renewable energy development because they offer unclear price signals to renewable energy investors about the attractiveness of development activity. In fact, RPS policies appear to have experienced more renewable projects development when applied in markets that still attract long-term power purchase agreements and therefore also long-term investment and financing.[211]

By providing a common definition of eligible resources and consistent compliance rules, a national RPS would help establish a uniform REC trading market allowing renewable generators to sell their RECs to retail suppliers anywhere in the nation. To comply with RPS mandates, regulated utilities would have the option of investing in their own renewable capacity or purchasing RECs at a uniform price determined by the competition between suppliers harnessing renewable resources wherever their development is most valuable.[212] Thus, expanded REC markets will avoid price fluctuation and provide a more stable flow of revenue for the industry and a more predictable financing environment for investors.[213]

Federal leadership is required to establish uniform rules for regulating an industry that has matured beyond state borders. A national RPS decreases the potential for government interventions to create "winners" and "losers' because it would give regulated utilities the flexibility to invest in renewable resources wherever their development is most cost competitive. A national RPS also would require utilities to meet predictable and consistent regulations devised by policymakers whose national perspective transcends the parochial interests that routinely drive state-based policy.

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[169] Garman, David K. (2005). "Testimony before the Committee on Energy and Natural Resources," United States Senate, March 8.
[170] Ibid. p.2
[171] Richard Cornes and Todd Sandler, The Theory of Externalities, Public Goods and Club Goods 2nd ed. (1996).
[172] DePalma, Anthony. (2005). "9 states in plan to cut emissions by power plants," *New York Times*, August 24.

[173] See comments from Attorney Generals in eleven states opposing the U.S. Environmental Protection Agency's mercury reduction rules at: http://www.oag.state.ny.us/press/2005/may/may18d_05.html
[174] NHDES (2004). Air Pollution Transport and How it Affects New Hampshire, May. Available at: www.des.state.nh.us/ARD/PollutionTransport/fullReport.pdf
[175] Caplan, C. (2001). "The Failure of Current Legal and Regulatory Mechanisms to Control Interstate Ozone Transport: The Need for New National Legislation," *Ecology Law Quarterly* 28, pp. 69-77.
[176] http://www.greenenergyohio.org/page.cfm?pageId=274
[177] See Nancy Rader and Richard Norgaard, "Efficiency and Sustainability in Restructured Electricity Markets: The Renewables Portfolio Standard," *Electricity Journal* (July, 1996), pp. 37-49; Daniel M. Kammen, "Renewable Energy: Taxonomic Overview," *Encyclopedia of Energy* 5 (2004), pp. 385-412.
[178] Morrison, J. (2006). "Mandated RPS Ignores Economic, Political Reality," *Electricity Journal*, December.
[179] Myers, T. (2006). "A guide to Initiative 937: Washington energy quotas," Washington Policy Center, October, p.13.
[180] In answer to the author's questions during a presentation at EUCI's 3rd Annual Renewable Portfolio Standards (RPS) Conference, April 23-24, 2007. Westminster, CO.
[181] Commission for Environmental Cooperation. (2003). "What is Renewable: A summary of eligibility criteria across 27 renewable portfolio standards," Background Document, June 20, p.4. Available at: http://www.cec.org/files/pdf/ECONOMY/What-is-Renewable_EN.pdf
[182] On November 14, 2006 the Arizona Corporation Commission (ACC) adopted final rules to expand the state's Renewable Energy Standard (RES) to include geothermal electric and geothermal heat pumps. However, Commissioner Kris Mayes confirmed that the new standard had not been implemented because it awaited final approval by the Office of the Arizona Attorney General as of publication of this report. http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=AZ03R&state=AZ&CurrentPageID=1&RE=1&EE=1
[183] Renewable Energy Policy Project. (2003). Case Study: Arizona, July. Available at: http://www.repp.org/articles/static/1/binaries/Arizona%20Case%20Study.pdf
[184] In comments to the EUCI 3rd Annual Renewable Portfolio Standards (RPS) Conference, April 23-24, 2007. Westminster, CO.
[185] Alan Nogee, Jeff Deyette, and Steve Clemmer, "The Projected Impacts of a National Renewable Portfolio Standard," *Electricity Journal* 20(4) (May, 2007), pp. 33-47.
[186] Source: National Renewable Energy Laboratory, 2003, http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig13.html.
[187] Source: U.E. EIA, available athttp://www.eia.doe.gov/cneaf/solar.renewables/page/solarphotv/photovoltaics2.gif.
[188] Source: U.S. EIA, available at http://www.eia.doe.gov/cneaf/solar.renewables/page/biomass/biomass.gif.
[189] Perez, Richard, "Photovoltaics Can Add Capacity To The Utility Grid: Mapping the Effective Load-Carrying Capacity of PV to Highlight Service Territories that Can Benefit From Photovoltaics," Department of Atmospheric Science at the State University of New York at Albany, Albany, NY, 1996.
[190] G. Silcker, "Peak Power Requirements", *Proceedings of the Solar Power 2004 Conference,* Solar Electric Power Association, 2004.
[191] Chris Robertson and Jill K. Cliburn, "UTILITY-DRIVEN SOLAR ENERGY AS A LEAST-COST STRATEGY TO MEET RPS POLICY GOALS AND OPEN NEW MARKETS," Presentation at the ASES Solar 2006 Conference, 2006.
[192] Beck, F. et.al. (2001). "Powering the South: A Clean & Affordable Energy Plan for the Southern United States," Renewable Energy Policy Project, p. 18. Available at: www.crest.org/articles/static/1/binaries/pts_repp_book.pdf
[193] Archer, C. and Jacobson, M. (2003). "Spatial and temporal distributions of U.S. winds and wind power at 80 m derived from measurements," *Journal of Geophysical Research*, 108:D9
[194] http://www.washingtonpost.com/wp-dyn/content/article/2006/05/11/AR2006051101967.html
[195] U.S. Department of Energy, "Wind and Hydropower Technologies Program: Wind Energy Multi Year Program Plan for 2005-2010," November, 2004 (Washington, DC: Office of Energy Efficiency and Renewable Energy), p. 6.
[196] http://www.otcnet.org/2006/tech_prog/sched/documents/otc183511.pdf
[197] Karmis, Michael, Abiecunas, Jason, Alwang, Jeffrey, Aultman, Stephen, Bird, Lori, Denholm, Paul, Heimiller, Donna, Hirsh, Richard F., Milbrandt, Anelia, Pletka, Ryan, Porro, Gian and Sovacool, Benjamin K.: 2005, *A Study of Increased Use of Renewable Energy Resources in Virginia*, Virginia Center for Coal and Energy Research, Blacksburg, VA, [online] at http://www.energy.vt.edu/Publications/Incr_Use_Renew_Energy_VA_rev1.pdf, accessed July 2006.
[198] National Hydropower Association. (2002). "Averting Disaster: Keeping the lights on with hydropower," Issue Brief, Tables 2 and 3.
[199] Tennessee Valley Authority. (2003) "Technical notes on important air quality issues: the role of renewable energy in reducing greenhouse gas buildup," September.
[200] Barkenbus, J. et. al. (2006). Resource and Employment Imact of a Renewable Portfolio Standard in the Tennessee Valley Authority Region," Institute for a Secure and Stable Environment, University of Tennessee, July.
[201] Sovacool, B. (2006). "PUCHA Repeal: Higher prices, less R&D, and more market abuses?," *Electricity Journal*, January/February, 19:1, p.85.
[202] Source: Image 79-2142, Electricity and Modern Physics Collection, National Museum of American History, copyright Smithsonian Institution. Available at: http://americanhistory.si.edu/powering/
[203] Casazza, J. & Delea, F., (2003). "Electric Power Systems: An Overview of the Technology and the Marketplace," Institute of Electrical Engineers (2003), pp. 137-155.

[204] MidAmerican Press Release, "MidAmerican Energy Holdings Company Acquisition of PacifiCorp Completed," (March 21, 2006). Available at http://www.midamerican.com/newsroom/aspx/newsdetails.aspx?id=330&type=archive
[205] In Michael T. Burr, "How Many Deals, and How Soon?" *Public Utilities Fortnightly* (October, 2005), p. 39.
[206] Bloom, D. "Repeal of Public Utilities Holding Company Act of 1935 – Will the States Rush In?" *Mayer Brown Rowe & Law, LLP*. (January, 2006). Available at http://www.mayerbrown.com/Energy/publications/article.asp?id=2552&nid=531
[207] Deseret News, (2007). "Doubts Cloud Coal-Plant Plan," February 7.
[208] http://www.nrel.gov/analysis/power_databook/docs/pdf/db_chapter03_8.pdf
[209] Commonwealth of Massachusetts, *Renewable Energy Portfolio Standard: Annual RPS Compliance Report for 2004* (Boston, MA: Office of Consumer Affairs and Business Regulation, Division of Energy Resources, January 9, 2006).
[210] Berendt, C. (2006). "A state-based approach to building a liquid national market for renewable energy certificates: The REC-EX model," *Electricity Journal*, June, p. 57.
[211] Ryan Wiser, Christopher Namovicz, Mark Gielecki, an d Robert Smith, "The Experience With Renewable Portfolio Standards in the United States," *Electricity Journal* 20(4) (May, 2007), pp. 8-20.
[212] See Cooper, C and Sovacool, B. (2006). "Green Means 'Go?' – A Colorful Approach to a U.S. National Renewable Portfolio Standard," *Electricity Journal,19:7,* August/September.
[213] Monzumder, P. & Marathe, A. (2004). "Gains from an integrated market for tradeable renewable energy credits," *Ecological Economics,* 49:269.

5. Litigation: A National RPS Avoids Costly Legal Battles

"You have well intended public utility commissioners. Unfortunately, they generally tend to be under-funded and so there is no way they can compete with the resources of a large, vertically integrated utility, and so they get overwhelmed. They may be trying to do the right thing but at the end of the day, they can't do it because the political will is not there and the economic rules are not there to support them. So you literally have a patchwork across the country whose markets are operating openly and fluently."

\- Respondent #28, Platt Survey of Utility Executives, 2006

In many states, ambiguities within RPS statutes and unclear expiration targets have created confusion among regulated utilities, resulting in protracted and expensive lawsuits. In Massachusetts, a vague definition of "renewable resources" precipitated legal battles over whether hydroelectric facilities were included in the standard or not.[214] In New Mexico, ambiguity over whether the state's RPS applied to existing or new renewable energy technologies prompted a law suit from El Paso Electric that went all the way to the New Mexico Supreme Court.[215]

A particularly ugly legal battle arose from one utility's claim that Iowa's RPS mandate was inconsistent with existing federal statute. In 1984, MidAmerican Energy Company, the largest investor-owned utility in the state, challenged the legality of Iowa's RPS mandate on the grounds that it obligated the utility to purchase power from renewable energy facilities at rates in excess of the avoided cost set by the federal Public Utility Regulatory Policies Act (PURPA).[216] MidAmerican and the state of Iowa spent 15 years and countless dollars locked in a heated legal battle before the issue was settled in 1999 (in the utility's favor).[217]

The legal morass generated by state-based RPS strategies also can discourage renewable energy investments by creating risky and unpredictable markets.

While MidAmerican was busy fighting Iowa's RPS statute in court, it was not installing new renewable capacity. Upon settlement of the dispute, however, the company invested roughly 10 percent of its entire portfolio in 568 MW of new wind energy. Similarly, PacifiCorp held back on investments in nearly 1,400 MW of renewable capacity throughout the nation until the situation in Iowa was resolved.[218]

Similar delays in renewable energy investments will occur with the continued emphasis on a state-by-state approach to RPS. Indeed, MidAmerican has signaled that it is prepared to litigate against new RPS statutes in Oregon and Washington, risking uncertainties in renewable energy investments in the Pacific Northwest for years, possibly decades.[219]

A. Risking Constitutional Challenge

Professor Joel B. Eisen, Director of the Center of Environmental Law and the University of Richmond, doesn't mince words in declaring his belief that the retail electricity market represents the essence of interstate commerce:

> Electricity involves a national marketplace that reaches every American and cannot be carved into neatly defined or clearly distinct markets and regulatory jurisdictions. It is perhaps the clearest case of unfettered Commerce Clause jurisdiction extant today.[220]

Yet, state RPS mandates remain perpetually unprotected from constitutional legal challenges. In many ways, the conflict created by having state RPS policies regulate an interstate electricity market sits precariously atop a legal house of cards that could collapse at any time. Article 1, section 8 of the Constitution grants Congress the power "to regulate commerce with foreign nations, and among the several states, and with Indian tribes." In the many years since ratification of the Constitution, the U.S. Supreme Court and other lower courts have consistently repealed state legislation that may hinder or prohibit interstate trade.[221]

The smooth functioning of the national market requires the federal government to prevent states from adopting protectionist or autarkic policies that would attribute a product's market share to its geographic origins rather to market mechanisms. States are permitted to promote in-state business, but they are not permitted to protect those businesses from out of state competition. The courts have ruled that this "dormant Commerce Clause" means that a state cannot "needlessly obstruct interstate trade or attempt to place itself in a position of economic isolation."[222]

State RPS statutes that set geographic restrictions or otherwise limit the interstate trade of RECs may be accused of violating this central tenant of the U.S. Constitution.

Not surprisingly, utilities have demonstrated a natural proclivity for successfully challenging state regulations on Commerce Clause grounds.[223] In 1982, New England Power Company successfully challenged a New Hampshire statute prohibiting a hydroelectric company from exporting electricity out of the state without the utility's approval. In 1992, utilities in Wyoming convinced the Supreme Court to overturn an Oklahoma statute requiring the state's regulated utilities to consume a certain percentage of Oklahoma-mined coal.[224]

But the Supreme Court's 2002 decision upholding the Federal Energy Regulatory Commission's (FERC) jurisdiction over the transmission component of retail sales may be the starkest signal yet that regulated utilities can call upon the federal government to intervene when they feel unfairly compromised by state regulations.[225] Indeed, Eisen argues that the practical implication of the Court's decision in New York v. FERC is that, "the federal government could assert jurisdiction all the way to the consumer's toaster if it so chose."

B. The Coming Commerce Clause Battle

It is only a matter of time before utilities and lawmakers challenge the constitutionality of certain state RPS mandates.[226] Nevada, New Jersey, and Texas have all adopted restrictions that only count in-state renewable resources toward their respective RPS mandates. Similarly, Pennsylvania, Maryland, and the District of Columbia stipulate that RPS-eligible renewable resources must come from within the PJM service territory.[227] In the Pacific Northwest, RECs can be sold only among the 14 members of the Western Renewable Energy Generation Information System.[228]

Some states have gone so far as to devalue RECs from other states. California's RPS, for example, requires RECs to be bundled with the electricity generated from renewable resources (which has the practical affect of restricting unbundled RECs from other states).[229] Even the California Public Utilities Commission has warned state policymakers that their position on out-of-state RECs may be constitutionally questionable.[230]

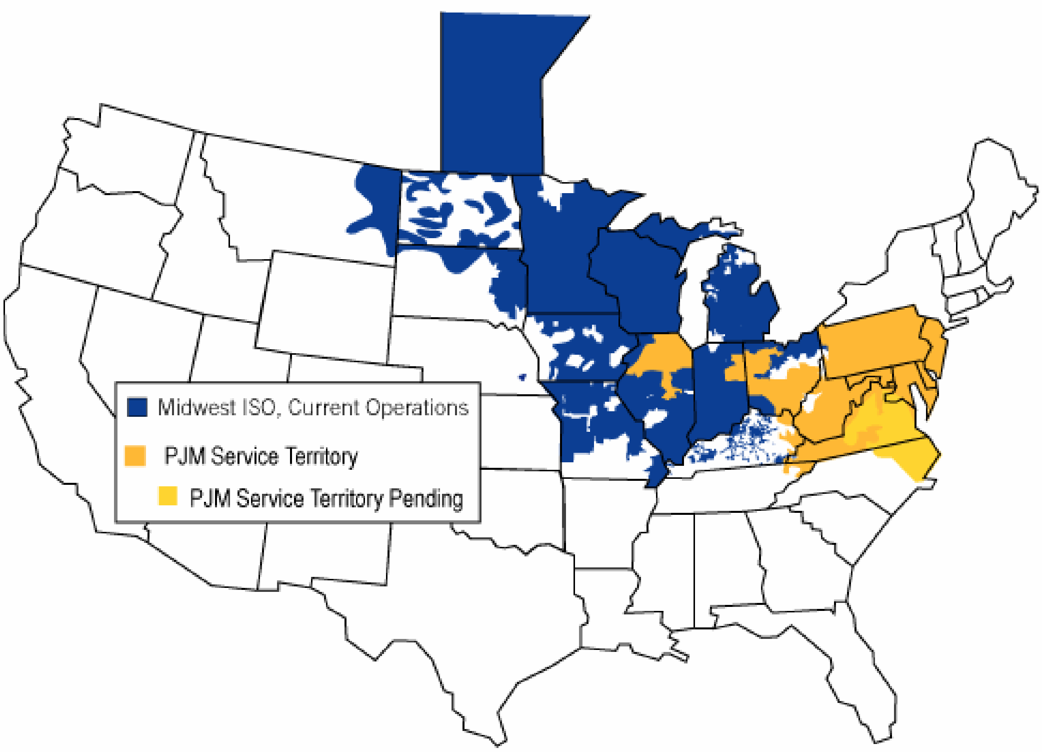
Pennsylvania

Under Pennsylvania's relatively new "Alternative Energy Portfolio Standard" (Act 213):

> *Energy derived only from alternative energy sources inside the geographical boundaries of this Commonwealth or within the service territory of any regional transmission organization that manages the transmission system in any part of this Commonwealth shall be eligible to meet the compliance requirements under this act.*

Virtually all of Pennsylvania is serviced by the PJM (Pennsylvania-New Jersey-Maryland) regional transmission organization. However, a tiny sliver along the state's Western border is serviced under the Midwest ISO (MISO, a regional transmission organization that controls electricity as far West as Minnesota, including one Canadian province). And another small area in Pike County does not fall into the service area of any regional transmission organization at all.

Figure 5.1: PJM and MISO Service Territories



Source: ActionPA.org, 2007

Even though the wording of the statute is unambiguous, in a 3-2 decision, Pennsylvania's Public Utility Commission decided that energy from MISO could only be used to meet the demand in the tiny area of the state that is on the MISO grid. This tortured interpretation invites a Commerce Clause challenge from generators anywhere within the MISO territory who may want to sell their energy to regulated utilities in Pennsylvania.

The Pike County electric distribution company may also be in a unique position to bring a Commerce Clause case since it appears to be the only area of the state barred from using out-of-state power sources to meet Act 213 mandates.[231]

Texas

In Texas, which recently surpassed California to become the nation's leading producer of wind energy, state lawmakers are proposing legislation that could spark a constitutional challenge from the state's wind generators, many of whom are profiting from selling excess wind generation to neighboring RPS states. The new law would require that RECs generated in-state apply toward Texas' RPS goals:

> *Commission shall ensure that all renewable capacity installed in this state and all renewable energy credits awarded, produced, procured, or sold from renewable capacity in this state are counted toward the goal*[232].

Texas' proposed legislation effectively would ban the out-of-state sale of RECs generated from in-state renewable capacity since any certified REC tracking system would mark the RECs as having been already counted. Texas wind generators, who can sell wind credits for much higher prices in other markets, could argue that the law is a clear violation of the constitutional right to interstate commerce.

State & Federal Brinksmanship

A Commerce Clause challenge may also be imminent because of a growing tension between state and federal electricity regulators.

While the legality of state RPS geographical restrictions has yet to be challenged on Commerce Clause grounds, Eisen warns that state and federal regulators are starting to engage in a kind of "Commerce Clause brinksmanship".[233] As recently as 2006, for example, Constellation Energy threatened to sue Maryland's Public Utility Commission on Commerce Clause grounds for rejecting its merger with Baltimore Gas and Electric.[234]

A June 2006 report from the Pew Center on Global Climate Change speculates that recent changes on the U.S. Supreme Court also call into question how long state restrictions can avoid Constitutional challenge:

> But it is conceivable that policies that are in some way designed to minimize the role of out-of-state renewables in meeting RPS targets could face a constitutional challenge. Examples of such policies include those that confine acceptable imports to those that arrive via a dedicated transmission line, most notably Nevada and Texas. The constitutional boundaries are not at all clear in this area, especially given the recent departure from the Supreme Court of Justices William Rehnquist and Sandra Day O'Connor, who held strong views on the power of the states in relation to the federal government.[235]

If a state RPS were found to violate the Commerce Clause, the practical affect would be its immediate repeal. While state legislatures could try to craft an RPS that would pass constitutional muster or appeal to a higher court, one successful challenge would be enough to risk a cascade of copy-cat litigation as regulated entities piggy-back on judicial precedent. In any event, the result is a risky and unpredictable regulatory environment threatening the longevity of state-based RPS mandates and the long-term stability of the nation's renewable energy market.

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[214] Ibid, p. 394-395.
[215] Ben Neary, "El Paso Electric Sues New Mexico Over Energy Rule," *Santa Fe New Mexican*, March 11, 2003, p. B1.
[216] Midwest Power Systems, Inc., 78 FERC (CCH) 61,067 (1997).
[217] See Brent Gale, "Renewable Energy Requirements and Net Billing—Lessons Learned from Iowa," 2000, Presentation to the IOWA PUC, available at http://www.state.sd.us/puc/2000/Wind/SD%20Wind/Session%206/Brent%20Gale.pdf; Brent Gale, "Governor's Energy Policy Task Force Meeting Minutes," April 3, 2001, p. 7; MidAmerican Energy Company Preliminary Comments, *Illinois Commerce Commission*
Request for Public Comment—Sustainable Energy Plan for Illinois, 2003, available at http://www.icc.illinois.gov/docs/en/050309ecCommentsMidAmer.doc.
[218] In a phone interview (February 20, 2007), Brent Gale stated that although the 1984 Iowa RPS remains unchanged at approximately 100 MW for the state's regulated utilities, MidAmerican has contracted for or owns 568 MW of wind (9.4% of the generation portfolio), making it the country's largest utility owner of wind energy. And it has plans for installing more. MidAmerican's sister utility, PacifiCorp, has contracted for or owns nearly 1500 MW of hydro-electric energy, 300 MW of wind energy, 26 MW of geothermal energy and 130 MW of other renewable energy resources (16% of the generation portfolio), and expects to increase its non-hydro renewable energy portfolio to 1400 MW by 2009.
[219] Brent Gale notes that thus far, PacifiCorp has been able to add renewable energy within the strictures of the least cost standards of the six states that it serves. However, if those states adopt RPS percentages and schedules that fail to consider the cost to customers, the continued existence of the least cost standards may create impediments to compliance similar to the problems encountered in Iowa.
[220] Eisen, Joel B. (2005). "Realizing the promise of electricity deregulation: regulatory linearity, commerce clause brinksmanship, and retrenchment in electric utility deregulation," *Wake Forest Law Review*, 40:545.
[221] See Kirsten H. Engel, "The Dormant Commerce Clause Threat to Market-Based Environmental Regulation: The Case of Electricity Deregulation," *Ecology Law Quarterly* 26 (1999), pp. 243-349; Steven Ferrey, "Renewable Orphans: Adopting Legal Renewable Standards at the State Level," *Electricity Journal* 19(2) (March, 2006), pp. 52-61; Hempling and Rader 1996.
[222] Scott Hempling and Nancy Rader, State Implementation of Renewables Portfolio Standards: A Review of Federal Law Issues (AWEA: January, 1996), p. 6.
[223] Michael S. Greve, "Cartel Federalism? Antitrust Enforcement by State Attorneys General," *University of Chicago Law Review* 72 (Winter, 2005), pp. 116-118.
[224] See New England Power Co v New Hampshire, 455 US 331 (1982); City of Philadelphia v New Jersey, 437 US 617 (1978); Wyoming v Oklahoma, 502 US 437 (1992).
[225] See New York v. FERC, 2002 (upholding FERC's claim in Order 888 of jurisdiction over the transmission component of retail sales in states that have taken on the task of separating generation charges from transmission and distribution).
[226] See Kirsten H. Engel, "The Dormant Commerce Clause Threat to Market-Based Environmental Regulation: The Case of Electricity Deregulation," *Ecology Law Quarterly* 26 (1999), pp. 243-349; Steven Ferrey, "Renewable Orphans: Adopting Legal Renewable Standards at the State Level," *Electricity Journal* 19(2) (March, 2006), pp. 52-61; Hempling and Rader 1996.
[227] Willing 2005, Ibid.
[228] Tony Usibelli, "Washington State's Energy Independence Act (Initiative 937): A Bit of a Different Animal," *Presentation at the 3rd Annual Renewable Portfolio Standards Conference*, Denver, Colorado, April 23, 2007.

[229] Ryan Wiser et al., "Does it Have to be This Hard? Implementing the Nation's Most Complex Renewables Portfolio Standard," *Electricity Journal* 18(8) (October, 2005), pp. 55-67.
[230] See Division of Strategic Planning, California Public Utilities Commission. *Renewable Energy Certificates and the California Renewables Portfolio Standard Program* (Sacramento: California Public Utilities Commission, April 20, 2006), p. 90-91. It should be noted, however, that California's stance on REC unbundling may be changed under PUC proceeding expected to start in mid-2007.
[231] See Ewall, M. (2007). Pennsylvanias's Alternative Energy Law: PA becomes the first state to include fossil fuels in an otherwise "renewable" portfolio standard. Available at: http://www.actionpa.org/cleanenergy/
[232] As reported by Jess Totten, Director of the Texas Public Utility Commission's Electricity Industry Oversight Division during a presentation to the EUCI 3rd Annual Renewable Portfolio Standards (RPS) Conference, April 23-24, 2007. Westminster, CO.
[233] In 1992, for example, the Supreme Court decided in *New Energy Co. of Indiana v. Limbach* that an income tax credit limited to in-state ethanol producers was unconstitutional. And in 1995, a federal court decided, in *Alliance for Clean Coal vs. Miller*, that an Illinois preference for the use of in-state coal to satisfy Clean Air Act amendments was unconstitutional.
[234] Paul Adams, "Merger-Veto Bill's Legality Questioned," *Baltimore Sun*, March 26, 2006, available at http://www.baltimoresun.com/news/local/politics/bal-bz.bgebill29mar29,0,6635559.story?coll=bal-mdpolitics-utility.
[235] Rabe, B. (2006). *Race to the Top: The Expanding Role of U.S. State Renewable Portfolio Standards*, Pew Center on Global Climate Change, June, p.25.

6. Environment: A National RPS Conserves Water, Air & Land

A. A National RPS Displaces Fossil Fuels and Nuclear Power.

The Department of Energy (DOE) has already determined that that "the imposition of [a national] RPS would lead to lower generation from natural gas and coal facilities."[236] Examinations of fuel generation in several states confirm this finding. The New York State Energy and Research Development Authority (NYSERDA), for example, looked at load profiles for 2001 and concluded that 65 percent of the energy displaced by wind turbines in New York would have otherwise come from natural gas facilities, 15 percent from coal-fired plants, 10 percent from oil-based generation, and 10 percent from out of state imports of electricity.[237] A more recent study conducted in Virginia found that the electricity mandated by a state RPS would otherwise be generated with a mix of 87 percent coal, 9 percent natural gas, and 4 percent oil.[238] In Texas, the Union of Concerned Scientists also confirmed that renewable energy technologies primarily displace natural gas and coal facilities.[239]

Often overlooked, is how RPS-induced renewable generation would offset nuclear power in several regions of the U.S. 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.[240] In Oregon, the Governor's Renewable Energy Working Group analyzed a 25 percent statewide RPS by 2025 and projected that every 50 MW of renewable energy would displace approximately 20 MW of base-load resources, including nuclear power.[241] Environment Michigan estimates that a 20 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.[242] Utilities in Ontario, Canada, are deploying renewable energy systems in an attempt to displace all coal and nuclear electricity generation in the region entirely.[243]

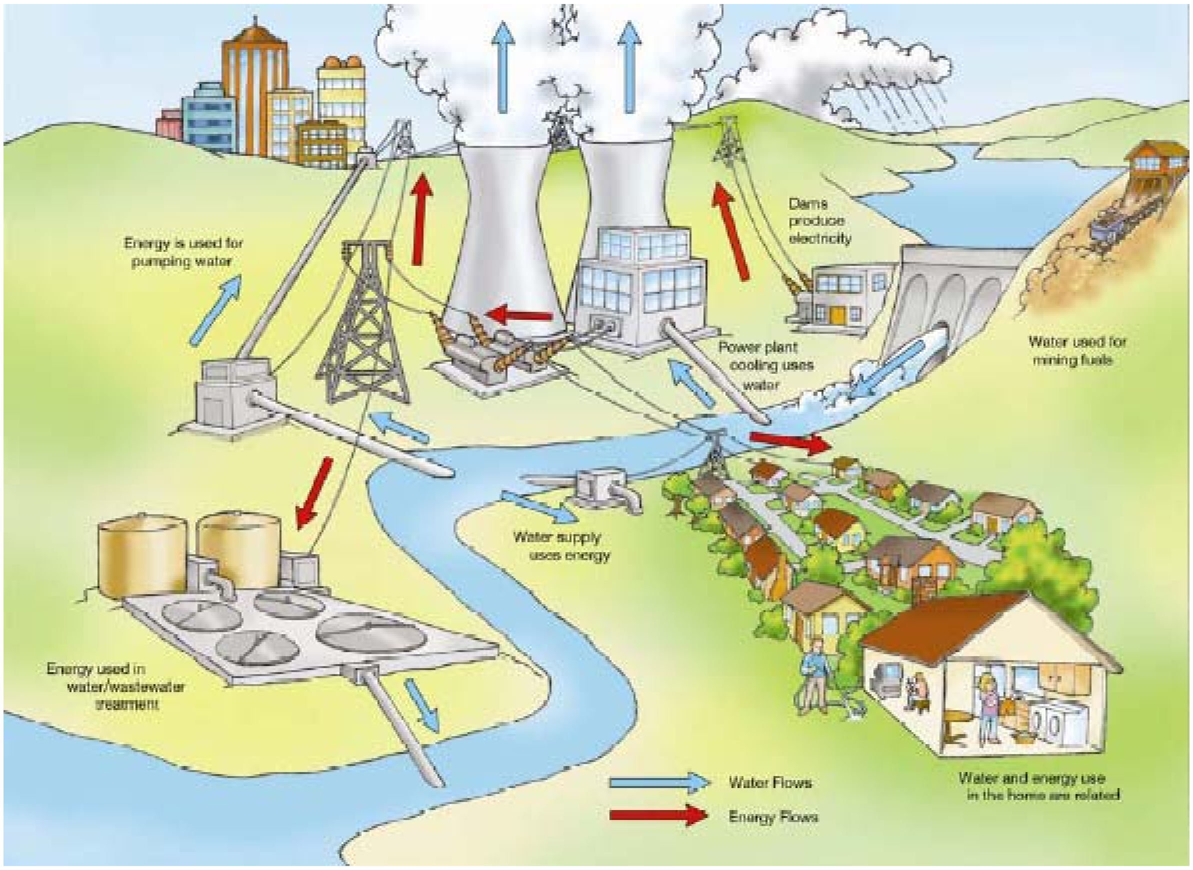
By offsetting the generation of conventional and nuclear power plants, a national RPS avoids many of the environmental and social costs associated with the mining, processing, transportation, combustion and clean-up of fossil and nuclear fuels.

B. Water Conservation

If projected electricity demand is met using water-intensive fossil fuel and nuclear reactors, America will soon be withdrawing more water for electricity production than for farming.

Perhaps the most important—and least discussed—advantage to a federal RPS is its ability to displace electricity generation that is extremely water-intensive. The nation's oil, coal, natural gas, and nuclear facilities consume about 3.3 billion gallons of water each day.[244] In 2006, they accounted for almost 40 percent of all freshwater withdrawals (water diverted or withdrawn from a surface- or ground-water source), roughly equivalent to all the water withdrawals for irrigated agriculture in the entire United States.[245]

Figure 6.1: Relationships between Water and Energy



Source: U.S. Department of Energy, Energy Information Administration

A conventional 500 MW coal plant, for instance, consumes around 7,000 gallons of water per minute, or the equivalent of 17 Olympic-sized swimming pools every day.[246] Older, less efficient plants can be much worse. In Georgia, the 3,400 MW Sherer coal facility consumes as much as 9,913 gallons of water for every MWh of electricity it generates.[247] Data from the Electric Power Research Institute (EPRI) also confirms that every type of traditional power plant consumes and withdraws vast amounts of water. Conventional power plants use thousands of gallons of water for the condensing portion of their thermodynamic cycle. Coal plants also use water to clean and process fuel, and all traditional plants lose water through evaporative loss.

Newer technologies, while they withdraw less water, actually consume more. Advanced power plant systems that rely on re-circulating, closed-loop cooling technology convert more water to steam that is vented to the atmosphere. Closed-loop systems also rely on greater amounts of water for cleaning and therefore return less water to the original source. Thus, while modern power plants may reduce water withdrawals by up to 10 percent, they contribute even more to the nation's water scarcity.[248]

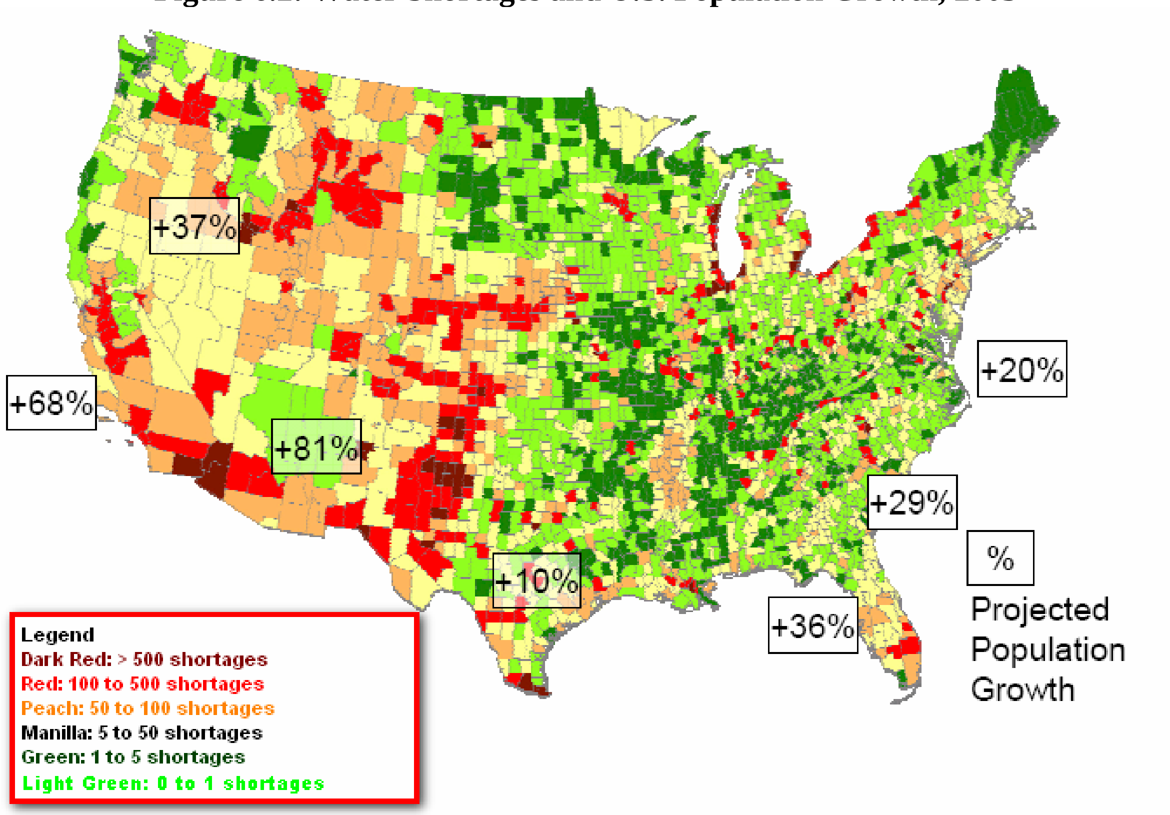
Nuclear reactors, in particular, require massive supplies of water to cool reactor cores and spent nuclear fuel rods. Because much of the water is turned to steam, substantial amounts are lost to the local water table entirely. One nuclear plant in Georgia, for example, withdraws an average of 57 million gallons every day from the Altamaha River, but actually "consumes" (primarily as lost water vapor) 33 million gallons per day from the local supply, enough to service more than 196,000 Georgia homes,.[249]

With electricity demand expected to grow by approximately 50 percent in the next 25 years, continuing to rely on fossil fuel-fired and nuclear generators could spark a water scarcity crisis. In 2006, the Department of Energy warned that consumption of water for electricity production could more than double by 2030, to 7.3 billion gallons per day, if new power plants continue to be built with evaporative cooling. This staggering amount is equal to the entire country's water consumption in 1995.[250]

Water Shortages

The electric utility industry's vast appetite for water has serious consequences, both for human consumption and the environment. Assuming the latest Census Bureau projections, the U.S. population is expected to grow by about 70 million people in the next 25 years.[251] Such population growth is already threatening to overwhelm existing supplies of fresh and potable water.

Figure 6.2: Water Shortages and U.S. Population Growth, 2003



Source: U.S. Department of Energy, Energy Information Administration

Few new reservoirs have been built since 1980 and some regions have seen groundwater levels drop as much as 300 to 900 feet over the past 50 years as aquifers extract water faster than the natural rate of replenishment.[252] Most state water managers expect either local or regional water shortages within the next 10 years, according to a recent survey, even under "normal" conditions.[253] In fact, 47 states in the country reported drought conditions during the summer of 2002.[254]

Water shortages risk becoming more acute in the coming years as climate change alters precipitation patterns. In the Pacific Northwest, for example, global warming is expected to induce a dramatic loss of snow-pack as more precipitation falls as rain. As a result, numerous studies have suggested that the hydrology of the region will be fundamentally altered with increased flood risks in the spring and reductions of snow in the winter.[255] Consequently, power retailers in the region have expressed concern that large hydroelectric and nuclear facilities will have to be shut down due to lack of adequate water for electricity generation and cooling.[256] During the steamy August of 2006, the record heat sparked unplanned reactor shutdowns in Michigan and Minnesota as nuclear plant operators scrambled to find enough water to cool radioactive fuel cores.[257]

Xcel energy had to similarly cancel a $1.2 billion coal facility in Pueblo, Colorado, because of water concerns.[258]

Thermal Pollution

The Argonne National Laboratory has documented how power plants have withdrawn hundreds of millions of gallons of water each day for cooling purposes and then discharged the heated water back to the same or a nearby water body. This process of "once-through" cooling presents potential environmental impacts by impinging aquatic organisms in intake screens and by affecting aquatic ecosystems by discharge effluent that is far hotter than the surrounding surface waters.[259] Drawing water into a plant often kills fish and other aquatic organisms, and the extensive array of cooling towers, ponds, and underwater vents used by most plants have been documented to severely damage riparian environments.

In some cases, the thermal pollution from centralized power plants can induce eutrophication—a process where the warmer temperature alters the chemical composition of the water, resulting in a rapid increase of nutrients such as nitrogen and phosphorous. Rather than improving the ecosystem, such alterations usually promote excessive plant growth and decay, favoring certain weedy species over others and severely reducing water quality. In riparian environments, the enhanced growth of choking vegetation can collapse entire ecosystems. This form of thermal pollution has been known to decrease the aesthetic and recreational value of rivers, lakes, and estuaries and complicate drinking water treatment.[260]

Toxic Waste Water

America's 600 coal and oil-fired power plants produce more than one hundred million tons of sludge waste every year. Seventy six million tons of these wastes are primarily disposed on-site at each power plant in unlined wastewater lagoons and landfills that are seldom fully monitored by the Environmental Protection Agency. These wastes are highly toxic, containing concentrated levels of poisons such as arsenic, mercury, and cadmium that can severely damage the human nervous system.[261]

Nuclear facilities may be even worse. To produce fuel for nuclear reactors, uranium is often "leached" out of the ground by pumping a water solution through wells to dissolve the uranium in the ore. The uranium is then pumped to the surface in a liquid solution. About 20 such in-situ leach facilities operate in the United States.[262]

At the reactor site, electricity generation using nuclear technology creates waste water contaminated with radioactive tritium and other toxic substances that can leak into nearby groundwater sources. In December 2005, for example, Exelon Corporation reported to authorities that its Braidwood reactor in Illinois had since 1996 released millions of gallons of tritium-contaminated waste water into the local watershed, prompting the company to distribute bottled water to surrounding communities while local drinking water wells were tested for the pollutant. The incident led to a lawsuit by the Illinois Attorney General and the State Attorney for Will County who claimed that "Exelon was well aware that tritium increases the risk of cancer, miscarriages and birth defects and yet they made a conscious decision not to notify the public of their risk of exposure."[263]

Renewables Save Water

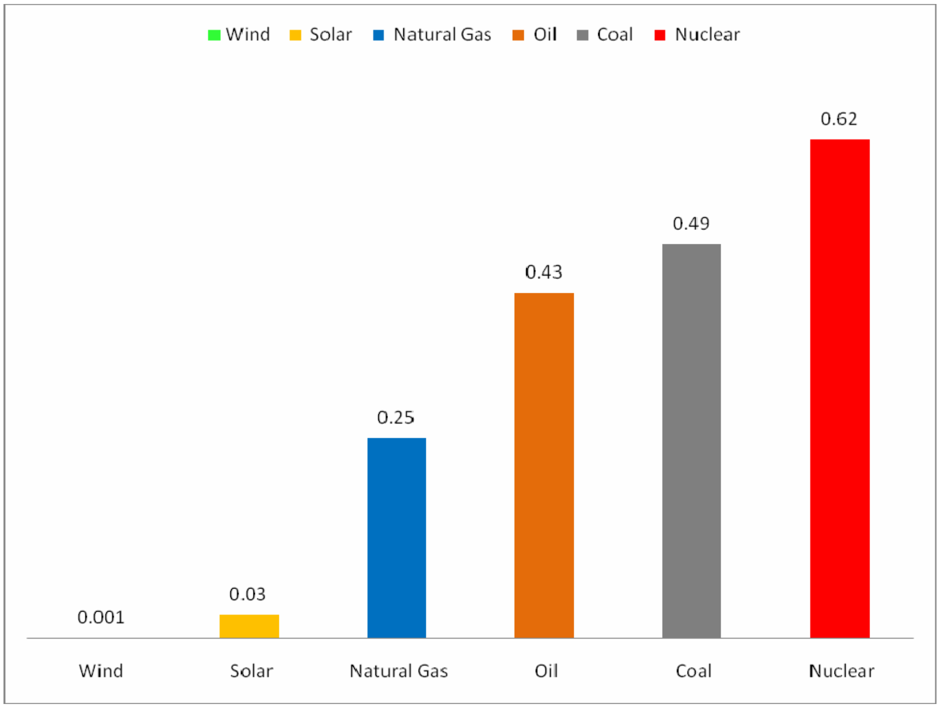
By promoting wind, solar, and other renewable resources that do not consume or withdraw water, a national RPS can help conserve this dwindling essential resource. In a 2006 report, the Department of Energy acknowledged wind power and solar photovoltaics could play a key role in averting a "business-as-usual scenario" where "consumption of water in the electric sector could grow substantially."[264]

A recent DOE report noted that "greater additions of wind to offset fossil, hydropower, and nuclear assets in a generation portfolio will result in a technology that uses no water, offsetting water-dependent technologies."[265]

Ed Brown, director of Environmental Programs at the University of Northern Iowa, estimated that a 100-watt solar panel would save approximately 2,000 to 3,000 gallons of water over the course of its lifetime. Similarly, Dr. Brown concluded that "billions of gallons of water can be saved every day" through the greater use of renewable energy technologies.[266]

The American Wind Energy Association conducted one of the most comprehensive assessments of renewable energy and water consumption. Their study estimated that wind power uses less than 1/600 as much water per unit of electricity produced as does nuclear, 1/500 as much as coal, and 1/250 as much as natural gas (small amounts of water are used to clean wind and solar systems).[267]

Figure 6.3: Water Consumption for Conventional and Renewable Power Plants in California (Gallons/kWh)[268]



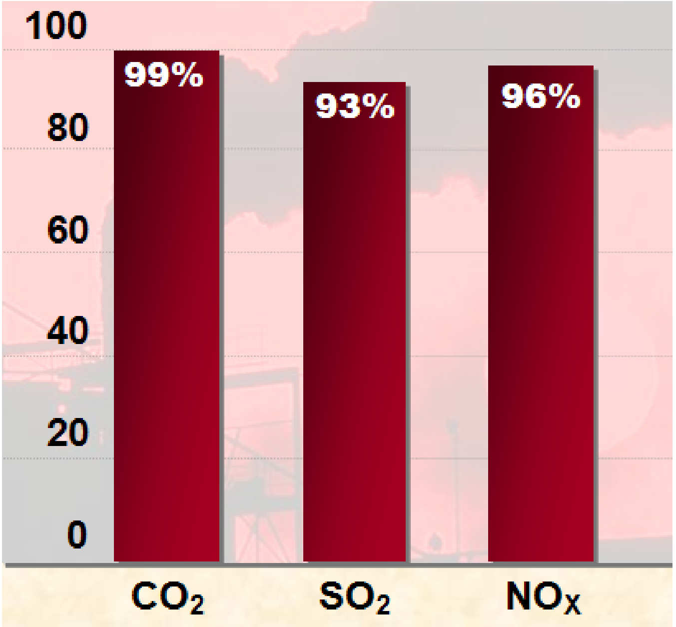
Source: American Wind Energy Association, 2007.

In short, by displacing centralized fossil fuel and nuclear generation, a national RPS conserves substantial amounts of water that would otherwise be withdrawn and consumed for the production of electricity.

C. Air Quality

Conventional electricity generation is by far the largest source of air pollutants that harm human health and contribute to global warming. In 2003, for example, fossil fuel use (for all energy sectors, not just electricity) was responsible for 99 percent of the country's carbon dioxide (CO_2) emissions, 93 percent of its sulfur dioxide (SO_x) emissions, and 96 percent of its nitrous oxides emissions (NO_x).[269]

Figure 6.4: U.S. Emissions from Fossil Fuel Use (by percentage), 2003[270]



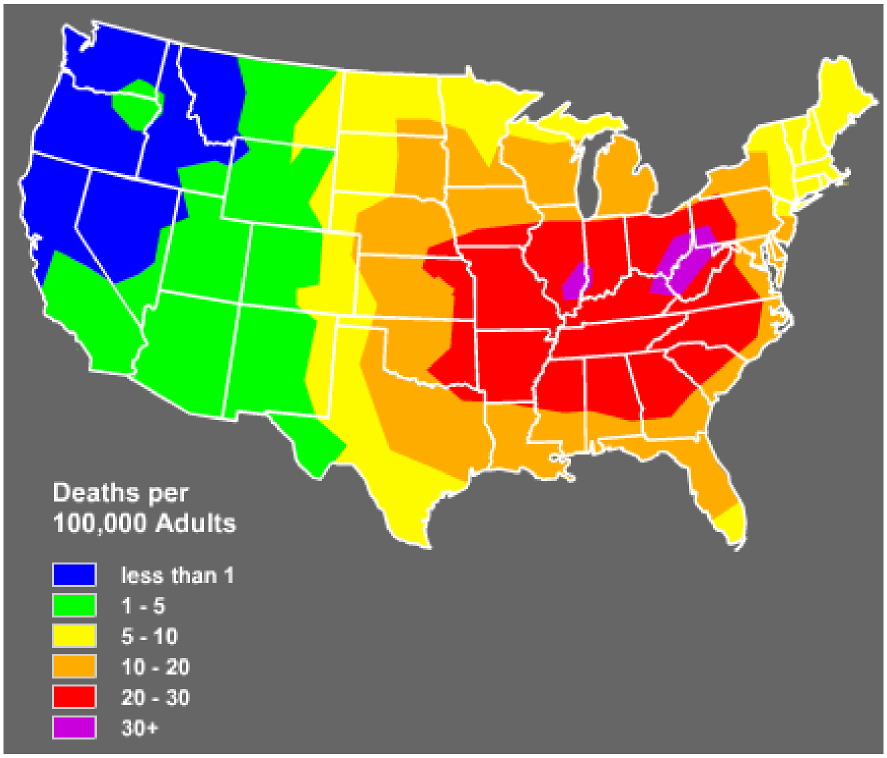
Source: Marilyn Brown, 2005.

Researchers at the Harvard School of Public Health estimated that the air pollution from conventional energy sources kills between 50,000 and 70,000 Americans every year.

These researchers found that the emissions from just 9 power plants in Illinois directly contributed to an annual risk of 300 premature deaths, 14,000 asthma attacks, and more than 400,000 daily incidents of upper respiratory symptoms among the 33 million people living within 250 miles of the plants.[271]

Compiling data from the American Cancer Society, Harvard School of Public Health, and Environmental Protection Agency, the Clean the Air Grassroots Network estimated that residents in every single U.S. state were at risk to premature death from air pollution.[272]

Figure 6.5: Estimated Power Plant Pollution Mortalities, 2007



Source: Clean the Air Grassroots Network, 2007

Children are particularly vulnerable to the pollution from fossil fuels. Because children spend more time outside and have smaller airways that necessitate more rapid breathing, they are much more vulnerable to develop illnesses associated with air pollution.[273]

By promoting technologies that displace conventional forms of electricity generation, a national RPS would substantially decrease air pollution in the U.S. A single 1 MW wind turbine running at only 30 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 (Hg) emissions.[274]

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.[275]

Table 6.2: Estimated Annual Emission and Pollution Savings from 580MW Wind Farm

	coal	natural gas	oil
NO_x, lbs/yr	6,200,000	182,000	462,000
SO_x, lbs/yr	7,444,000	12,000	620,000
CO_2, lbs/yr	2,256,000,000	1,207,000,000	1,602,000,000
PM, lbs/yr	372,000	161,000	350,000
water consumption, gal/yr	553,000,000	282,000,000	485,000,000
fuel saved, annually	153,000 tons	3,760,000,000 cf	663,000 barrels

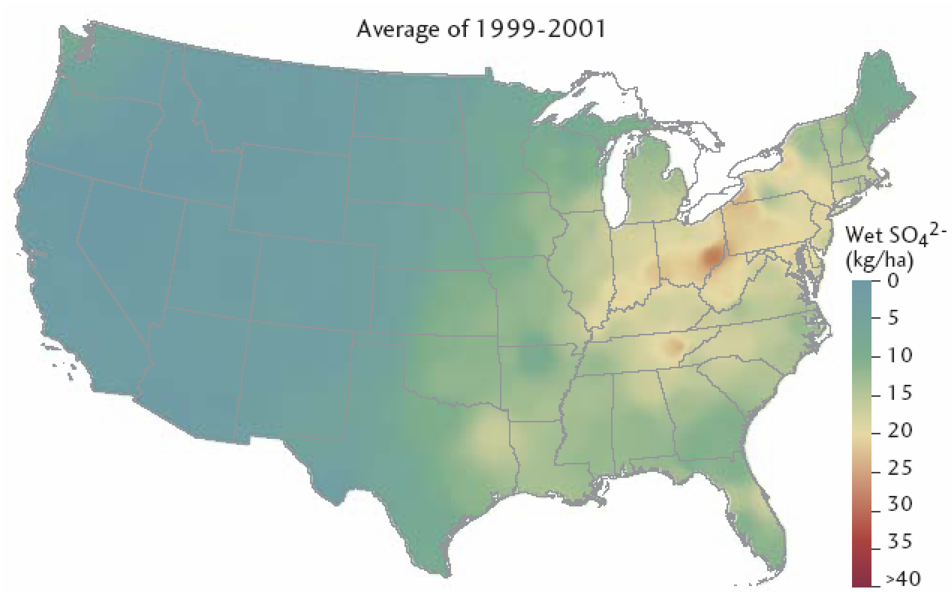
Source: Pacific Winds, 2005

The study estimated that the wind farm would displace more than 24 billion pounds of nitrous oxides, sulfur dioxides, particulate matter and carbon dioxide over the course of its 20-year lifetime — enough to cover the entire city of Oakland in a pile of toxic pollution 40 stories high.[276]

Sulfur Dioxide (SO_x) and Nitrous Oxide (NO_x)

Sulfur dioxide (SO_2) is a pollutant responsible for lake- and forest-damaging acid precipitation and a precursor to health-damaging particulates. In 2003, the Environmental Protection Agency (EPA) estimated that roughly 40 million Americans lived in areas with unhealthy levels of SO_2.[277]

Figure 6.6: Wet SO_2 Deposits, 1999-2001 (Yellow, Orange, and Red Are Unhealthy Levels)

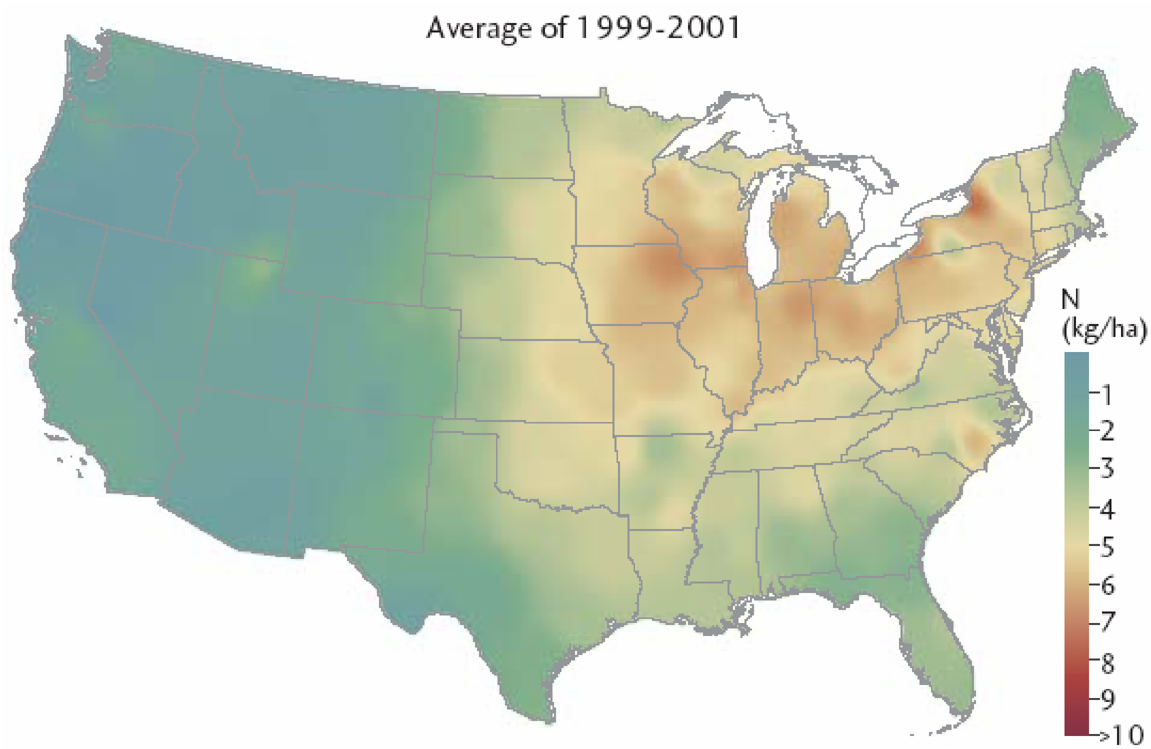


Source: U.S. Environmental Protection Agency (EPA), 2003

Nitrous oxide (NO_x) emissions react with volatile organic compounds in the atmosphere (gasoline vapors or solvents, for example) and produce compounds that can result in severe lung damage, asthma, and emphysema, if inhaled.[278]

NO_x is also a major source of ground-level ozone (smog) and contributed to acid rain, and pollution of surface water.[279] In 2003, the EPA estimated that more than 70 million Americans lived in areas with unhealthy deposits of NO_x.

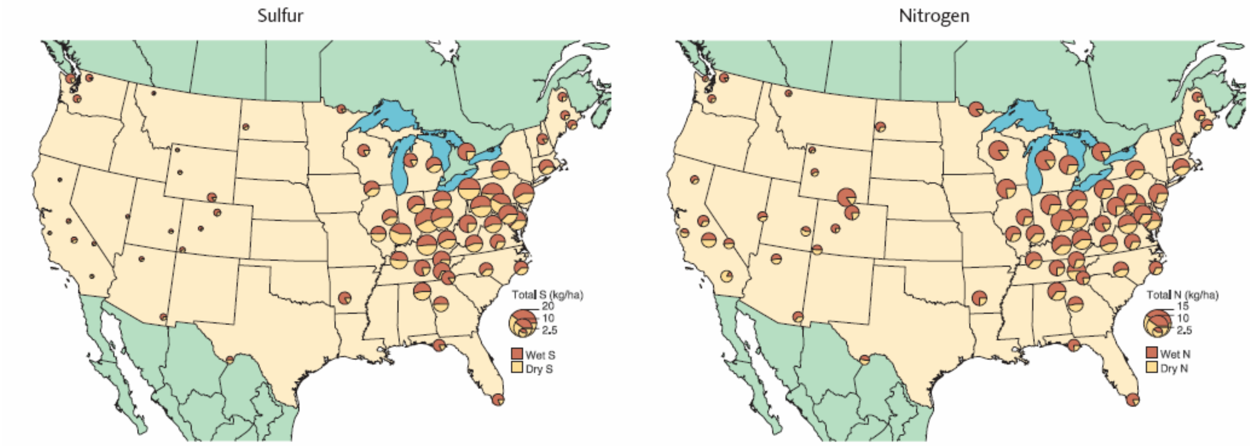
Figure 6.7: Wet NO_x Deposits, 1999-2001 (Yellow, Orange, and Red levels are unhealthy)



Source: U.S. Environmental Protection Agency (EPA), 2003

Emissions of SO_2 and NO_x create further problems when they react together in the atmosphere to form compounds that are transported long distances and induce acidification of lakes, streams, rivers, and soils.[280] Many parts of the country (especially the Ohio Valley and mid-Atlantic states) have hazardous concentrations of sulfur and nitrogen deposits.[281]

Figure 6.8: Total Sulfur and Nitrogen Deposits, 2003



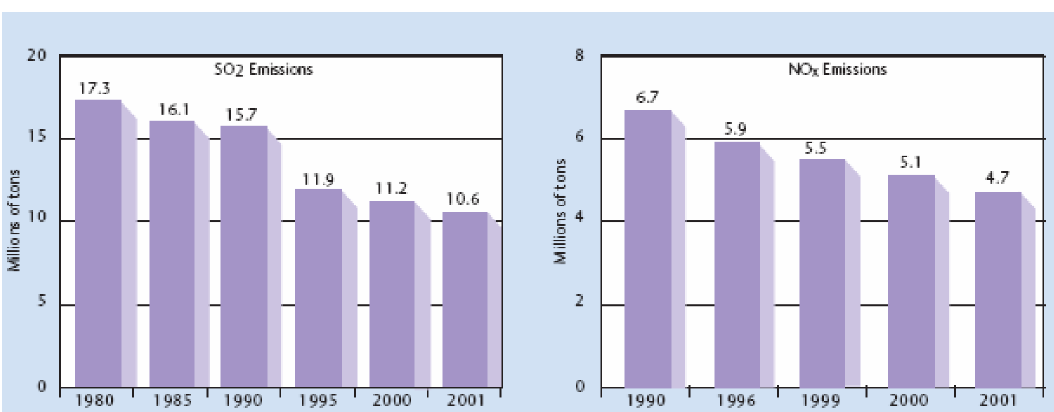
Source: U.S. Environmental Protection Agency (EPA), 2003

Acid rain from SO_2 and NO_x compounds can render many bodies of water unfit for certain fish and wildlife species. Acidic deposition can also mobilize toxic amounts of aluminum, increasing its availability for uptake by plants and fish that are then ingested by humans.

Concern over the significant environmental impacts of SO_2 and NO_x led the Environmental Protection Agency (EPA) to implement a "cap-and-trade" system that limits the aggregate emissions of SO_2 and NO_x and distributing allowances to regulated entities. Companies that reduce their emissions beyond the caps can sell allowances to other companies that have not reduced their emissions enough under the existing caps. The EPA periodically reduces the emissions caps to ensure that the total amount of pollution decreases over time.

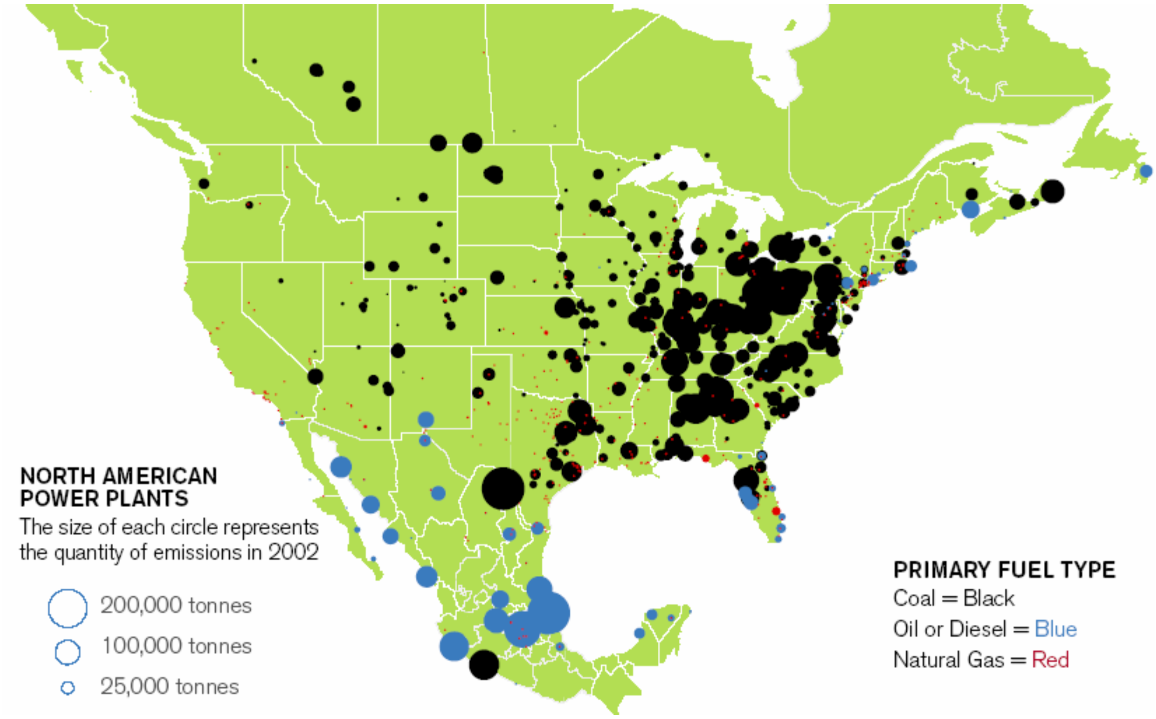
While stricter environmental controls like the SO_2 and NO_x cap-and-trade system have helped to decrease power plant emissions, in 2004 fossil fuel-fired plants in the U.S. still emitted nearly 10 million tons of sulfur dioxide (SO_2) (roughly two-thirds of the nation's entire output) and 4 million tons of nitrous oxides (NO_x).

Figure 6.9: Power Plant SO_2 and NO_x emissions, 1980 to 2001



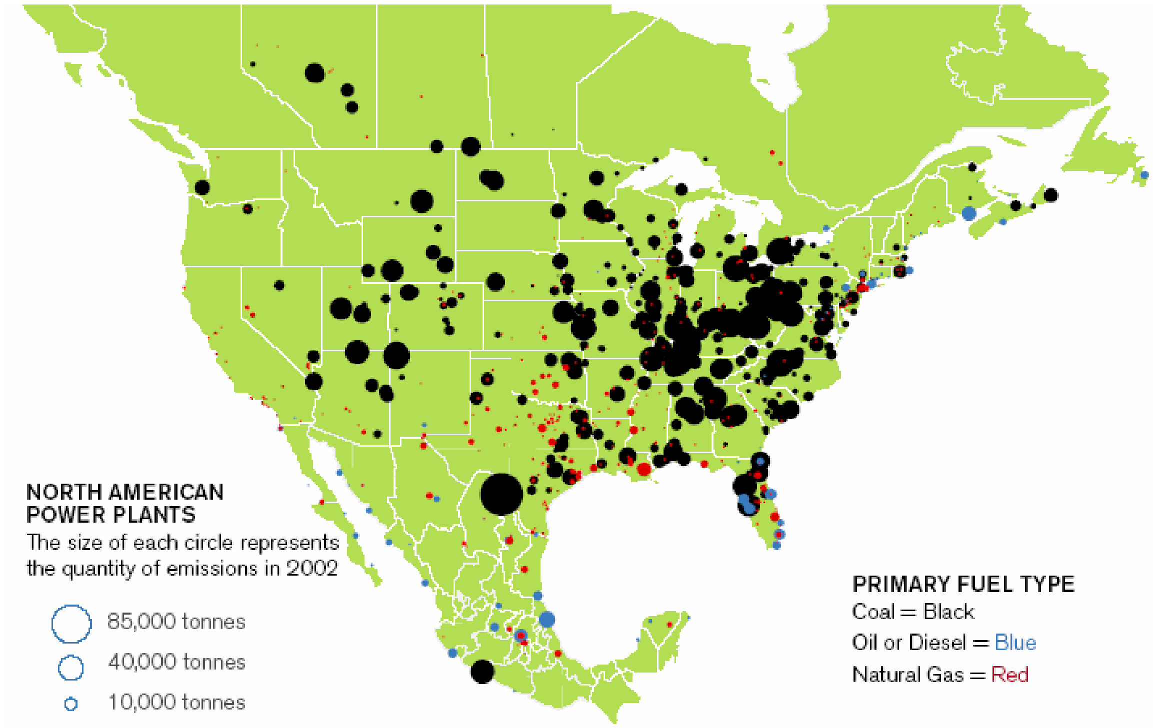
Source: U.S. Environmental Protection Agency (EPA), 2003

Figure 6.10: Geographic Distribution of Power Plant $S0_2$ Emissions, 2004[282]



Source: Commission for Environmental Cooperation, 2004

Figure 6.11: Geographic Distribution of Power Plant $N0_x$ Emissions, 2004[283]



Despite the immense progress made under the Clean Air Act Amendments of 1990, the EPA noted in 2003 that surface water sulfate concentrations have actually increased in the Ridge and Blue Ridge provinces of Virginia and that some parts of the Northern Appalachian Plateau region continue to experience dangerously high levels of stream acidification.[284]

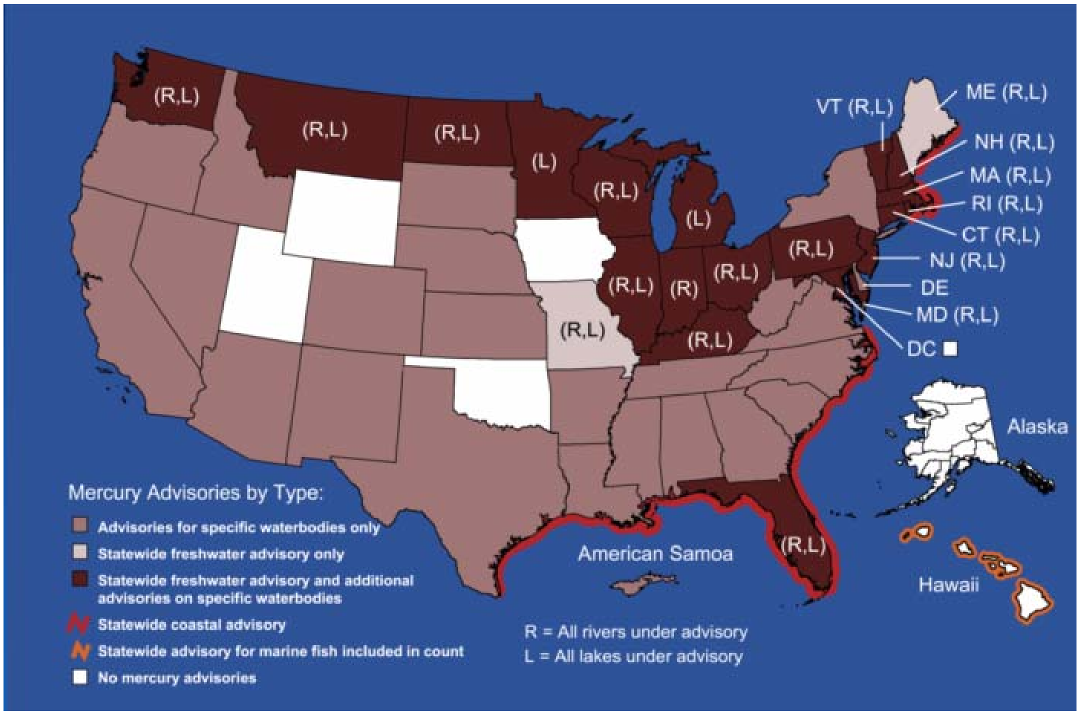
By mandating a higher penetration of renewable generation, a national RPS should empower regulators to expedite SO_2 and NO_x cap reductions while still maintaining the market-based cap-and-trade system that has proved marginally successful at reducing power plant emissions over the past 15 years.

Mercury (Hg)

A comprehensive EPA study on mercury noted that epidemics of mercury poisoning following high-doses in Japan and Iraq have demonstrated that neurotoxicity is of greatest concern when mercury exposure occurs to the developing fetus. Dietary mercury is almost completely absorbed into the blood and distributed to all tissues including the brain; it also readily passes through the placenta to the fetus and fetal brain.[285]

Most Americans do not ingest mercury directly, but accumulate small amounts of the poisonous metal through the consumption of fish. In 2003, 43 states had to issue mercury advisories to warn the public to avoid consuming contaminated fish from in-state water sources.[286]

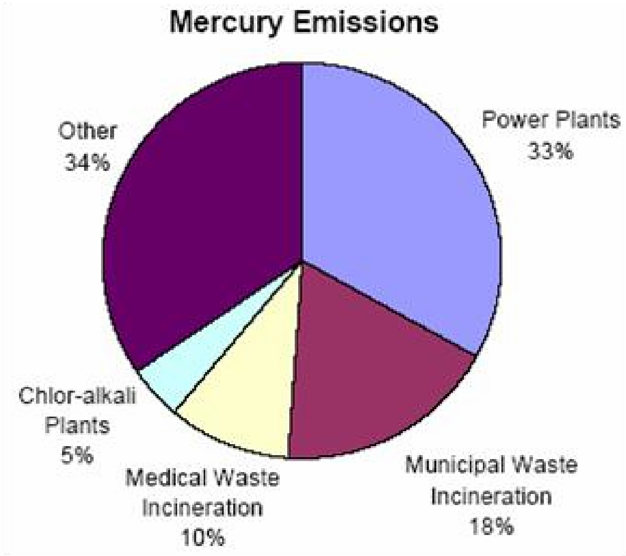
Figure 6.12: State Advisories for Mercury Contamination, 2003



Source: U.S. Environmental Protection Agency, 2003

The EPA estimates that as many as 3 percent of women of child-bearing age eat sufficient amounts of fish to be at risk from mercury exposure. Conventional power plants are responsible for nearly one third of all U.S. emissions of mercury.[287]

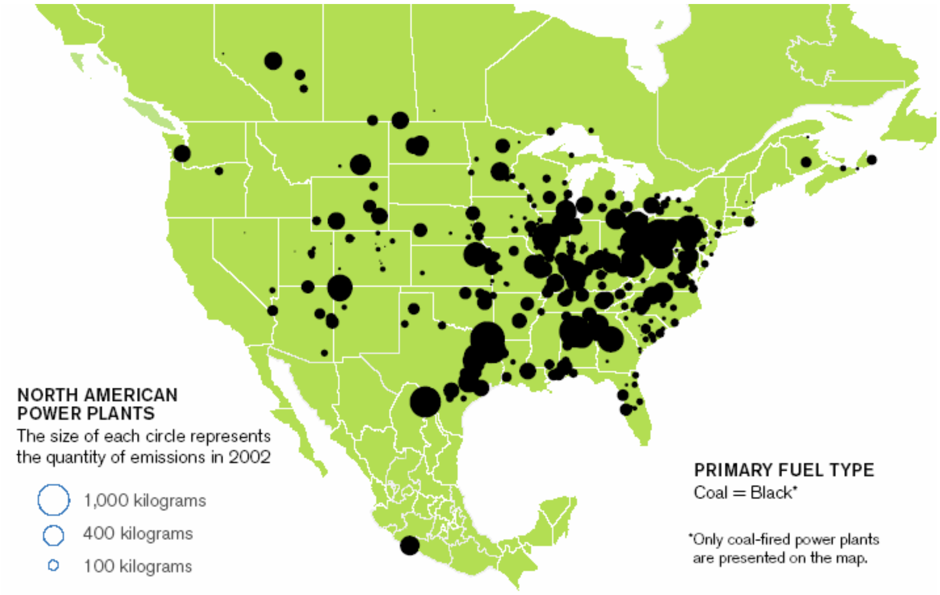
Figure 6.13: U.S. Mercury Emissions, by Source[288]



Source: U.S. Environmental Protection Agency, 1997

In 2004, for example, U.S. coal-fired power plants alone released about 100,000 lbs. of mercury into the nation's air. The greatest concentrations of these emissions were found in the southern Great Lakes and Ohio River valley, the Northeast and scattered areas in the South. However, the most elevated concentrations were found in the Miami and Tampa areas.[289]

Figure 6.14: Geographic Distribution of Power Plant Mercury Emissions, 2004[290]



Source: Commission for Environmental Cooperation, 2004

Particulate Matter (PM)

Particulate matter is not a specific pollutant itself, but instead refers to a mixture of fine particles of harmful pollutants such as soot, acid droplets, and metals. Particulate matter (PM) is the generic term for the mixture of these microscopic solid particles and liquid droplets in the air. Because its make-up is often complex, PM is by far the most difficult pollutant to detect and monitor.

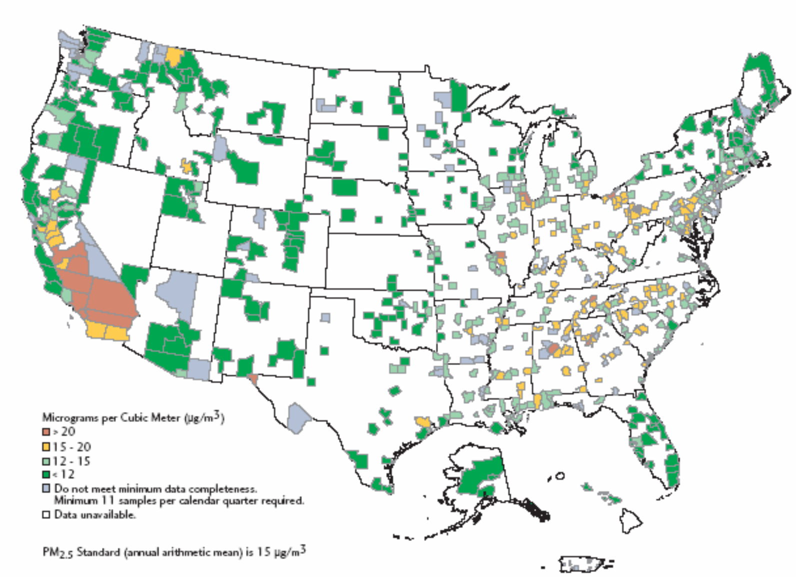
Roughly half of the nation's 250,000 tons of PM emissions come indirectly from the NOx and Sox emitted from power plants, which react in the atmosphere to form dangerous PM particles.[291] When both these primary and secondary conditions are included in estimates, individual power plants release between 100 and 400 tons of PM every year.[292]

Inhalation of PM is strongly associated with heart disease and chronic lung disease.[293] Since microscopic solids or liquid droplets are so small, they can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked PM exposure to:

- Irritation of the airways, coughing, or difficulty breathing
- Decreased lung function
- Aggravated asthma
- Development of chronic bronchitis
- Irregular heartbeat
- Nonfatal heart attacks
- Premature death in people with heart or lung disease.[294]

Roughly 80 million Americans live in areas where PM emissions are considered dangerous.[295]

Figure 6.15: Annual Average Particulate Matter Concentrations, 2001



Source: U.S. Environmental Protection Agency, 2003

Particulate matter emissions from power plants alone are responsible for more than 23,000 premature deaths each year

…as well as nearly 22,000 hospital admissions, more than a half-million asthma attacks (resulting in 26,000 hospital emergency room visits), more than 38,000 heart attacks, and over16,000 cases of chronic bronchitis.[296] These health affects have a devastating impact on the U.S. economy and are estimated to have cost the U.S. workforce over three million lost work days.[297]

Figure 6.16 Annual Health Impacts / Per Capita Deaths from Power Plant PM Pollution (by state, 2004):

States: Health Impacts (Annual)

Rank	State	Mortality	Hospital Admissions	Heart Attacks
1	Pennsylvania	1,825	1,664	3,329
2	Ohio	1,743	1,638	2,873
3	Florida	1,416	1,367	2,145
4	Illinois	1,356	1,333	2,361
5	New York	1,212	1,191	2,455
6	Texas	1,160	1,105	1,791
7	North Carolina	1,133	1,013	1,603
8	Virginia	989	895	1,421
9	Michigan	981	968	1,728
10	Tennessee	952	804	1,276
11	Georgia	946	837	1,352
12	Indiana	887	845	1,491
13	Missouri	754	699	1,237
14	Kentucky	745	639	1,022
15	Maryland	687	631	1,014

States: Per Capita Deaths

Rank	State	Total Mortality (annual)	Mortality Risk Per 100,000 adults
1	West Virginia	399	33.1
2	Kentucky	745	28.2
3	Tennessee	952	25.1
4	Ohio	1,743	24.6
5	Indiana	887	23.3
5	Pennsylvania	1,825	23.3
7	Arkansas	395	22.8
8	Alabama	643	21.9
9	North Carolina	1,133	21.5
10	Virginia	989	21.2
11	Missouri	754	21.1
12	South Carolina	564	20.7
13	Maryland	687	19.9
14	Mississippi	337	19.1
15	Oklahoma	400	18.6

Source: Ledford, 2004

Carbon Dioxide (CO_2) and Other Greenhouse Gases (GHG)

In its most recent report released on April, 2007, the Intergovernmental Panel on Climate Change (IPCC)—a forum made up of thousands of the world's top climate scientists—concluded that continued emissions of greenhouse gases will contribute directly to global:

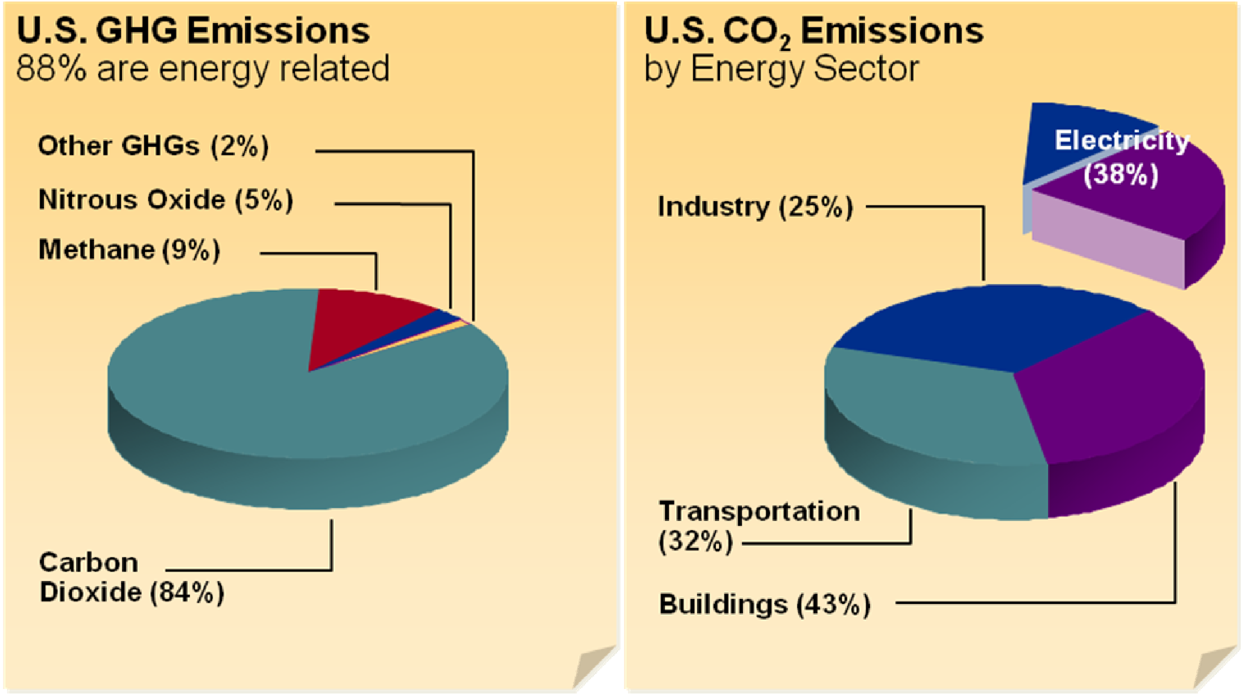
- Changes in the distribution, availability, and precipitation of water, resulting in severe water shortages for millions of people.
- Destruction of ecosystems, especially the bleaching of coral reefs and widespread deaths of migratory species.

- Complex, crop productivity and fishing impacts.
- Damage from floods and severe storms, especially among coastal areas.
- Deaths arising from changes in disease vectors and an increase in the number of heat waves, floods, and droughts.[298]

Policymakers should not underestimate the impacts of global warming for the United States. The Pew Center on Global Climate Change estimates that, in the Southeast and southern Great Plains, the financial costs of climate change could reach as high as $138 billion by 2100. Indeed, Pew researchers warn that "waiting until the future" to address global climate change might bankrupt the U.S. economy.[299]

Yet carbon-intensive fuels continue to dominate electricity generation in the United States. By 2005, almost 90 percent of the country's greenhouse gas emissions were energy-related, with the electric utility industry outpacing all other sectors (including transportation) with 38 percent of national carbon dioxide (CO_2) emissions.

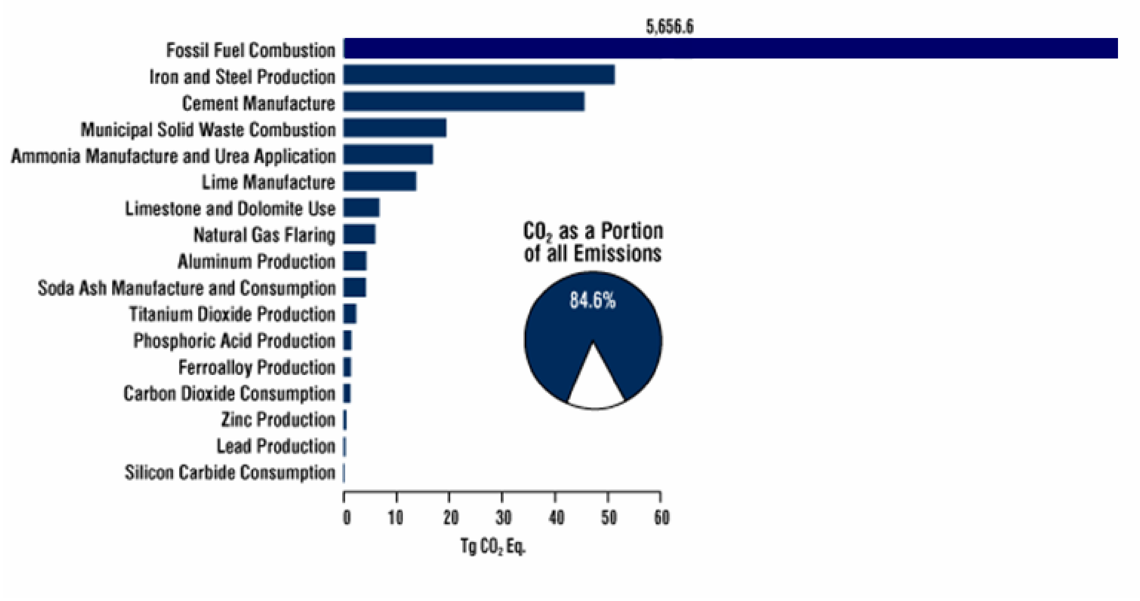
Figure 6.17: U.S. Greenhouse Gas (GHG) Emissions by Pollutant and Sector, 2003[300]



Source: Marilyn Brown, 2005.

Fossil-fueled power plants in the U.S. emitted 2.25 billion metric tons of $C0_2$ in 2003, more than 10 times the amount of $C0_2$ compared to the next-largest emitter, iron and steel production.[301]

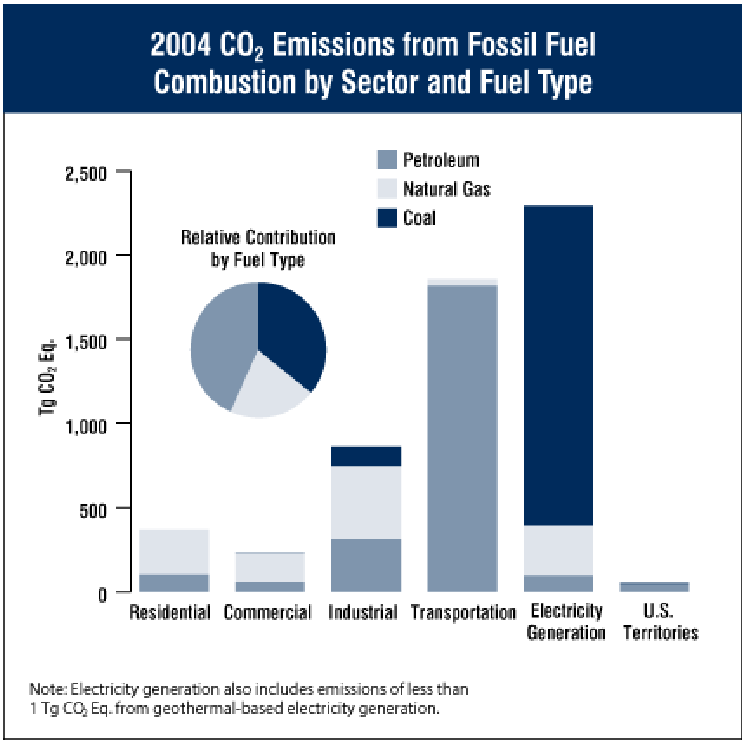
Figure 6.18: Sources of $C0_2$ in the United States, 2004



Source: Modified from U.S. Environmental Protection Agency, 2007.

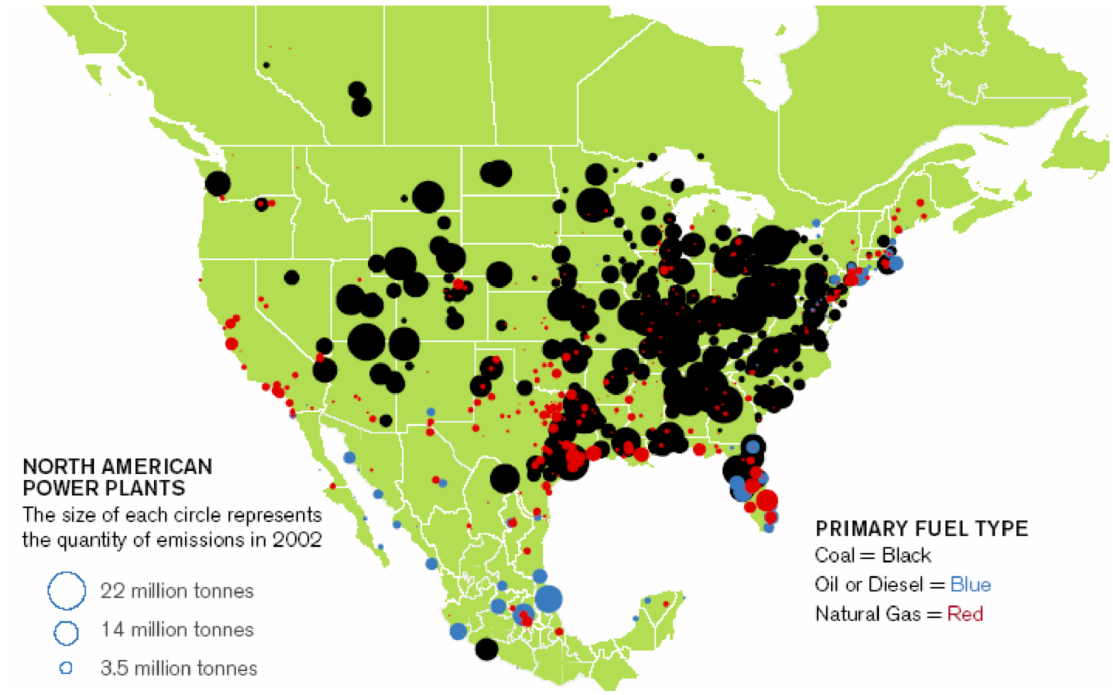
Put simply, of all U.S. industries, electricity generation is—by substantial margins—the single largest contributor of the pollutants responsible for global warming.

Figure 6.19: Fossil Fuel Emissions of $C0_2$ by Sector and Fuel Type



In 2004, almost every state in country was home to at least one power plant with significant $C0_2$ emissions.

Figure 6.20: Geographic Distribution of Power Plant $C0_2$ Emissions, 2004

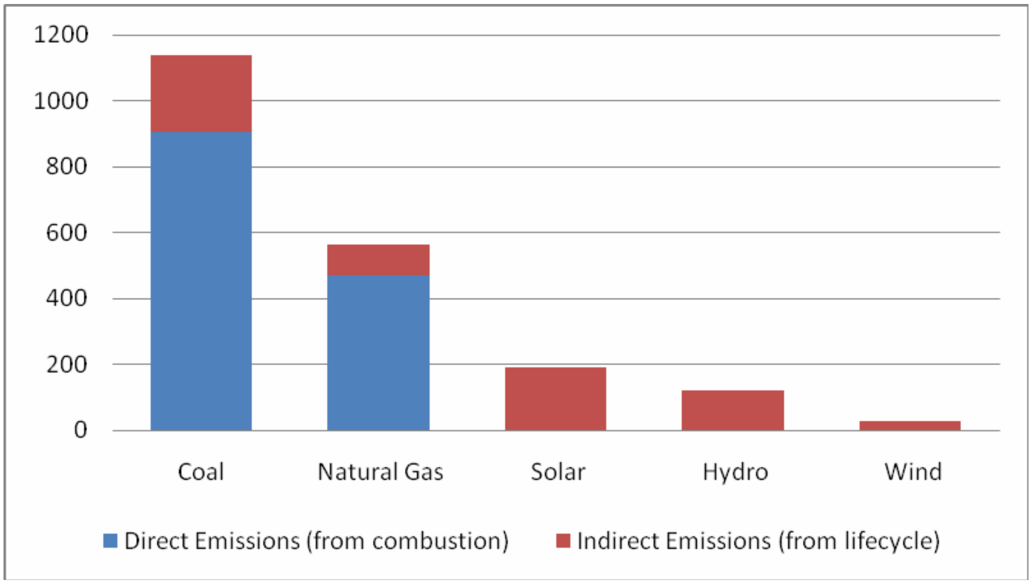


Source: Commission for Environmental Cooperation, 2004

Nuclear energy is not much of an improvement, despite recent claims by the Nuclear Energy Institute (NEI) that nuclear power is "the Clean Air Energy." Reprocessing and enriching uranium requires a substantial amount of electricity, often generated from fossil fuel-fired power plants. Data collected from one uranium enrichment company alone revealed that it takes a 100-megawatt power plant running for 550 hours to produce the amount of enriched uranium needed to fuel a 1,000 megawatt reactor (of the most efficient design currently available) for one year.[302] According to the *Washington Post*, two of the nation's most polluting coal plants (in Ohio and Indiana) produce electricity exclusively for the enrichment of uranium.[303] Because uranium enrichment consumes so much electricity derived from fossil fuels, many nuclear power plants contribute indirectly, but substantially, to global climate change and do virtually nothing to end U.S. dependence on foreign oil.

The International Atomic Energy Agency estimates that when direct and indirect carbon emissions are included, coal plants are around 10 times more carbon intensive than solar and more than 40 times more carbon intensive than wind. Natural gas fares little better, at three times as carbon intense as solar and 20 times as carbon intensive as wind.[304] 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 20 percent RPS would reduce carbon dioxide emissions by 434 million metric tons by 2020—a reduction of 15 percent below "business as usual" levels, or the equivalent to taking nearly 71 million automobiles off the road.[305]

Figure 6.21: Direct and Indirect Carbon Emissions by Electricity Technology (equivalent grams of CO_2/kWh)



Source: Malcolm Griston.[306]

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 by 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".[307]

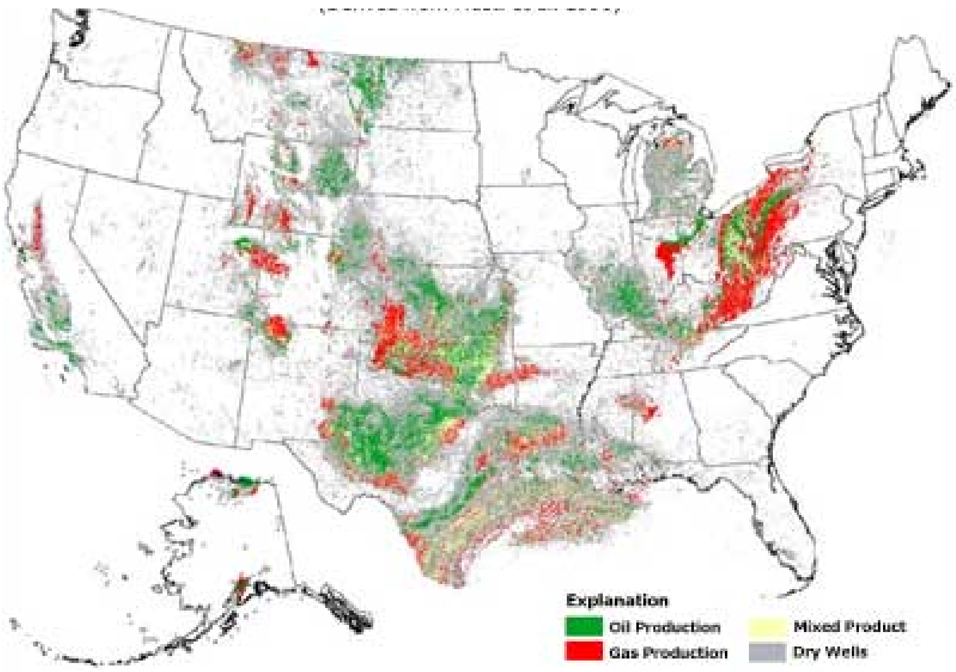
D. Fuel Production Impacts

In addition to the environmental damage caused by fossil fuel combustion, the production of fossil fuels and uranium – the drilling, mining, processing and transportation – produces a substantial amount of pollution and toxic waste. In the United States, there are more than 150 refineries, 4,000 offshore platforms, 410 underground gas storage fields, 125 nuclear waste storage facilities, 160,000 miles of oil pipelines, and1.4 million miles of natural gas pipelines. Each can degrade their surrounding environment and negatively impact the health and safety of Americans.[308]

Oil and Gas Drilling

The United States Geological Survey estimated that there are more than two million oil and natural gas wells in the domestic U.S. The most intense areas of oil and gas production are off the shores of the Gulf of Mexico and along the northern coast of Alaska.

Figure 6.22: Oil and Natural Gas Production in the United States, 1998[309]



Source: U.S. Geological Survey (USGS)

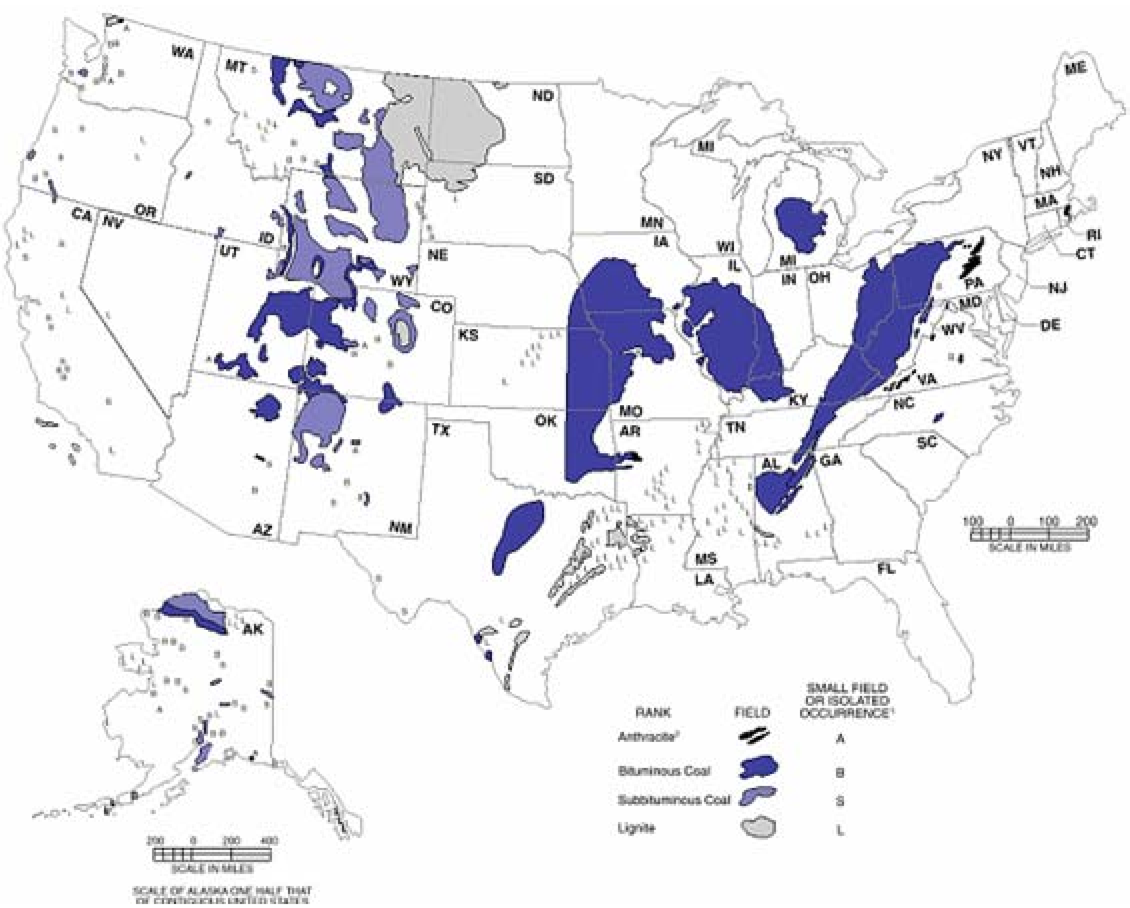
Offshore oil and natural gas exploration and production in the Gulf of Mexico chronically exposes aquatic and marine wildlife to low-level releases of many chemicals through the discharge and seafloor accumulation of drilling muds and cuttings, as well as the continual release of low-levels of hydrocarbons around production platforms. These chronic environmental perturbations and the biological exposures continue to threaten marine biodiversity over wide areas of the Gulf.[310]

Independent studies undertaken by three groups of ecologists and the National Academies of Science have concluded that arctic oil and gas production on the North Slope in Alaska disrupts tundra surfaces and alters the hydrological processes of wetland ecosystems responsible for the spawning and development of wildlife. North Slope oil production also undermines nutrient availability for tundra plants necessary for food, habitats, and land integrity, and prematurely thaws the ice and permafrost.[311]

Coal Mining

Coal extraction, processing, and transportation have a direct affect on water and land resources. Of the more than 1 billion tons of coal mined in the United States annually, roughly 70 percent comes from surface mines.[312]

Figure 6.23: United States Coal Regions and Fields, 2004[313]



Source: U.S. Department of Energy, Energy Information Administration

Mountaintop removal—a newer technique for mining coal that uses heavy explosives to blast away the tops of mountains—in the Appalachians has destroyed streams, blighted landscapes, and diminished the water quality of rural communities.

Figure 6.24: Mountaintop Removal Coal Mining near Kayford Mountain, West Virginia

Source: Vivian Stockman, Ohio Valley Environmental Coalition

Failing coal slurry impoundments, acid mine drainage, aquifer disruption, saline pollution from coal-bed methane recovery, and occupational safety and health hazards (including mine-related deaths) are among the impacts of continued reliance on coal-fired electricity production.[314]

Coal Transportation

Most coal is transported an average distance of 500 miles before it is combusted in power plants.[315] The safety of coal trucks is not a minor concern. Roadway fatalities are twice as high on coal-hauling roads. Safety advocates in Kentucky have expressed concern with the operation of coal trucks within the state, which in one four-year period witnessed more than 1 person killed each month by coal-hauling trucks.

Between 2000 and 2004, Kentucky documented 704 accidents involving coal trucks, resulting in the deaths of 53 people and the injury of more than 535.[316]

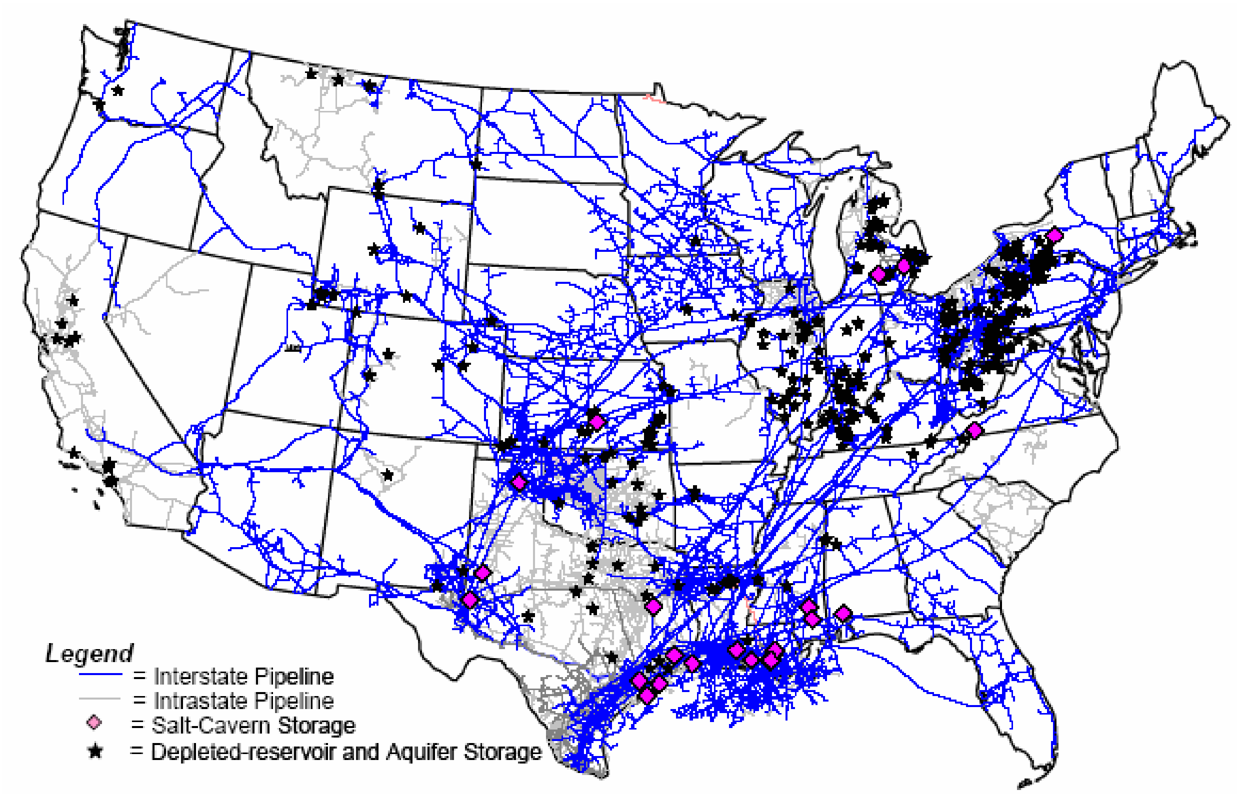
Figure 6.25: Coal Trucks in Tennessee (2006)

Source: Network for New Energy Choices

Natural Gas Storage

During the summer months, domestic natural gas production and imported natural gas far exceed demand, so excess supply is placed in large underground storage facilities.[317] Around 400 natural gas storage facilities have been constructed in the United States, storing an estimated 8.25 trillion cubic feet of natural gas. The three principal types of underground storage sites used are depleted oil and gas reservoirs, aquifers, and salt cavern formations.[318]

Figure 6.26: U.S. Underground Natural Gas Storage Facilities in Relationship to the National Natural Gas Transportation Grid[319]



Source: U.S. Department of Energy, Energy Information Administration

The DOE and energy companies spent an estimated $4 billion (in 2000 dollars) to create artificial caverns and salt domes below the surface to store oil.

Oil and natural gas storage facilities, in addition to significantly adding to the cost of natural gas and oil infrastructure, are susceptible to serious accidents that can pollute the air and water of local communities. One report from the Lawrence Berkeley National Laboratory noted that leaks can occur due to improper well design, construction, maintenance, operation.[320] The report cautioned that leakage from natural gas storage structures can be especially hazardous when they cause natural gas to migrate into drinking-water aquifers or escape to the surface, creating a "significant safety risk." Leaked natural gas can significantly endanger life and property, water resources, vegetation, and crops.[321]

Indeed, In January, 2001, hundreds of explosions rocked the Yaggy field—a natural gas salt formation storage site in Hutchinson, Kansas—when natural gas escaped from one of the storage wells and erupted into a seven mile wall of fire (burning an estimated 143 million cubic feet of natural gas). Clean up for the disaster necessitated the construction of 57 new vent wells, extending a distance of more than 9 miles and devastating the local ecology.[322]

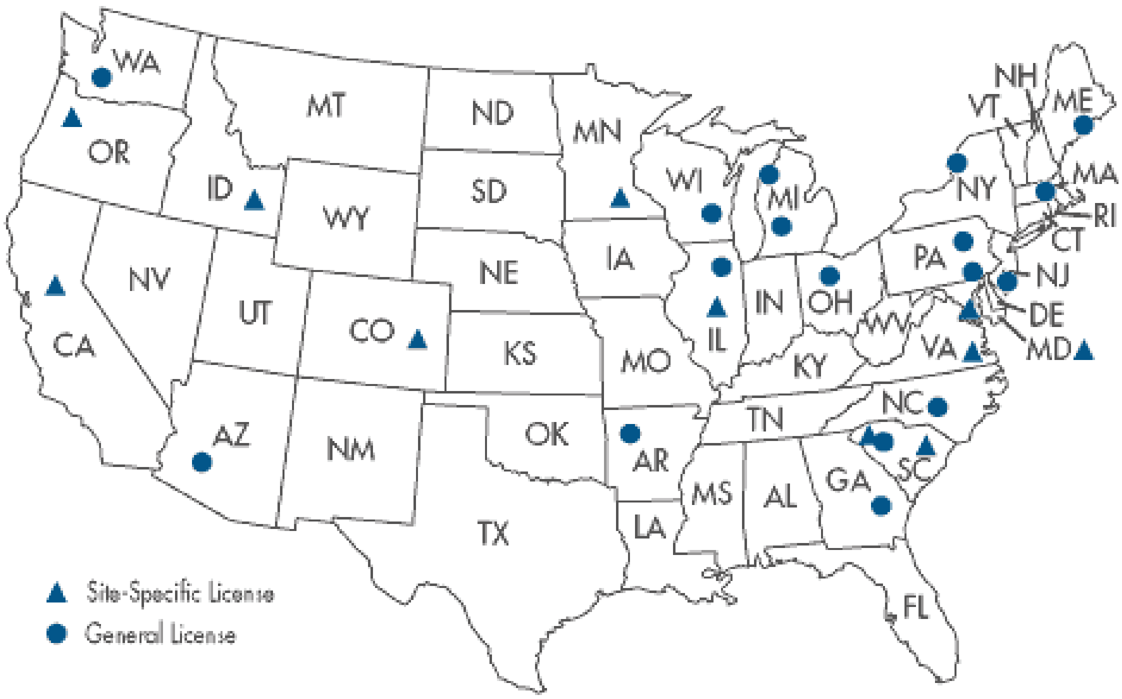
Overpressurization (needed to enlarge gas bubbles and obtain higher delivery rates) is another main cause of leakage, as many underground natural gas storage projects tend to be operated at pressures exceeding their original designs. Such leaks can become excessively costly: The Gulf South Pipeline Company's Magnolia facility—a $234 million salt-cavern facility—opened in 2003 only to permanently close a few months later after a well collapsed.[323]

Nuclear Waste Storage

The safety and security of spent nuclear fuel remains a serious problem in the U.S. Nuclear reactor facilities are running out of space to store nuclear waste, and Yucca Mountain—a federally funded permanent storage facility being built in Nevada—has only enough space for 63,000 tons.[324]

The Department of Energy has relied upon on-site storage as a stop-gap remedy until Yucca Mountain is finalized or the U.S. finds a long-term solution to nuclear waste. As a result, by 2004, more than 49,000 tons of spent nuclear fuel was scattered in dry casks and storage pools in seventy different locations in the U.S. That amount is expected to more than double to 105,000 tons by 2039. [325]

Figure 6.27: Current and Potential Nuclear Spent Fuel Storage Installations, 2007[326]



Source: U.S. Nuclear Regulatory Commission (NRC), 2007

E. Land Use

Wind and Solar Uses Less Land

Recent advances in renewable energy technologies have made them much less land-intensive. In fact, the Worldwatch Institute recently estimated that harnessing renewable energy for electricity production requires less land than conventional systems. The study noted that solar power plants that concentrate sunlight in desert areas, for instance, require 2,540 acres per billion kWh. On a lifecycle basis, this is less land than a comparable coal or hydropower plant generating the same amount of electricity.[327] Similar projections from the National Renewable Energy Laboratory (NREL) demonstrate that solar and wind technologies use extensively *less* land than conventional systems when their complete fuel cycles are considered.

Table 6.3: Comparative Land Use for Renewable and Coal Technologies per installed GW[328]

Technology	Capacity Factor	Land (km^2) per year
Flat-Plate Photovoltaics	20%	10 to 50
Solar Thermal	15-25%	20 to 50
Wind	30%	25 to 78
Traditional Coal Fired*	85%	100 (using open cut coal mine)

Source: National Renewable Energy Laboratory (NREL), 2004. *Diesendorf, 2006

The American Wind Energy Association (AWEA) estimates that in open and flat terrain a large-scale wind plant will require about 60 acres per MW of installed capacity (this drops to as little as 2 acres per MW for hilly terrain). However, AWEA emphasizes that only 5 percent (3 acres) or less of this area is actually occupied by turbines, access roads, and other equipment—95% remains free for other compatible uses such as farming or ranching.[329]

At the High Winds Project in Solano, California, 8 different landowners host 90 separate 1.8 MW wind turbines that total 162 MW of electricity capacity, but are still able to use almost all of the farmland around and between the turbines.

Figure 6.28: Turbines at High Winds Project in Salano, California

Source: Florida Power & Light

Using a conservative figure of 26 acres for each wind turbine, researchers from Oberlin College estimated that 40 square miles could support roughly 38,000 turbines producing 3-4% of total US electric demand each year. The actual footprint of these turbines would be roughly 10,000 acres, leaving the surrounding 990,000 acres of land either untouched or available for other uses. This figure beats both coal and natural gas in terms of total land use.[330]

NREL estimates that solar PV could supply every kilowatt-hour of our nation's current electricity requirements with modules on only 7% of the country's available roofs, parking lots, highway walls, and buildings without substantially altering appearances.

Solar PV requires even less new land. A PV system at the California Exposition Center in Sacramento, California, for example, fully integrates 450 kW of PV into a parking lot. Indeed, NREL concluded that, "a world relying on PV would offer a landscape almost indistinguishable from the landscape we know today."[331]

For example, the Energy Policy Initiatives Center at the University of San Diego School of Law recently estimated that the City of San Diego could construct 1,726 MW of solar PV relying only on available roof area downtown.[332]

Figure 6.29: PV System at the California Exposition Center in Sacramento, California

Source: Sacramento Municipality Utility District, 2004

[236] U.S. Energy Information Administration, *Impacts of a 10-Percent Renewable Portfolio Standard* (Washington, DC: U.S. Department of Energy, February, 2002), available at http://tonto.eia.doe.gov/FTPROOT/service/sroiaf(2002)03.pdf.
[237] *The Effects Of Integrating Wind Power On Transmission System Planning, Reliability, And Operations: Report On Phase 2: System Performance Evaluation*, New York State Energy Research & Development Authority (Mar 2005) http://www.nyserda.org/publications/wind_integration_report.pdf.
[238] Alden Hathaway, "The Impact of a Renewable/EE Portfolio Standard on Future Rate Hikes in Virginia," *Presentation to the Energy Virginia Conference*, October 17, 2006, 21 pp.
[239] Union of Concerned Scientists, *Increasing the Texas Renewable Energy Standard: Economic and Employment Benefits* (Washington, DC: UCS, February, 2005).
[240] Jonathan Winer, Mon-Fen Hong, and Dick Spellman, "Renewable Portfolio Standard: Analysis for the State of North Carolina," March 8, 2007, p. 18.
[241] Governor's Renewable Energy Working Group, "Considerations regarding a Renewable Portfolio Standard (RPS) Framework for the State of Oregon," July 11, 2006, p. 14.
[242] Mike Shriberg, "Clean Energy Testimony," *Hearing before the State Senate Technology & Energy Committee*, January 18, 2006, available at http://www.environmentmichigan.org/testimony/new-energy-future/new-energy-future-testimony/renewable-portfolio-standards.
[243] Platts Renewable Energy Report, "Canada: Coop Sells Green Tags," June, 2002, p. 21.
[244] U.S. Department of Energy, *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* (Washington, DC: U.S. DOE, December, 2006), available at http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/DOE%20energy-water%20nexus%20Report%20to%20Congress%201206.pdf.
[245] U.S. Department of Energy, *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* (Washington, DC: U.S. DOE, December, 2006), available at http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/DOE%20energy-water%20nexus%20Report%20to%20Congress%201206.pdf.

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246 Thomas J. Feeley, "Tutorial on Electric Utility Water Issues," *Presentation to the 28th International Technical Conference on Coal Utilization and Fuel Systems* (National Energy Technology Laboratory, March 10-13, 2003), p. 4.
247 Sara Barczak and Rita Kilpatrick, "Water Conservation Opportunities Through Energy Efficiency in Georgia," *Proceedings of the 2005 George Water Resources Conference*, April 25-27, 2005, Athens, Georgia), pp. 1-4.
248 U.S. Department of Energy, *The Wind/Water Nexus* (Washington, DC: U.S. Department of Energy, April, 2006, DOE/GO-102006-2218).
249 See Southern Alliance for Clean Energy, (2007). "Water," Available at: http://www.cleanenergy.org/programs/programs.cfm?ID=5
250 U.S. Department of Energy, *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* (Washington, DC: U.S. DOE, December, 2006), available at http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/DOE%20energy-water%20nexus%20Report%20to%20Congress%201206.pdf.
251 U.S. Census Bureau, "Population Projections: 2004," available at http://www.census.gov/population/www/projections/popproj.html.
252 U.S. Department of Energy, *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* (Washington, DC: U.S. DOE, December, 2006), available at http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/DOE%20energy-water%20nexus%20Report%20to%20Congress%201206.pdf.
253 U.S. Department of Energy, *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* (Washington, DC: U.S. DOE, December, 2006), available at http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/DOE%20energy-water%20nexus%20Report%20to%20Congress%201206.pdf.
254 Bill Smith, Bob Goldstein, and Keith Carns, *Water and Sustainability—The EPRI Research Plan* (Washington, DC: EPRI, July 25, 2002).
255 U.S. Global Climate Change Research Program, "U.S. National Assessment of Potential Consequences of Climate Variability and Change: Regional Paper, Pacific Northwest," 2004, available at http://www.usgcrp.gov/usgcrp/nacc/education/pnw/pnw-edu-3.htm; and Palmer, R. & Hahn, M. (2002). The Impacts of Climate Change on Portland's Water Supply. Portland, Oregon: Portland Water Bureau.
256 U.S. Global Climate Change Research Program, "U.S. National Assessment of Potential Consequences of Climate Variability and Change: Regional Paper, Pacific Northwest," 2004, available at http://www.usgcrp.gov/usgcrp/nacc/education/pnw/pnw-edu-3.htm; and Palmer, R. & Hahn, M. (2002). The Impacts of Climate Change on Portland's Water Supply. Portland, Oregon: Portland Water Bureau.
257 Foss, B. (2006). "Natural gas jumps 14%; Oil drifts higher," *Arkansas Democrat Gazette*, August 1.
258 John Norton, "Water, Taxes in Pueblo, Colo., Hamper Xcel Energy Power Plant Expansion," *The Pueblo Chieftain*, November 20, 2003, p. 12.
259 John Veil Impacts of Electric Power and Coal Industries on Water Resources, Argonne National Laboratory, http://www.ead.anl.gov/project/dsp_topicdetail.cfm?topicid=77.
260 Bartram, J., Wayne W. Carmichael, Ingrid Chorus, Gary Jones, and Olav M. Skulberg. 1999. Chapter 1. Introduction, In: Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring and management. World Health Organization.
261 B.K. Sovacool, "Coal and Nuclear Technologies: Creating a False Dichotomy for American Energy Policy," Policy Sciences 40 (2007), forthcoming.
262 U.S. Nuclear Regulatory Commission, "Regulating Nuclear Fuel," September, 2001, available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/brochures/br0280/br0280r1.pdf.
263 Staff Reporter, (2006). "Illinois Sues Exelon for Radioactive Tritium Releases Since 1996," Environment News Service, March 21. Available at: http://www.ens-newswire.com/ens/mar2006/2006-03-21-02.asp
264 U.S. Department of Energy, *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* (Washington, DC: U.S. DOE, December, 2006), available at http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/DOE%20energy-water%20nexus%20Report%20to%20Congress%201206.pdf, p. 10.
265 U.S. Department of Energy, *The Wind/Water Nexus* (Washington, DC: U.S. Department of Energy, April, 2006, DOE/GO-102006-2218), p. 2.
266 Ed Brown, "Renewable Energy Brings Water to the World," *Renewable Energy Access* (August 23, 2005), available at http://www.renewableenergyaccess.com/rea/news/story?id=35664.
267 American Wind Energy Association, "Wind Web Tutorial," 2007, available at http://www.awea.org/faq/wwt_environment.html#How%20much%20land%20is%20needed%20for%20a%20utility-scale%20wind%20plant.
268 American Wind Energy Association, "Wind Web Tutorial," 2007, available at http://www.awea.org/faq/wwt_environment.html#How%20much%20land%20is%20needed%20for%20a%20utility-scale%20wind%20plant.

[269] Benjamin K. Sovacool, “The Energy-Environment Nexus,” *Presentation at the 2006 Choices and Challenges Forum,* Virginia Tech, November 2, 2006, p. 3.
[270] Marilyn A. Brown, “Ending the Energy Stalemate: Facts and Figures from the National Commission on Energy Policy,” Oak Ridge Center for Advanced Studies Seminar, June 30, 2005.
[271] Harvard School of Public Health, “Impact of Pollution on Public Health,” January 3, 2001, available at http://www.hsph.harvard.edu/press/releases/press01032001.html.
[272] Source: Clean the Air, “Dirty Air, Dirty Power,” available at http://www.cleartheair.org/dirtypower/map.html.
[273] Michael T. Kleinman, *The Health Effects of Air Pollution on Children* (Los Angeles: University of California, 2000).
[274] Reeves, Ari and Becker, Fredric: 2003, *Wind Energy for Electric Power: A REEP Issue Brief*. Renewable Energy Policy Project, Washington, DC, USA.
[275] Source: Pacific Winds, “The Health Benefits of Altamont Pass Wind Power,” 2005, available at http://www.powerworksinc.com/healthbenefits.asp.
[276] Pacific Winds, “The Health Benefits of Altamont Pass Wind Power,” 2005, available at http://www.powerworksinc.com/healthbenefits.asp.
[277] Source: U.S. EPA, 2003.
[278] David R. Wooley, *A Guide to the Clean Air Act for the Renewable Energy Community* (Washington, DC: Renewable Energy Policy Project, 2000), pp. 7-14.
[279] Rodney Sobin, “Energy Myth Seven: Renewable Energy Systems Could Never Meet Growing Electricity Demand in America,” In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007), pp. 171-199.
[280] Rodney Sobin, “Energy Myth Seven: Renewable Energy Systems Could Never Meet Growing Electricity Demand in America,” In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007), pp. 171-199.
[281] Source: U.S. EPA, 2003.
[282] Commission for Environmental Cooperation, *North American Power Plant Emissions*, 2004, available at http://www.cec.org/files/PDF/POLLUTANTS/PowerPlant_AirEmission_en.pdf.
[283] Commission for Environmental Cooperation, *North American Power Plant Emissions*, 2004, available at http://www.cec.org/files/PDF/POLLUTANTS/PowerPlant_AirEmission_en.pdf.
[284] Source: U.S. EPA, 2003.
[285] Source: U.S. EPA, *Mercury Study—Report to Congress* (Washington, DC: U.S. EPA, 1997), available at http://www.epa.gov/ttn/oarpg/t3/reports/volume1.pdf; U.S. EPA, “Fact Sheet on Mercury,” 2001, available at www.**epa**.gov/ost/fishadvice/mercupd.pdf.
[286] Source: http://epa.gov/waterscience/presentations/fishslides/2003_files/frame.htm
[287] David R. Wooley, *A Guide to the Clean Air Act for the Renewable Energy Community* (Washington, DC: Renewable Energy Policy Project, 2000), pp. 7-14.
[288] Source: U.S. EPA, *Mercury Study—Report to Congress* (Washington, DC: U.S. EPA, 1997), available at http://www.epa.gov/ttn/oarpg/t3/reports/volume1.pdf.
[289] Rodney Sobin, “Energy Myth Seven: Renewable Energy Systems Could Never Meet Growing Electricity Demand in America,” In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007), pp. 171-199.
[290] Commission for Environmental Cooperation, *North American Power Plant Emissions*, 2004, available at http://www.cec.org/files/PDF/POLLUTANTS/PowerPlant_AirEmission_en.pdf.
[291] See Angela Ledford, “The Dirty Secret Behind Dirty Air,” Clean Air Taskforce Report, June, 2004, available at http://www.cleartheair.org/dirtypower/docs/dirtyAir.pdf.
[292] See Angela Ledford, “The Dirty Secret Behind Dirty Air,” Clean Air Taskforce Report, June, 2004, available at http://www.cleartheair.org/dirtypower/docs/dirtyAir.pdf.
[293] David R. Wooley, *A Guide to the Clean Air Act for the Renewable Energy Community* (Washington, DC: Renewable Energy Policy Project, 2000), pp. 7-14.
[294] U.S. EPA, “Particulate Matter: Health and Environment,” 2006, available at http://www.epa.gov/oar/particlepollution/health.html.
[295] Source: U.S. EPA, 2003.
[296] See Angela Ledford, “The Dirty Secret Behind Dirty Air,” Clean Air Taskforce Report, June, 2004, available at http://www.cleartheair.org/dirtypower/docs/dirtyAir.pdf.
[297] Rodney Sobin, “Energy Myth Seven: Renewable Energy Systems Could Never Meet Growing Electricity Demand in America,” In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007), pp. 171-199.
[298] IPCC, “Summary for Policymakers,” *Climate Change: 2007,* available at http://www.ipcc.ch/SPM6avr07.pdf.
[299] Eileen Claussen and Janet Peace, “Energy Myth Twelve—Climate Policy Will Bankrupt the U.S. Economy,” In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007), pp. 311-340..
[300] Marilyn A. Brown, “Ending the Energy Stalemate: Facts and Figures from the National Commission on Energy Policy,” Oak Ridge Center for Advanced Studies Seminar, June 30, 2005.

[301] Rodney Sobin, "Energy Myth Seven: Renewable Energy Systems Could Never Meet Growing Electricity Demand in America," In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007), pp. 171-199.
302 See Arjun Makhijani, Lois Chalmers, and Brice Smith, "Uranium Enrichment: Just Plain Facts to Fuel an Informed Debate on Nuclear Proliferation and Nuclear Power," *Report for the Institute for Energy and Environmental Research*, 2005, p. 6-7, available http://www.ieer.org/reports/uranium/enrichment.pdf,; USEC Incorporated, "What's a SWU," 2004, available at http://www.usec.com/v2001_02/HTML/Aboutusec_swu.asp. The calculation works like this: it takes approximately 55 kWh of electricity to enrich one separative work unit (SWU) of uranium; it also takes 100,000 SWU to produce 1,000 MW of electricity. Therefore, it means that 5,500 MWh are needed to generate 1,000 MW of electricity.
[303] Peter Asmus, "Nuclear Dinosaur," *The Washington Post*, July 6, 2005, p. A7, available at http://www.washingtonpost.com/wp-dyn/content/article/2005/07/05/AR2005070501291.html.
[304] Spider J, Langlois L and Hamilton B (2000), "Greenhouse gas emissions of electricity generation chains-assessing the difference", *IAEA Bulletin* 42, available at http://www.iaea.org/Publications/Magazines/Bulletin/Bull422/article4.pdf.
[305] Union of Concerned Scientists, *Clean Energy Blueprint*, 2001, available at *www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=44.*
[306] Modified from Malcolm Griston, available at http://www.publications.parliament.uk/pa/cm200506/cmselect/cmenvaud/584/584we67.gif.
[307] Neil Strachan and Hadi Dowlatabadi, "Distributed Generation and Distribution Utilities," *Energy Policy* 30 (2002), p. 660.
[308] Source: Daniel Yergin, "Ensuring Energy Security," *Foreign Affairs* 85(2) (2006), p. 78; U.S. Office of Civilian Radioactive Waste Management, "What are Spent-Nuclear Fuel Waste?" September, 2004, http://www.ocrwm.doe.gov/factsheets/doeymp0338.shtml; and U.S. Nuclear Regulatory Commission, "Regulating Nuclear Fuel," September, 2001, available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/brochures/br0280/br0280r1.pdf.
[309] Source: USGS, "National Oil and Gas Assessment," available at http://geology.usgs.gov/connections/blm/energy/o&g_assess.htm.
[310] Charles H. Peterson et al., "Ecological Consequences of Environmental Perturbations Associated With Offshore Hydrocarbon Production: A Perspective on the Long-Term Exposures in the Gulf of Mexico," *Canadian Journal of Fisheries and Aquaculture Science* 53 (1996), pp. 2637-2654.
[311] Truett, J.C. and Johnson, S.R., The Natural History of an Arctic Oil Field: Development and the Biota, Academic Press, New York, 2000; National Academies, Cumulative Effects of Oil and Gas Activities on Alaska's North Slope, National Academies Press, Washington, DC, 2003; Reynolds, J.F. and Tenhunen, J.D., Landscape Function and Disturbance in Arctic Tundra, Springer, New York, 1996.
[312] Rodney Sobin, "Energy Myth Seven: Renewable Energy Systems Could Never Meet Growing Electricity Demand in America," In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007), pp. 171-199.
[313] Source; U.S. EIA, "Coal Reserves," 2004, available at http://www.eia.doe.gov/cneaf/coal/reserves/chapter1.html
[314] Rodney Sobin, "Energy Myth Seven: Renewable Energy Systems Could Never Meet Growing Electricity Demand in America," In B.K. Sovacool and M.A. Brown (Eds.) *Energy and American Society—Thirteen Myths* (New York: Springer, 2007), pp. 171-199.
[315] Richard F. Bonskowski, "U.S. Metallurgical Coal and Coke Supplies—Prices, Availability, and the Emerging Futures Markets," 2002, available at http://www.eia.doe.gov/cneaf/coal.
[316] Brandon Ortiz, "Advocates Blame Industry for Accidents; Industry Points at the Public," *The Lexington Herald-Ledger*, Janaucy 16, 2005, p. A2.
[317] U.S. Energy Information Administration, "Why Do Natural Gas Prices Fluctuate So Much?" *Natural Gas 1998 Issues and Trends* (Washington, DC: U.S. DOE, 1998), available at http://www.eia.doe.gov/pub/oil_gas/naturalgas, p. 1.
[318] U.S. Energy Information Administration, U.S. Underground Natural Gas Storage Developments: 1998-2005 (Washington, DC: U.S. Department of Energy, 2006), available at http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2006/ngstorage/ngstorage.pdf.
[319] U.S. Energy Information Administration, U.S. Underground Natural Gas Storage Developments: 1998-2005 (Washington, DC: U.S. Department of Energy, 2006), available at http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2006/ngstorage/ngstorage.pdf.
[320] Marcello J. Lippman and Sally M. Benson, "Relevance of Underground Natural Gas Storage to Geologic Sequestration of Carbon Dioxide," Lawrence Berkeley National Laboratory Report, 2004, available at http://www.osti.gov/bridge/servlets/purl/813565-MVm7Ve/native/813565.pdf.
[321] Marcello J. Lippman and Sally M. Benson, "Relevance of Underground Natural Gas Storage to Geologic Sequestration of Carbon Dioxide," Lawrence Berkeley National Laboratory Report, 2004, available at http://www.osti.gov/bridge/servlets/purl/813565-MVm7Ve/native/813565.pdf.
[322] Susan E. Nissen et al, *Geologic Factors Controlling Natural Gas Distribution Related to the January 2001 Gas Explosions in Hutchinson, Kansas*, 2001, available at http://www.kgs.ku.edu/PRS/publication/2004/AAPG/NG_Migration/P1-02.html
[323] U.S. Energy Information Administration, *Ungerground Natural Gas Storage Developments, 1998-2005* (Washington, DC: DOE, 2006), available at www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2006/ngstorage/ngstorage.pdf.

[324] B.K. Sovacool, "Think Again: Nuclear Energy," *Foreign Policy* 150 (September, 2005), available at http://www.foreignpolicy.com/users/login.php?story_id=3250&URL=http://www.foreignpolicy.com.
[325] Sovacool, Think Again: Nuclear Power, 2005. (should be previously cited).
[326] Source: U.S. Nuclear Regulatory Commission, 2007, http://www.nrc.gov/waste/spent-fuel-storage/locations.html.
[327] Christopher Flavin, Janet L. Sawin, John Podesta, Ana Unruh Cohen, and Bracken Hendricks, *American Energy: The Renewable Path to Energy Security* (Washington, DC: Worldwatch Institute & the Center for American Progress, September, 2006).
[328] Source: Wind and coal estimates come from Mark Diesendorf, "Refuting Fallacies About Wind power," University of New South Wales, August 27, 2006, available at http://www.ceem.unsw.edu.au/content/userDocs/RefutingWindpowerFallacies.pdf; PV and solar thermal estimates come from National Renewable Energy Laboratory, "Renewable Energy and Land Use," February, 2004, available at http://www.nrel.gov/docs/fy04osti/35097.pdf.
[329] American Wind Energy Association, "Wind Web Tutorial," 2007, available at http://www.awea.org/faq/wwt_environment.html#How%20much%20land%20is%20needed%20for%20a%20utility-scale%20wind%20plant.
[330] Mike Roth, "Could wind power replace MTR coal?" Alternatives (2006), available at http://www.appvoices.org/index.php?/site/voice_stories/could_wind_power_replace_mtr_coal/issue/518
[331] National Renewable Energy Laboratory, "PV FAQs," February, 2004, available at http://www.nrel.gov/docs/fy04osti/35097.pdf.
[332] Scott Anders, *Technical Potential for Rooftop Photovoltaics in the San Diego Region* (Energy Policy Initiatives Center, 2003), available at http://www.sandiego.edu/epic/publications/documents/060309_ASESPVPotentialPaperFINAL.pdf.

7. Industry: A National RPS Supports a Domestic Materials and Manufacturing Sector

A. Wind Turbines

Three primary components constitute the bulk of a wind turbine's cost and weight: fiberglass for its blades, and steel and cement for its tower. Industry projections for each of these components look exceptionally positive, suggesting lower prices for future projects.

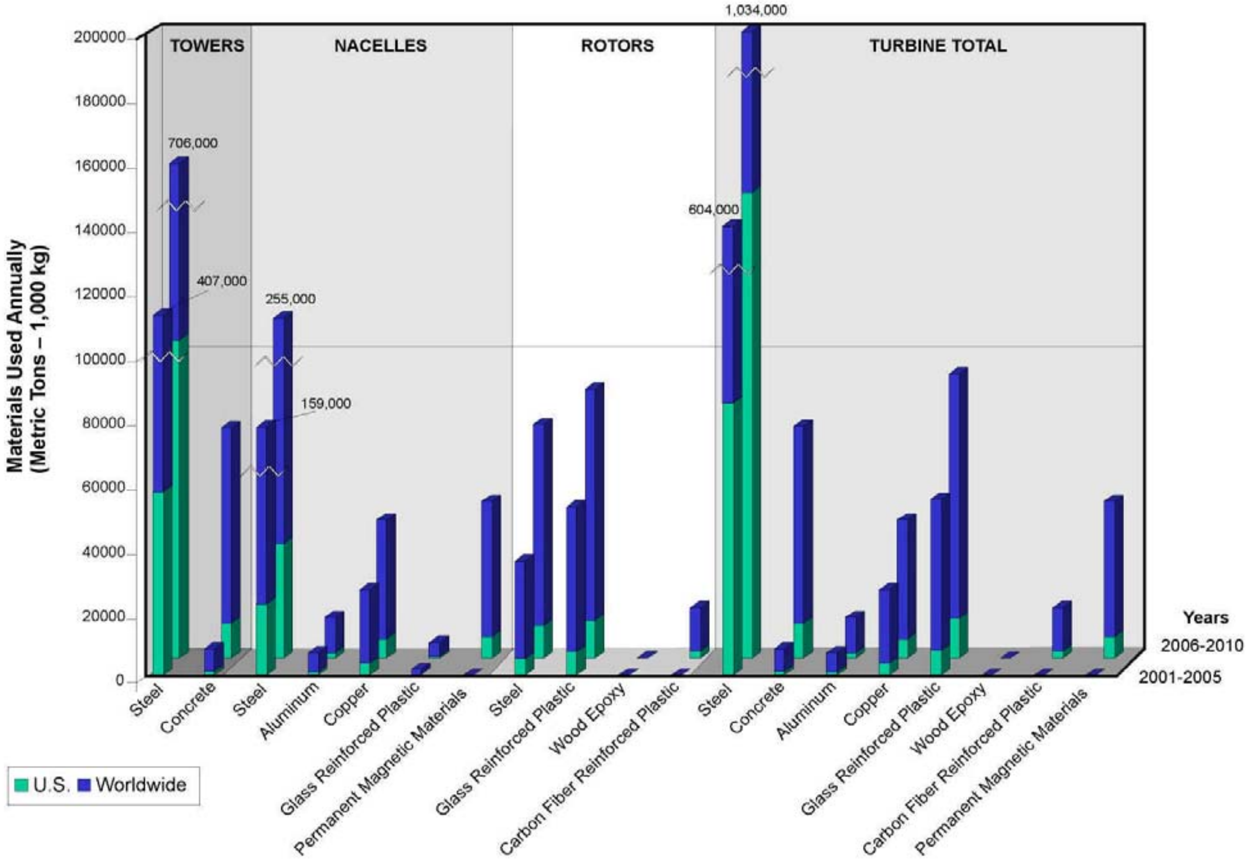
Around 81 percent of wind turbines currently in operation utilize fiberglass blades (the first models tended to use wood epoxy). Fiberglass blades are the only wind turbine component designed and manufactured uniquely for wind energy applications. The U.S. composites and reinforced plastics industry shipped a record volume of 4.5 billion pounds of finished composites products to domestic customers in 2006. To put this figure in perspective, while U.S. consumption of steel has doubled since 1960 and use of aluminum has almost quadrupled, composites shipments have multiplied 18 fold—and industry representatives says they could easily expand much more. The American Composites Manufacturing Association (ACMA) projects that composite manufacturers would be able to provide enough fiberglass at competitive prices in the next three years to power 100,000 MW of wind energy (or 6 percent of the country's *entire* electricity supply).[333]

The availability of steel and concrete looks just as positive. The global steel industry outperformed all other basic-material sectors in 2006, achieving a total shareholder return of 37 percent. Such sustained profits are helping to stabilize steel prices and is encouraging significant investment in the industry, which is expected to grow 4 percent every year reaching a production level of 1.7 billion tons by 2015.[334] Industry consolidation, as well as growing demand in India and China, has made producers much more "cost efficient and sensitive to changes in global consumption patterns."[335]

The global concrete industry—an $8.6 billion industry in the United States—continues to operate in an environment of similar guaranteed profits, as at least one segment of the construction industry is always in demand for their products.[336] Cement companies have announced plans to invest more than $3.6 billion dollars to expand domestic capacity totaling more than 11 million tons between now and 2010—enough to keep prices low even with the added demand of wind turbine installations.[337]

The DOE projects the costs for all other components of wind turbines to remain stable or even decline, especially as greater bulk purchases drive costs down.[338]

Figure 7.1: Wind Turbine Materials Usage, 2002-2010



Source: Department of Energy, Office of Industrial Technologies, 2002

One DOE report noted that "low cost of materials and reliability" will continue to be the "primary drivers" fueling expansion of wind energy.[339]

Costs will continue to decline as developers diversify some of the materials used to make wind turbines. New manufacturing techniques, such as resin infusion and vacuum bagging, as well as material innovations (such as carbon and glass epoxies, improved resin systems, and better exploitation of traditional fiberglass reinforcement with engineered fabrics) have enabled turbine manufacturers to optimize weight in modern turbine designs.[340] The next generation of turbines will have longer, thinner, and more durable blades.[341]

In 2004, the Renewable Energy Policy Project (REPP) found that demand for wind turbine materials and components would allow more than 16,000 companies (with approximately 1 million employees) to enter the turbine manufacturing market.

Table 7.1: Manufacturing Firms with the Technical Potential to Enter the U.S. Wind Turbine Market[342]

NAICS code	Code Description	Total Employees	Annual Payroll ($1000s)	Number of Companies
326199	All other Plastics Products	501,009	15,219,355	8,174
331511	Iron Foundries	75,053	3,099,509	747
332312	Fabricated Structural Metal	106,161	3,975,751	3,033
332991	Ball and Roller Bearings	33,416	1,353,832	198
333412	Industrial and Commercial fans and blowers	11,854	411,979	177
333611	Turbines, and Turbine Generators, and Turbine Generator Sets	17,721	1,080,891	110
333612	Speed Changer, Industrial	13,991	539,514	248
333613	Power Transmission Equip.	21,103	779,730	292
334418	Printed circuits and electronics assemblies	105,810	4,005,786	716
334519	Measuring and Controlling Devices	34,499	1,638,072	830
335312	Motors and Generators	62,164	2,005,414	659
335999	Electronic Equipment and Components, NEC	42,546	1,780,246	979
Total		**1,025,327**	**35,890,079**	**16,163**

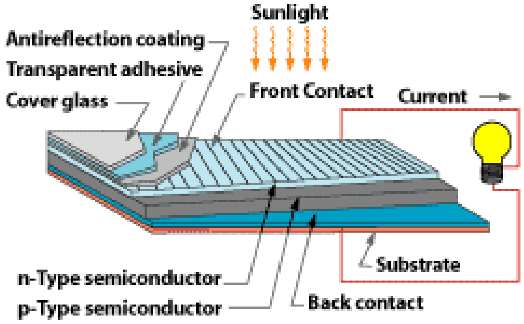
Source: Renewable Energy Policy Project (REPP), 2004

The REPP report concluded that sustained demand for wind turbine materials and components would encourage these sectors to invest more around $50 billion in 50,000 MW of wind capacity should demand for wind turbines required it. [343]

B. Solar Photovoltaics

A typical, solar photovoltaic (PV) panel consists of five "layers" of materials: a glass or plastic cover, a plastic anti-reflective layer made of plastic, a front contact to allow electrons to enter a circuit, the semiconductor layers that directly convert sunlight into electricity, and a back contact to allow electrons to complete the circuit.

Figure 7.2: Typical Silicone/Thin Crystalline Photovoltaic (PV) Cell



Source: Department of Energy, 2007

Most solar cells are manufactured using crystalline silicon as the primary raw material (the same material used to produce integrated circuits for computers). More than 90 percent of PV manufacturers use traditional mono- or polycrystalline silicon wafers in their modules (which represent the bulk of the total cost of the solar cell).[344]

While the industry experienced a shortage of silicon for PV production a few years ago (the price for silicone doubled from $30 per kilogram in 2003 to $60 per kilogram in 2005), the crisis helped spur rapid investment in PV manufacturing.

Most companies now have extensive stockpiles of silicon needed to guarantee PV production, and many have signed fixed-price contracts guaranteeing a supply of silicon.[345]

The CFO of one large international PV manufacturer recently boasted that, "at this time we have 100 percent of our silicon wafer supply contractually secured."[346] The sale of Shell Solar's crystalline solar business to SolarWorld in 2006 is expected to secure even more access to silicon and promote more efficient production processes with higher yields.[347]

Since the high demand for PV modules has enabled manufactures to pre-pay for supply, many silicon companies have massively expanded their production processes: Tokuyama is building a 200-ton half commercial vapor to liquid distillation pilot plant in Japan. Wacker already has a 100-ton fluidized bed reactor pilot plant in Germany. The company REC is looking to build a 200-ton pilot plant in Moses Lake, WA. These expansions ensure that an additional silicon production capacity of 5,900 tons per year dedicated exclusively for PV arrays will come online in 2008.[348]

Annual revenues for the solar industry are expected to increase more than fourfold from $20 billion 2006 to $90 billion in 2010. At the same time, production costs are projected to fall dramatically.[349] In April, 2007, the managing director of Australia's largest PV manufacturer, noted that the industry was seeing "incremental changes in innovation which are pushing down costs and helping the sector's expansion." He concluded that falling costs will make the solar power industry increasingly competitive.[350]

C. A National RPS Improves Manufacturing Efficiency

Because the U.S. does not currently have a national RPS, it also lacks a relatively robust manufacturing base for most renewable energy technologies. Renewable energy developers in the U.S. largely rely on European or other overseas manufacturers for the requisite materials (and sometimes expertise and labor) to install renewable energy systems. This reliance on foreign materials and labor increases construction lead-times as well as shipping costs. It also increases the likelihood of unexpected delays and shortages.

The fragmented nature of state-based RPS policies actually compounds this problem by creating artificial bottlenecks in the distribution of materials necessary to deploy renewable energy systems. New state mandates can create unexpected surges in demand for renewable energy projects, driving up the price of components and labor. Roger Garratt, Director of Resource

Acquisition for Puget Sound Energy, recently remarked that the quick and somewhat unanticipated passage of Washington's initiative-driven RPS mandate "created a seller's market caused by increasing competition for projects and a shortage of turbine supplies" among wind manufacturers.[351]

A national RPS would instigate market-based solutions to unexpected material bottlenecks in at least three ways:

First, by providing a stable investment stream and a predictable regulatory environment, investors would have a greater incentive to establish domestic manufacturing facilities and to rely on local materials and labor.

Second, under a national RPS, American developers would no longer suffer unfavorable exchange rates (given the recent weakening of the dollar) when purchasing materials. One wind company (Nordex) even estimated that changes in the exchange rate between Euros and dollars alone cost some American developers as much as $152,000 per project.[352]

Third, given the certainty of a national market for renewable energy, investors would likely develop better economies of scale in manufacturing in order to ensure that a sufficient number of materials would exist to satisfy the resulting demand for renewable energy projects.

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[333] Ray MacNeil, "The U.S. Composites Outlook 2007 & Beyond," CM Magazine (2007), available at http://www.acmanet.org/CM/0107/feature_a0107.cfm.
[334] PR Newswire, "Further Growth and Consolidation Predicted in Global Steel," February 20, 2007, p. 20.
[335] Shikha Mishra, "Steel: Sleek Yet Strong," Global News Wire, June 28, 2006.
[336] Portland Cement Association, "Overview of the Cement Industry," 2007, available at http://www.cement.org/basics/cementindustry.asp
[337] Dave Fentress, "A Concrete Look at the Construction Industry," *Northwest Construction* 9(5) (May 1, 2006), pp. 21-23.
[338] Office of Industrial Technologies, U.S. Department of Energy, Wind Turbine—Materials and Manufacturing (Washington, DC: DOE, 2002).
[339] Office of Industrial Technologies, U.S. Department of Energy, Wind Turbine—Materials and Manufacturing (Washington, DC: DOE, 2002).
[340] Luc Peters, ""New Structural Materials for Wind Turbine Blades," Power Engineering¸ January, 2007, available at http://pepei.pennnet.com/display_article/282536/6/ARTCL/none/none/New-Structural-Materials-for-Wind-Turbine-Blades/.
[341] Sandia National Laboratory, "Wind Turbine Blades," 2006, available at http://www.sandia.gov/wind/Blades.htm.
[342] George Sterzinger and Matt Svrcek, *Wind Turbine Development: Location of Manufacturing Activity* (Washington, DC: Renewable Energy Policy Project, September, 2004), available at http://www.crest.org/articles/static/1/binaries/WindLocator.pdf.
[343] George Sterzinger and Matt Svrcek, *Wind Turbine Development: Location of Manufacturing Activity* (Washington, DC: Renewable Energy Policy Project, September, 2004), available at http://www.crest.org/articles/static/1/binaries/WindLocator.pdf.
[344] Jesse W. Pichel and Ming Yang, Solar Year-End Review and 2006 Solar Industry Forecast (Piper Jaffray & Company, January 11, 2006), available at http://www.renewableenergyaccess.com/rea/news/story?id=41508.
[345] Jesse W. Pichel and Ming Yang, "2006 Solar Industry Forecast," January 11, 2006, available at http://www.renewableenergyaccess.com/rea/news/story?id=41508.
[346] Ann Steffora Mutschler, "JA Solar Gives Sunny Outlook," March 30, 2007, available at http://www.edn.com/article/CA6429568.html.
[347] Catherine Lacoursiere, "Silicone Shortage Drives Global Solar Mergers and Acquisitions," February 23, 2006, available at http://www.renewableenergyaccess.com/rea/news/story?id=43983.
[348] Jesse W. Pichel and Ming Yang, "2006 Solar Industry Forecast," January 11, 2006, available at http://www.renewableenergyaccess.com/rea/news/story?id=41508.
[349] Peter Marsh, "Sunny Outlook for Solar Power Players," April 5, 2007, available at http://www.theaustralian.news.com.au/story/0,20867,21506195-36375,00.html
[350] Peter Marsh, "Sunny Outlook for Solar Power Players," April 5, 2007, available at http://www.theaustralian.news.com.au/story/0,20867,21506195-36375,00.html

[351] Roger Garratt, "Utility Resource Acquisition in an RPS Environment," *Presentation at the EUCI 3rd Annual RPS Conference*, April 23, 2007, p. 15.
[352] Nordex, "Wind Energy Investment Patterns," 2005, available at http://www.nordexonline.com/fileadmin/MEDIA/Geschaeftsberichte/Nordex_02_3_Q1_E.pdf

8. Design: Federal Statute Based on State Experience

In his evaluation of state RPS policies, LBNL analyst Ryan Wiser found that the design of a mandate was critical to its effectiveness. An RPS mandate can be poorly designed and ineffective or elegant and cost effective.[353] Design also plays a "critical consideration" in whether RPS mandates truly promote renewable energy or simply provide economic incentives for renewable energy that would have been developed regardless.[354]

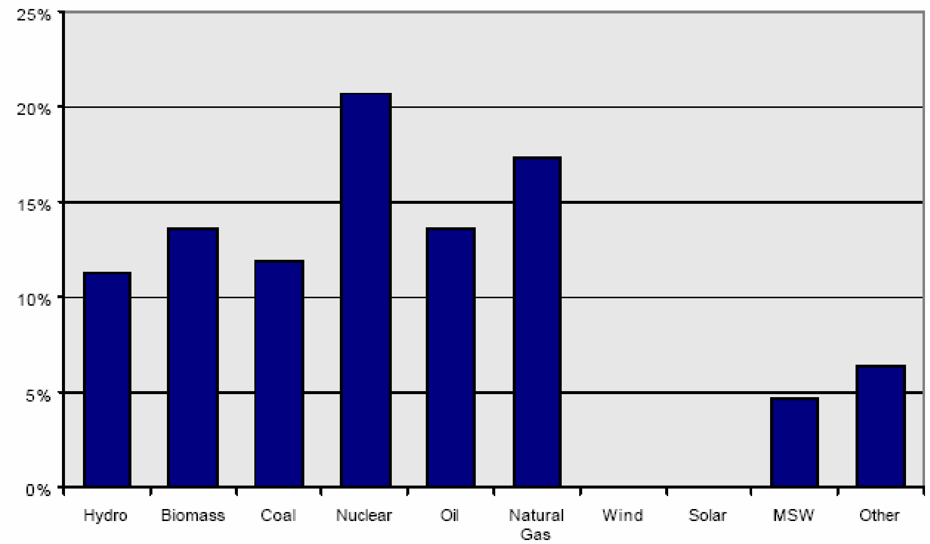
We have noted how vague definitions of regulated utilities have provoked prolonged legal battles in some states. In others, overly broad definitions of eligible resources have resulted in programs that "have largely supported or will support existing (not new) renewable generation."[355] In crafting a federal RPS mandate, eight lessons can be learned from the experience of several states over the past two decades.

Lesson 1: The RPS target must be large enough to create economies of scale, but phased in gradually to protect utilities.

To bring the benefits of renewable energy to most consumers, a national RPS must set a target large enough to achieve economies of scale in manufacturing. Economic models have found significant benefits from a 20 percent by 2020 mandate, for example.

If the target is not set large enough, it may fail to promote renewable energy technologies at all. The clearest example of a state RPS that has failed to produce new renewable energy is Maine. The Maine legislature passed an RPS that took effect in March, 2000, setting an immediate and seemingly large target of 30 (and including large hydroelectric facilities as an eligible resource). However, existing hydroelectric, biomass, and landfill gas generators in the state were already exceeding the standard.[356]

Figure 8.1: Electricity Generators Serving Customers in Maine, by Fuel Source (2002)



Source: Maine Public Utilities Commission, 2004

NREL analysts concluded that Maine's RPS, "has failed to lead to any new renewable resources, and has failed to generate significant revenues above commodity electricity market prices."[357] Even the Maine Public Utilities Commission admitted that "the experience to date, however, reveals that the current portfolio requirement is not satisfying the Restructuring Act's stated policy of encouraging the promotion of new renewable energy resources."[358]

In contrast, Nevada's RPS set the target level *above* the state's existing level of renewable generation, creating an incentive for utilities to expand their deployment of renewable technologies. The state passed one of the more aggressive RPS statutes in 2001, requiring that load serving entities provide 5 percent of their electricity from renewable resources in 2003, but increase renewable generation to15 percent by 2013. Sierra Pacific and Nevada Power held their first solicitation for renewable energy in late 2001 and received 49 bids at very competitive prices for 4,300 MW of eligible power (including 3,000 MW of wind, 385 MW of solar, and 784 MW of geothermal). By making its targets large enough, the statute successfully promoted new renewable energy development. Most recently, for instance, Nevada Power signed a 17 year power purchase agreement to build an 85.5 MW wind site to contribute renewable energy toward its state RPS mandate.[359]

Figure 8.2: Wind Turbines Contracted to Meet Nevada's RPS

Source: Florida Power & Light, 2006

Another key feature of successful state RPS statutes is that they set gradual benchmarks towards reaching the final target. Gradual yet specific benchmarks—such as 6 percent by 2008; 7 percent by 2009; 9 percent by 2012; 14 percent by 2015; 17 percent by 2018; 20 percent by 2020; 23 percent by 2023; and 25 percent by 2025— give transmission and system operators time to adjust and implement programs to ensure system reliability.

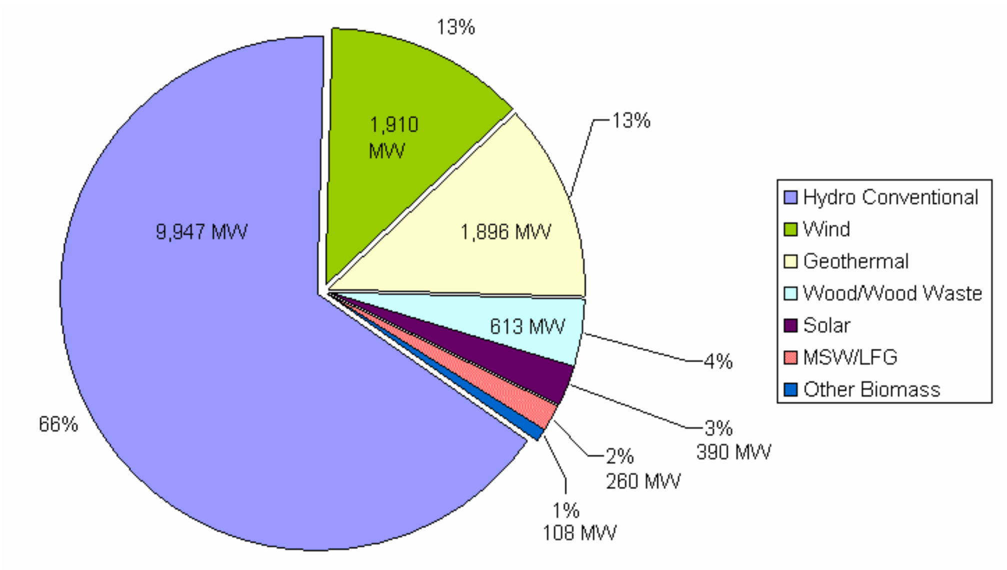
The initial target size should also be set at slightly below the level of existing capacity for the first year, giving suppliers time to arrange contracts. For example, if a national standard were to include hydroelectric facilities, it could set the standard at 6 percent for 2008, since the country already provides slightly more than 6 percent of its capacity using renewable energy which includes hydroelectric. RPS targets that step-up deployment percentages gradually would give power providers time to inventory their resources and adjust their system management.

Furthermore, by increasing the amount of renewable energy slowly over time, the standard ensures that the renewable energy market will result in competition, efficiency and innovation that will deliver renewable energy at the lowest possible cost. A gradual phase-in provides time to set up standards for credit certification, monitoring, and compliance. It creates relative certainty and stability in the renewables market by enabling long term contracts and financing for the renewable power industry, in turn lowering costs. And it gives utilities and generation companies an incentive to drive down the cost of renewables to reduce their RPS compliance costs.[360]

California provides an excellent example of how a gradual-phase in makes an RPS more effective. When California implemented their RPS in 2002, they required investor-owned utilities, energy service providers, and community choice aggregators to meet 20 percent of their electricity load with renewable resources by 2017. But to reach the target, the California RPS also obligated each utility to increase the percentage of its load with renewable energy by 1 percent each year.

The gradual phase-in clearly worked. The state's three major investor-owned utilities have increased their purchase of renewable energy from 19,190 GWh in 2002 to 23,110 GWh in 2005. From 2002 to 2005, Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric have each increased the percentage of their load served by renewable energy by approximately 1 percent, 1.5 percent, and 4.5 percent (respectively). In 2003, the state boasted more than 1,900 MW of wind and 600 MW of biomass, largely induced by phase-in targets set to meet the state's aggressive RPS goal.

Figure 8.3: California Renewable Energy Capacity by Source, 2003



Source: U.S. Energy Information Administration, 2005

In total, approximately 1,452 to 2,789 MW of new renewable energy capacity are already approved or awaiting approval, with more to come.[361]

Lesson 2: Definitions of eligible renewable resources must be clear, consistent, and comprehensive

A national RPS should include all renewable resources and discriminate against none. The definition of eligible renewable resources could be based on the renewable aspects of the fuels used rather than any particular technologies deployed. For instance, eligible resources could be defined as:

> Any electrical generator that creates electricity from sunlight, wind, falling water, renewable plant or animal material, and/or natural geothermal sources.

A fuel-based definition does not rely on policymakers to determine the forms of technology that should receive market preference and does not require policymakers to continuously revise the mandate to include new technology that may be developed.

By including both new and existing generators as eligible resources, a national RPS would avoid bitter debates concerning whether certain “upgrades” to existing systems make them “new,” as with the feud over New Source Review under the Clean Air Act. Gradual benchmarks ensure that new renewable generation is developed without having to distinguish between “existing” and “new” renewable energy systems. Avoiding this debate reduces administrative complexity and frees generators from continuously monitoring regulatory rulings to determine whether a particular expenditure will be considered maintenance and refurbishment of an existing facility or a new investment that qualifies toward the RPS mandate.

A fuel-based definition of eligible resources would include large hydroelectric facilities. The construction of new hydroelectric facilities and incremental improvements to existing ones could help utilities to use renewable resources to provide base-load power. Including incremental hydropower also allows areas like the Southeast and the Pacific Northwest to benefit from their regions' substantial sources of existing clean energy.

And, finally, a fuel-based definition of eligible resources would ensure that truly renewable resources attain a greater proportion of the nation's electricity fuel portfolio. While alternative technologies such as non-renewable distributed generation, clean coal with carbon capture and storage, and energy efficiency should be encouraged, there are strong market-based reasons that they should not be directly included in an RPS. Such sources would neither diversify energy resources nor achieve the economic benefits of a vibrant renewable energy sector. Renewables should compete with other renewables, just as clean coal should compete with dirty coal and light water reactors with advanced nuclear generators. Healthy market-based competition ensures that the best mechanisms for utilizing each fuel source are supported.

Lesson 3: A national RPS should apply to electricity demand, not installed capacity

Rather than mandate a fixed amount of renewable capacity, a national RPS should require utilities to meet a percentage of electricity demand through renewable resources. A demand-based mandate ensures that suppliers are concerned more with the actual delivery of electricity than the construction of renewable energy systems that may never produce a watt of energy actually sent to consumers.

Setting the RPS as a function of electricity demand also provides utilities with an incentive to pursue cost effective demand-side management and energy efficiency strategies as a way of reducing electricity demand and, therefore, the total compliance level. For instance, if a utility had to meet 20 percent of its electricity sales with eligible renewable resources and worried that it could not affordably generate enough renewable electricity or purchase enough credits, it could first pursue aggressive energy efficiency and demand-side management strategies in an effort to lower sales and reduce the total amount of renewable generation needed to comply with the standard. A demand-based RPS is an elegant way of including energy conservation in the mandate while adding a level of flexibility in meeting RPS targets.

Lesson 4: A national RPS should apply equally to all retail power providers

Some state-based RPS statutes initially excluded some power providers in an attempt to protect certain types of utilities. In practice, the attempt to carve out exemptions through imprecise statutory language created confusion and uncertainty for regulated entities. In Connecticut, for example, the state's RPS exempted default service providers, creating speculation among all of the state's regulated utilities that the law would not be enforced at all.[362] And in Washington, utilities with no load growth are exempted from the state's RPS mandate, if parts of the state experience decreased population growth or diminished electricity demand, load serving entities would be absolved from their regulatory burden entirely.[363]

Applying the standard to *all* retail power providers—including investor owned utilities, publicly owned utilities, municipalities, and rural electric cooperatives—creates an equal playing field and avoids creating inconsistencies in regulation. Requiring all retail providers to meet the mandate reduces opportunities for "free riders" within the electricity sector. Regulated utilities, which pay to clean the air and conserve the water, would not be required to subsidize the generation of dirty, low-cost non-renewable electricity from exempt generators.

A standard applying to all providers also creates better economies of scale and ultimately helps drive down the cost of renewable generation for all suppliers. By applying the mandate uniformly and without exemption, a national RPS avoids the kind of regulatory unpredictability that initially plagued Connecticut's program.

Lesson 5: A national RPS must establish uniform rules for trading renewable energy credits (RECs)

Absent a REC trading scheme, verifying the compliance of a national RPS would require tracking all renewable energy transactions within an entire trading region, an enormously complicated (perhaps impossible) task. Moreover, REC tracking would not follow the actual delivery of power, since "most states share electricity generation and transmission infrastructure, and cannot ensure that all of the renewable electricity they use will be generated in state."[364]

A national REC trading market would provide utilities immense flexibility in meeting the standard. To comply with the federal mandate, utilities could either generate their own renewable electricity, purchase unbundled credits from renewable generators anywhere in the nation, or import electricity bundled with renewable credits from wherever it is practicable.

Utilities located in areas with poor renewable resources would not be punished because they have the ability to invest in energy generation in resource-rich areas. A robust REC trading market also allows credits derived from intermittent technologies such as wind and solar to be sold at any time, regardless of when the power was generated.[365]

Massachusetts provides an excellent example of how a vibrant REC trading mechanism is instrumental to the success of an RPS. In 2004, Massachusetts utilities obligated to meet the state RPS could only generate 486,000 MWh from qualified renewable resources. 65 percent of the standard was met by landfill gas generation; 35 percent from biomass; 4 percent from anaerobic digestion; and around 1 percent from wind. Unexpected delays in the Cape Wind project in Nantucket Sound, revisions to the state's definition of eligible biomass, and uncertainty over the federal production tax credit all unexpectedly hindered renewable energy development and created an unanticipated shortfall in renewable generation.

Figure 8.4: Greenpeace Activists Build Public Support for the Cape Wind Project near Nantucket Sound, Massachusetts, 2002

Source: Greenpeace, 2005

Rather than scrap the mandate or force utilities to pay hefty non-compliance fees, the Massachusetts statute permitted power providers to import RECs (265,000 MWh of them in 2004) to meet their compliance obligations. By allowing utilities to trade RECs, the state RPS ensured that the standard was met and that utilities invested in new clean electricity generation that benefits Massachusetts and the nation. The shortfall also signaled to investors the strong market for renewable generation and encouraged rapid development of in-state renewable resources to offset future shortfalls.[366]

Lesson 6: A national RPS should have flexible compliance rules, but aggressive penalties for non-compliance

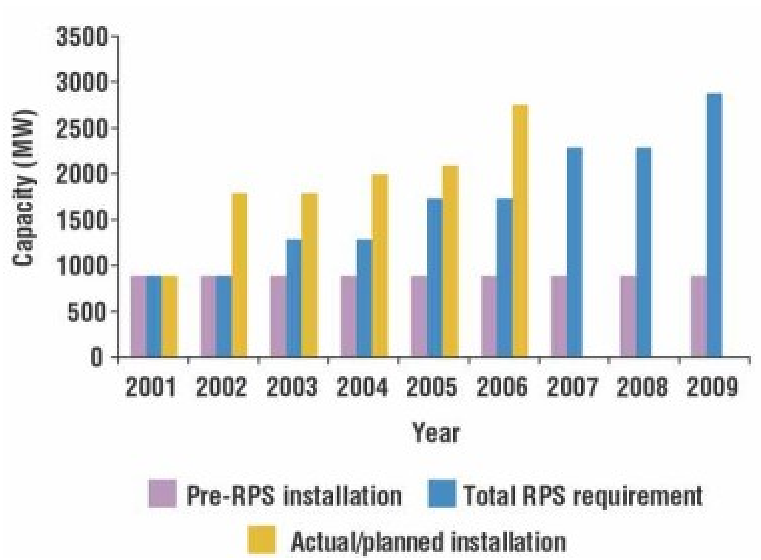
To deter utilities wishing to escape RPS obligations, any national standard must have penalties for noncompliance equal to several times the market price of renewable energy credits. A noncompliance penalty is needed not just to achieve more renewable generation, but also to reduce aggregate compliance costs. This is because, in part, investors will base their renewable energy commitments on the certainty that a market will exist for their product. Automatic penalties imposed for each required tradable credit that retails fail to produce will give investors confidence that there will be potential buyers for renewable electricity and unbundled RECs.[367]

Failure to create strict noncompliance penalties runs the risk of creating a "Catch-22" situation where utilities make an insincere effort to obtain renewables from potential suppliers, and then—when no renewables get built—claim that none are available. Policymakers could then view the utility's noncompliance as being in good faith, since there were no renewable energy technologies available for purchase, rather than seeing the situation as proof that the utility never intended to comply.[368]

An aggressive non-compliance penalty becomes self-enforcing and avoids the need to resort to costly administrative and investigative measures. Such a program could be modeled after the federal SO_2 allowance trading program, under which an automatic $2,000/ton penalty (indexed to inflation) is imposed for each excess ton of SO_2 produced.[369] It could also be based on the Environmental Protection Agency's National Ambient Air Quality standards, which require 22 states and the District of Columbia to reduce NO_x emissions significantly by 2007[370]

Texas provides one of the best examples of the success of setting high non-compliance penalties. In 1999, the Texas government required utilities to install 2,000 MW of new renewable capacity by 2009. The standard was exceeded in 2001, with 915 MW of wind installed in that year alone (See Figure X). [371]

Figure 8.5: Texas RPS Targets and Actual Installations (2005 data)



Source: Sloan, 2005

What made the state RPS so successful? An in-state REC trading scheme was established to help track and account for renewable energy capacity, and coupled with strict enforcement penalties. Utilities failing to meet the standard had to pay the lesser of 5 cents per kWh or 200 percent price of average REC prices for each missing kWh. Because non-compliance penalties were set high above cost for installing new renewable energy technologies, not a single utility failed to comply.[372]

Flexibility in compliance rules also helps reduce non-compliance. In September, 2006, for example, California accelerated its RPS from 20 percent by 2017 to 20 percent by 2010, effectively adopting the most ambitious RPS mandate in the nation. However, to help regulated utilities meet such an aggressive RPS target, the legislature adopted rules giving any utility the option of deferring up to 25 percent of its compliance obligation in any single year for up to three years. This rule effectively granted each regulated utility the ability to set its own compliance schedule without substantially altering the regulated RPS target.

California's regulated utilities responded favorably to the change. Hal LaFlash, Director of Renewable Energy Policy and Planning for Pacific Gas & Electric (PG&E), recently told industry analysts that the increased flexibility recognized market realities and "will facilitate construction leadtimes and reduce boom-bust cycles." [373]

Lesson 7: A national RPS should set only a floor, allowing the states to be more aggressive

Setting a "floor" rather than a "ceiling" ensures that more aggressive state statutes are not precluded or restricted under a federal standard. In essence, then, a national RPS would set a minimum that only prohibits states (or in this case, utilities that operate within and between states) from deploying less renewable energy than a national standard, not more. The states should be free to exceed the federal standard as much as they wish. This type of compliance with state programs is often called "dual compliance" or "simultaneous compliance." The national standard would only guarantee the promotion of a minimum level of renewable energy deployment.

Such language should be clear and explicit in any national legislation, so as to provide the maximum amount of clarity and predictability to utilities and investors, and to avoid leaving the question open to political attacks during Congressional deliberations. Congress did something similar with the Clean Air Act of 1965, which allowed California to establish vehicle air pollution emission standards. All other states were given the opportunity to adopt California's standards or remain subject to the federal standards developed by the Environmental Protection Agency.[374] Such flexibility ensured that the states could continue to innovate while also mandating that all states moved forward in promoting cleaner air.

Lesson 8: A national RPS should be simple, and set no further regulatory interventions

Many advocates of both state and national RPS proposals have argued (sometimes fiercely) in favor of adding even more complexity into such statutes. Some have argued for price ceilings on electricity rates to give utilities a possible safety valve; others have argued for mid-course reviews of RPS statutes to make sure that they are working; still others have argued for credit multipliers (also called tiers or carve outs) for particular resources (such as solar), geographic restrictions, and limits on the capacity and size of eligible resources.

While some of these ideas have merit, the burden is on those in favor further market interventions to justify them. Further regulations may unnecessarily complicate RPS statutes and inhibit the efficiency of a national RPS program. As researchers from the Lawrence Berkeley National Laboratory recently concluded:

> A well-designed RPS should generally encourage competition among renewable developers and provide incentives to electricity suppliers to meet their renewable purchase obligations in a least-cost fashion.[375]

Two of the fundamental elements of an RPS—competition and least cost—are violated by creating carve outs, multipliers, geographic restrictions, or limits on capacity and size. In principle, competition and cost effectiveness is best served by letting the marketplace dictate when and where renewable technologies are deployed. In practice, such interventions have weakened the effectiveness of some state RPS proposals.

In Colorado, regulators unintentionally created a "catch-22" situation for renewable energy developers by inserting a "safety valve" into the state's RPS that limited electricity rates should renewable energy end up costing more than expectations, In designing the "safety valve", regulators pegged the rate cap to the avoided cost of natural gas generation by stipulating that:

> For each qualifying utility, the commission shall establish a maximum retail rate impact for this section of one percent of the total electric bill annually for each customer. The retail rate impact shall be determined net of new nonrenewable alternative sources of electricity supply reasonably available at the time of the determination.[376]

In other words, the regulations limited the difference in the cost of renewable electricity relative to the cost of the same amount of electricity if it had been generated using natural gas. The problem is (as we fully explain in Section 2), the more renewable energy is deployed, the more it depresses the cost of natural gas. As renewable resources reach certain levels in the market, they offset natural gas consumption and decrease gas prices.

By pegging the rate cap of renewable technologies to the cost of natural gas, Colorado's regulators have created a vicious cycle where renewable energy technologies can never reach sufficient levels: the more they effectively lower natural gas prices, the more they are penalized by the rate cap.[377] In essence, Colorado regulators may have inadvertently undermined the state's RPS by intervening in the normal operation of the electricity supply market in order to "correct" a previous intervention.

As a second example, consider Arizona, which created a "carve out" for solar photovoltaic technologies by mandating that at least 50 percent of the state's RPS must be met by solar technologies. To meet the non-solar part of the RPS, utilities bought approximately 10 MW landfill gas and several additional MW of biomass energy. However, utilities have been unable to fully comply with the solar mandate because of the sizeable financial commitment needed to purchase more expensive solar technology.[378]

Arizona has created even more incentives for the solar market by offering $4 per watt of utility-scale installed photovoltaics. However, utilities pass the higher cost of solar onto ratepayers. Tucson Electric Power is scheduled to complete a 64 MW thermal solar plant in Boulder City, Arizona, by the end of 2007, costing ratepayers an estimated $106 million,[379] even though solar photovoltaic is still by far the most expensive renewable energy technology in the state (See Table 1).[380]

Table 8.1: Delivered Average cost of Renewable Energy in Arizona (in 2004 dollars)

Renewable Resource	Cost per Installed kW	Cost per Delivered kW
Solar	15 to 30 cents/kW	45 to 90 cents/kWh
Wind	4 to 5 cents/kW	16 to 20 cents/kWh
Biomass	6.5 to 10 cents/kW	6.5 to 10 cents/kWh
Geothermal	5 to 7 cents/kW	5 to 7 cents/kWh

Source: TSS Consultants, 2004

Allowing the market to dictate deployment does not mean utilities will not invest in solar and other more expensive renewable energy technologies. It does, however, mean that utilities will not invest in them first. Instead, power providers will maximize all of their least-cost options before moving to more expensive technologies. The Renewable Energy Policy Project put it this way:

> The RPS will tend to support those renewables that are cheapest at the margin. In California's case, wind power would likely benefit the most, with geothermal and biomass also benefiting as the size of the requirement increases. Distributed renewable generation technologies such as PV and small wind turbines are unlikely to benefit as much from the RPS in the near term, due to their higher cost and greater barriers to installation.[381]

The long term stability of an RPS ensures that investors and manufacturers will have time to develop more cost effective methods of utilizing renewable resources. In the long run, manufacturers may benefit from waiting until renewable energy technologies are ready for the market instead of forcing deployment of inferior technology to meet unrealistic state targets.

Table 8.2: The Eight Lessons of RPS Design

Lesson 1:	*Make the target aggressive but gradual*
Lesson 2:	*Instead of listing technologies, use a fuel-based definition of eligible resources*
Lesson 3:	*Apply the standard to electricity sales, not installed capacity*
Lesson 4:	*Require all retail providers to meet the standard (without exemption)*
Lesson 5:	*Establish uniform rules for trading RECs*

Lesson 6:	*Create flexible compliance rules with tough non-compliance penalties*
Lesson 7:	*Ensure that the national standard does not preempt more aggressive state action*
Lesson 8:	*Craft simple rules that do not require further regulatory intervention*

In the end, the point of an RPS is not to set restrictions on when and where renewables can be deployed. Like "natural selection", it is the market—not the regulators or politicians—that should decide which technologies investors should develop to meet a national RPS mandate. [382]

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[353] Wiser, Ryan. (2006). "State RPS Policies: Experiences and Lessons Learned," Power Point Presentation before the Oregon Renewable Energy Working Group, May 31.
[354] Trent Barry and Mark Jaccard, "The Renewable Portfolio Standard: Design Considerations and an Implementation Survey," *Energy Policy* 29 (2001), pp. 263-277.
[355] Ibid, p. 18.
[356] Source: Maine Public Utilities Commission, *Report and Recommendations on the Promotion of Renewable Resources*, 2004, available at http://maineghg.raabassociates.org/Articles/PUC_DraftRPSReport.pdf.
[357] Bob Grace, Ryan Wiser, and Mark Bolinger, *Renewable Portfolio Standards: Background and Analysis for New York State* (Berkeley, CA: Lawrence Berkeley National Laboratory, May 2, 2002), p. 3.
[358] Source: Maine Public Utilities Commission, *Report and Recommendations on the Promotion of Renewable Resources*, 2004, available at http://maineghg.raabassociates.org/Articles/PUC_DraftRPSReport.pdf, p. 4.
[359] Bob Grace, Ryan Wiser, and Mark Bolinger, *Renewable Portfolio Standards: Background and Analysis for New York State* (Berkeley, CA: Lawrence Berkeley National Laboratory, May 2, 2002), pp. 4-5.
[360] American Wind Energy Association (AWEA), "The Renewables Portfolio Standard: How it Works and Why It's Needed," October, 1997, available at
http://www.awea.org/policy/rpsbrief.html.
[361] See Ryan Wiser, Kevin Porter, Mark Bolinger, and Heather Raitt, "Does it Have to Be This Hard? Implementing the Nation's Most Complex Renewables Portfolio Standard," *Electricity Journal* 18(8) (October, 2005), pp. 55-56.
[362] Rader 2000.
[363] Tony Usibelli, "Washington State's Energy Independence Act (Initiative 937): A Bit of a Different Animal," *Presentation at the 3rd Annual Renewable Portfolio Standards Conference*, Denver, Colorado, April 23, 2007.
[364] Rabe 2006, 8.
[365] Nancy Rader, "The Hazards of Implementing Renewables Portfolio Standards," *Energy & Environment* 11(4) (2000), pp. 391-405.
[366] Commonwealth of Massachusetts, *Renewable Energy Portfolio Standard: Annual RPS Compliance Report for 2004* (Boston, MA: Office of Consumer Affairs and Business Regulation, Division of Energy Resources, January 9, 2006).
[367] Rader 2000.
[368] See Rader 2000, pp. 398-400.
[369] AWEA 1997.
[370] Fredric Beck and Eric Martinot, "Renewable Energy Policies and Barriers," *Encyclopedia of Energy* 5 (2004), pp. 365-383.
[371] Source: Mike Sloan, "The Texas RPS," February 21, 2005, available at
http://www.earthscan.co.uk/news/article/mps/uan/324/v/3/sp/.
[372] Ole Langniss and Ryan Wiser, "The Renewables Portfolio Standard in Texas: An Early Assessment," *Energy Policy* 31 (2003), pp. 527-535.
[373] LaFlash, H. (2007). "Renewable Portfolio Standards & California Senate Bill 107," Presentation at the EUCI 3rd Annual Renewable Portfolio Standards (RPS) Conference, April 23-24, slide 11.
[374] Kristen H. Engel, "Harnessing the Benefits of Dynamic Federalism in Environmental Law," *Emory Law Journal* 56 (2006).

[375] Cliff Chen, Ryan Wiser, and Mark Bolinger, *Weighing the Costs and Benefits of Renewables Portfolio Standards: A Comparative Analysis of State-Level Policy Projections* (Berkeley, CA: Lawrence Berkeley National Laboratory, January, 2007, LBNL-61580), p. 1.
[376] PSCo Rule 40-2-124(1)(g)(I).
[377] Richard Mignogna, "Implementing Colorado's Renewable Portfolio Standard," *Presentation at the 3rd Annual Renewable Portfolio Standards Conference*, Denver, Colorado, April 23, 2007.
[378] Bob Grace, Ryan Wiser, and Mark Bolinger, *Renewable Portfolio Standards: Background and Analysis for New York State* (Berkeley, CA: Lawrence Berkeley National Laboratory, May 2, 2002), pp. 1-2.
[379] See Environmental Leader, "Arizona Utility Coalitions Considers 250 MW Solar Power Plant," February 5, 2007, available at http://www.environmentalleader.com/2007/02/05/arizona-utility-coalition-considers-250-mw-solar-power-plant/.
[380] Tss Consultants, "Arizona Biomass Energy Opportunities," March 3, 2004, available at http://www.cc.state.az.us/utility/electric/EPS-TSSC.pdf.
[381] Renewable Energy Policy Project, *Renewable Energy for California*, 2002, p. 4.
[382] See United Nations Environment Program, *Natural Selection: Evolving Choices for Renewable Energy Technology and Policy* (Paris: UNEP Division of Technology, Industry, and Economics, 2000).

9. Conclusion: Time to Choose

Politicians and real estate moguls are fond of referring to things as "win-win" situations. The truth is most important policy decisions involve winners *and* losers; benefits that accrue to one group often come at the expense of another. Every so often, constituencies align like the stars and policymakers are faced with a true "win-win" situation. A properly designed national RPS is one of those rare choices. When compared to conflicting state-based RPS policies and their impact on energy markets and electricity pricing, it is easy to find that a federal mandate could benefit ratepayers *and* regulated utilities in several unique ways that most policy advocates have not even considered.

A National RPS Benefits U.S. Consumers

A national RPS would decrease consumer electricity prices by:

- Decreasing the cost of fossil fuels used to generate electricity
- Decreasing the cost of natural gas used to heat and power homes
- Decreasing the cost of transmission congestion
- Protecting against rate hikes to recover infrastructure investments and stranded costs
- Preventing predatory trade-offs that require some ratepayers to subsidize others

A National RPS Benefits Regulated Utilities

A national RPS decreases regulatory compliance costs by:

- Reducing the need for costly litigation to clarify vague and competing state regulations
- Lowering the administrative costs associated with inconsistent state standards
- Making regulations more predictable to ease planning of resource investments
- Creating economies of scale that decrease the cost of renewable energy technologies
- Giving utilities greater flexibility in meeting RPS mandates by expanding the market of eligible renewable resources.
- Decreasing the cost of RECs by creating a uniform national market
- Encouraging the tracking of greenhouse gas emissions reductions before the implementation of a national carbon cap-and-trade program

A national RPS increases utility profits by:

- Maximizing the “hedge” benefits of renewable energy investments
- Decreasing construction cost overruns and encouraging more modular generation
- Decreasing transportation costs associated with fossil fuel supply chains
- Overcoming public opposition to new transmission infrastructure
- Speeding cost recovery of transmission investments
- Reducing the need for expensive reserve capacity
- Creating a level playing field that rewards strategic investment, rather than location

A national RPS benefits American industry

A national RPS would help American companies by:

- Producing thousands of new manufacturing, installation and maintenance companies and encouraging thousands of existing companies to expand into the burgeoning renewable technology manufacturing sector.
- Creating more new jobs for American workers in the same states that have lost the most manufacturing jobs
- Decreasing the number of sick days workers take because of illnesses related to power plant air pollution and accidents related to the mining, transportation and processing of fossil fuels and uranium.
- Increasing total consumer income by up to $8.2 billion by 2020
- Enhancing U.S. Gross Domestic Product (GDP) $10.2 billion by 2020

A national RPS benefits American taxpayers

A national RPS would provide secondary environmental and social benefits by:

- Conserving substantial amounts of water in drought-prone areas
- Decreasing the number of premature deaths and illnesses related to power plant air pollution and transportation and storage accidents
- Offsetting millions of tons of greenhouse gasses that contribute to global warming

• Reducing the amount of America's wilderness than is consumed to generate electricity using fossil fuels and nuclear power

Given such obvious and overwhelming advantages, it is hard to believe that many utilities and policymakers diligently oppose a federal RPS mandate, 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 RPS policy 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 of a national RPS wheel out these war-torn myths every time the issue is considered:

Myth #1: A national RPS would create "winners and losers"

Truth: All states have renewable resources they can affordably develop. However, under the current system of state mandates, some RPS states are "losers" by subsidizing the cheap, polluting electricity in non-RPS states. Other RPS 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 to other states 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 RECs or develop renewable resources anywhere they are cost competitive.

Myth #2: A national RPS would increase electricity rates

Truth: In most states, RPS mandates have not significantly increased rates and a consensus of economic models predict that a national policy would generate substantial consumer savings over even the existing patchwork of state programs. By expanding the amount of energy that would offset gas-fired generation, a national RPS 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.

Myth #3: A national RPS would cost the electricity sector

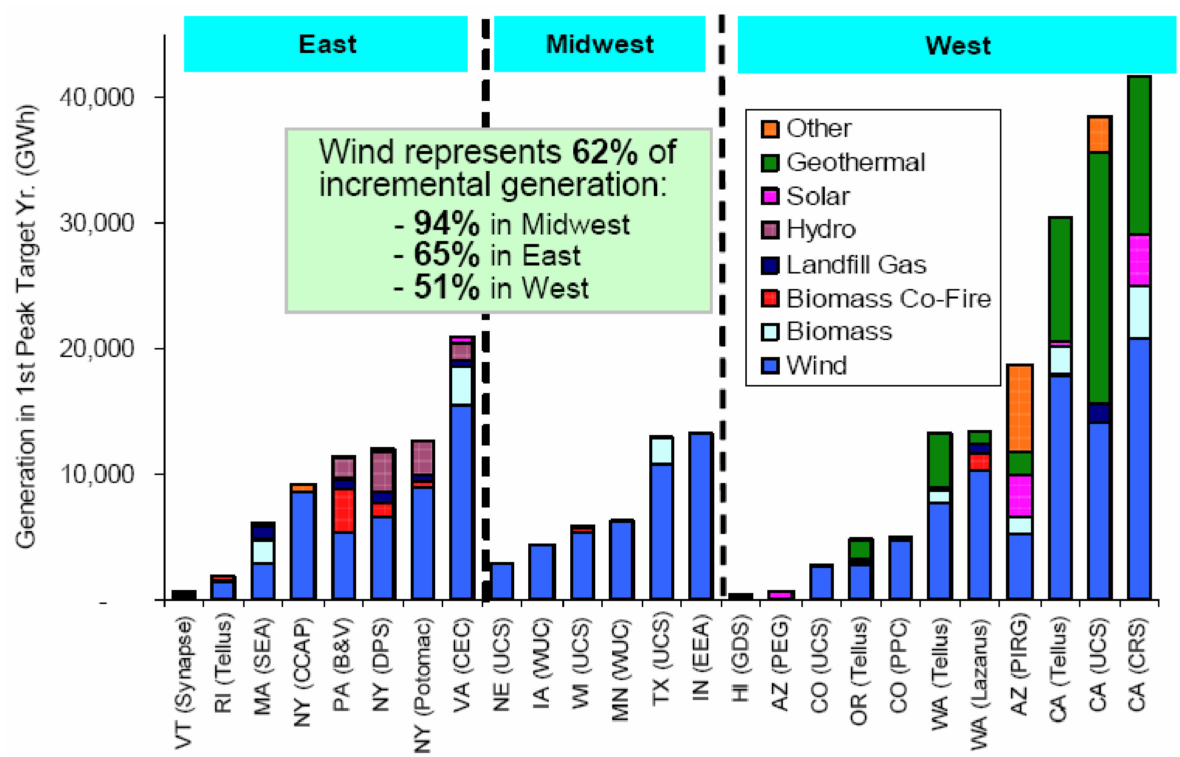
Truth: When utilities say a national RPS "costs" the sector, they are usually assuming future profits they will not be able to recover from consumers through higher electricity rates. For policymakers, balancing utility profits with electricity prices is one of the hard decisions we elect them to make.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

Myth #4: A national RPS would only benefit one technology – large wind installations

Truth: Experience from existing state RPS programs proves that mandates with broad eligibility actually have led to the development of many different renewable resources. Utilities have already demonstrated that they can meet state RPS requirements by deploying a diverse portfolio of renewable resources that best match their service areas.

A meta-analysis of 25 different RPS studies revealed that *each* of the states that have already responded to their own mandates by deploying a diverse array of renewable energy technologies.

Figure 9.1: Diversification of Renewable Energy Technologies by RPS Study



Source: Lawrence Berkeley National Laboratory, 2007.

By expanding (geographically and monetarily) the market for renewable resources, a national RPS is likely to diversify the deployment of renewable energy technologies even further. In Nevada, geothermal energy may be cheaper to develop than wind. In the Pacific Northwest, incremental hydro 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 uniform 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.

It is time that federal policymakers engage in an informed, comprehensive and rational debate about the few remaining objections to a federal RPS mandate. America faces serious and mounting energy problems:

- continued dependence on dwindling foreign sources of fossil fuels and uranium

- an undiversified electricity fuel mixture that leaves the nation vulnerable to serious national security threats

- reliance on an ancient and overwhelmed transmission grid that risks more common, more pronounced, and more expensive catastrophic system failures

- an impending climate crisis that will require massive and expensive emissions controls costing billions of dollars and substantially reducing U.S. GDP

- loss of American economic competitiveness as Europe and Japan become the major manufacturing center for new clean energy technologies

It is time to decide. By establishing a consistent, national mandate and uniform trading rules, a national RPS can create a more just and more 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 national RPS would decrease electricity prices for American consumers while protecting human health and the environment.

There is a time for accepting the quirks and foibles of state experimentation in national energy policy; and there is a time to take look to the states as laboratories for policy innovation. Now is the time to model the best state RPS policies and craft a coherent national policy that protects the interests of regulated utilities *and* American consumers.

Now is the time for federal leadership.