Consumer Federation of America

A CONSUMER ANALYSIS OF ENERGY EFFICIENCY AND RENEWABLE ENERGY STANDARDS:

THE CORNERSTONE OF CONSUMER-FRIENDLY ENERGY/ENVIRONMENTAL POLICY

DR. MARK COOPER

DIRECTOR OF RESEARCH

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A CONSUMER ANALYSIS OF ENERGY EFFICIENCY AND RENEWABLE ENERGY STANDARDS:

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EXECUTIVE SUMMARY

This paper analyzes the impact of the integrated Energy Efficiency Resource Standard and the Renewable Energy Standard (EERS-RES) contained in the American Clear Energy and Security Act of 2009 as circulated in the initial draft Waxman-Markey bill (that is, a 25 percent RES by 2025 and a 15 percent electricity and 10 percent natural gas EERS by 2020). It concludes that the aggressive EERS-RES is technologically feasible and economically practicable, yielding the lowest cost approach to a low carbon electricity sector.

- By 2030 the aggressive EERS and RES policies in the draft bill would save consumers over $200 billion dollars per year compared to the costs that would be incurred if investor owned utilities are left to pursue their preference for expensive central station generation units.

This analysis focuses on the EERS/RES originally proposed in the Waxman-Markey draft legislation, rather than the negotiated compromise (currently, the RES stands at 12 to 15 percent and the EERS stands at 5 to 8 percent, for a 20 percent total), for two reasons. First, if the aggressive EERS/RES mandates in the original draft bill are found to be beneficial for consumers, less aggressive mandates, though still beneficial, actually leave about half of the potential consumer savings on the table. Second, the agreement to relax the near-term 2020 target does not affect the long-term 2030-2050 targets. Soon enough, utilities will be looking for more low cost options to meet the need for electricity without emitting greenhouse gasses. The consumer gains that were left on the table in the first decade will have to be picked up and cashed in to ensure that the reduction in emissions is accomplished in the lowest cost manner possible.

We arrive at this conclusion by examining a wide range of studies of both the cost and availability of efficiency options and renewable resources. The analysis of the potential for efficiency improvements to meet future needs for electricity is based on a review of both the past performance of efficiency programs and estimates of the technical potential for efficiency improvements in the residential, commercial and industrial sectors (see Exhibit ES-1).

- Studies of the technical potential for easily implemented energy efficiency improvements in states from all regions of the nation find that efficiency could lower demand by as much as 30 percent at costs that are well below the current cost of producing electricity.

The analysis of the potential for renewable resources to supply electricity is based on a review of more than half a dozen recent studies by Wall Street and independent analysts on the cost of supply-side options.

- As shown in Exhibit ES-2, these studies find not only that efficiency is the lowest cost option available, but that there are a number of renewable sources of energy that are available at costs well below both current average costs and the cost of low carbon central

station generation technologies. Many of these options are substantially lower than the current average cost of supplying energy.

This analysis also finds that the potential for cost-competitive efficiency and renewables is more than adequate to meet the targets established by the Waxman-Markey legislation, without causing the cost of electricity to increase (see Exhibit ES-3).

- The supply of low cost efficiency and renewables is readily available to meet the targets for efficiency and renewables initially set out in Waxman-Markey in 2020 and 2025. Furthermore, use of efficiency measures and renewable sources can meet the broader goals of the Act for almost three decades. In the intervening decades, analysts expect the cost of important renewable sources to decline dramatically.

The analysis focuses on the cost of efficiency/renewables in contrast to central station generation because the investor owned utilities have a preference for and economic incentive to favor those types of facilities. The IOUs prefer central station facilities because they increase the rate base and therefore the profits the utilities earn. As shown in analyses by Moody's and MIT, the profits of more expensive central station facilities are two to four times higher than other supply-side options. The disparity between central station facilities and efficiency is even greater.

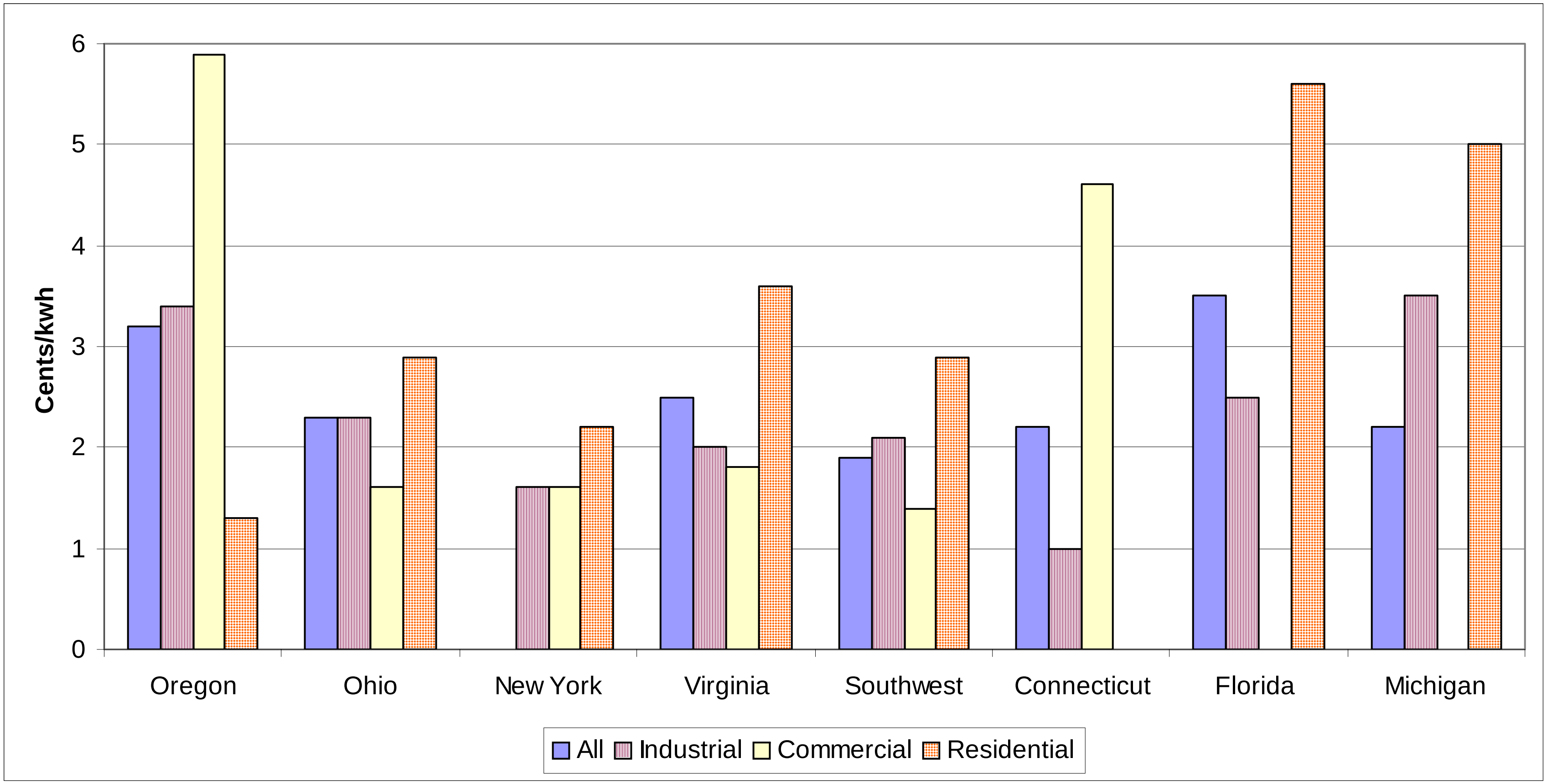
- Left to pursue their economic interest, the utilities will choose the more expensive central station options at the expense of the less expensive efficiency and renewable options.

The study also examines the reasons why the marketplace cannot be expected to counteract the utility bias toward expensive central station facilities. As shown in Exhibit ES-4, there are market imperfections on both the demand side and the supply side of the electricity market and at every stage of production, preventing efficiency and renewables from entering the market at their true social cost. These imperfections have plagued the electricity market for decades and prevented lower cost, more environmentally benign options from entering the market.

- Therefore, energy efficiency and renewable energy standards force utilities to think about, analyze, and invest in alternatives that are not their private preference, but are vastly more consumer-friendly and socially preferable to the status quo.

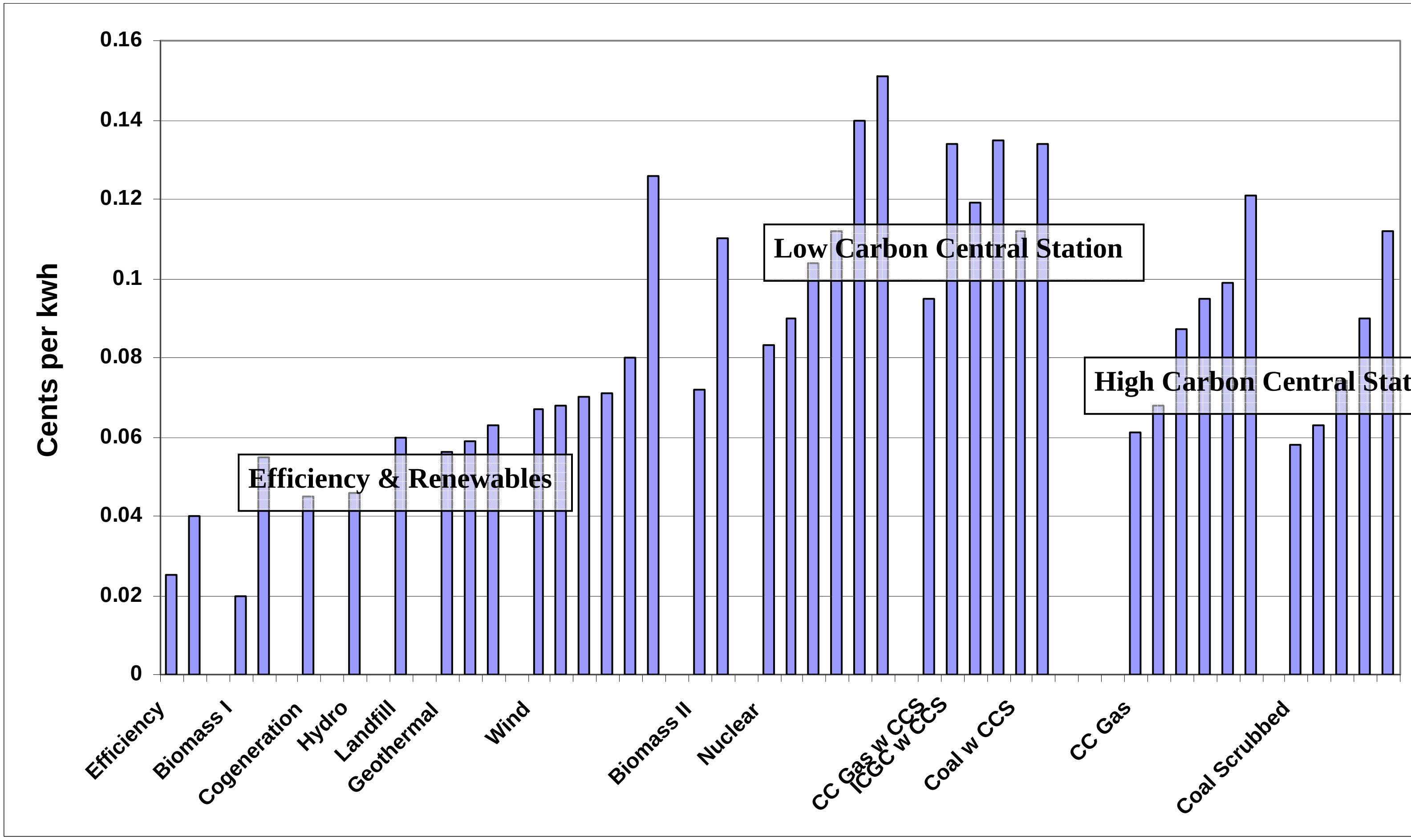
In a carbon constrained world, it is more important than ever to ensure efficiency and renewables can play their full role in meeting our energy needs. This analysis shows that vigorous pursuit of low cost efficiency and renewables can mitigate the potential impact of the carbon constraint, but it can do so only if the IOU preference for expensive, central station facilities is blunted. Thus, integrated energy efficiency and renewable energy standards should be a central part of national energy policy, particularly if that policy includes a commitment to carbon abatement. The supply of low cost, low carbon resources to satisfy electricity needs is broad enough to meet the goals of the Waxman-Markey bill for three decades or more, but only if Congress supports standards that help level the playing field. The stakes for consumers are huge.

Exhibit ES-1: Average Cost of Saved Energy By Sectors



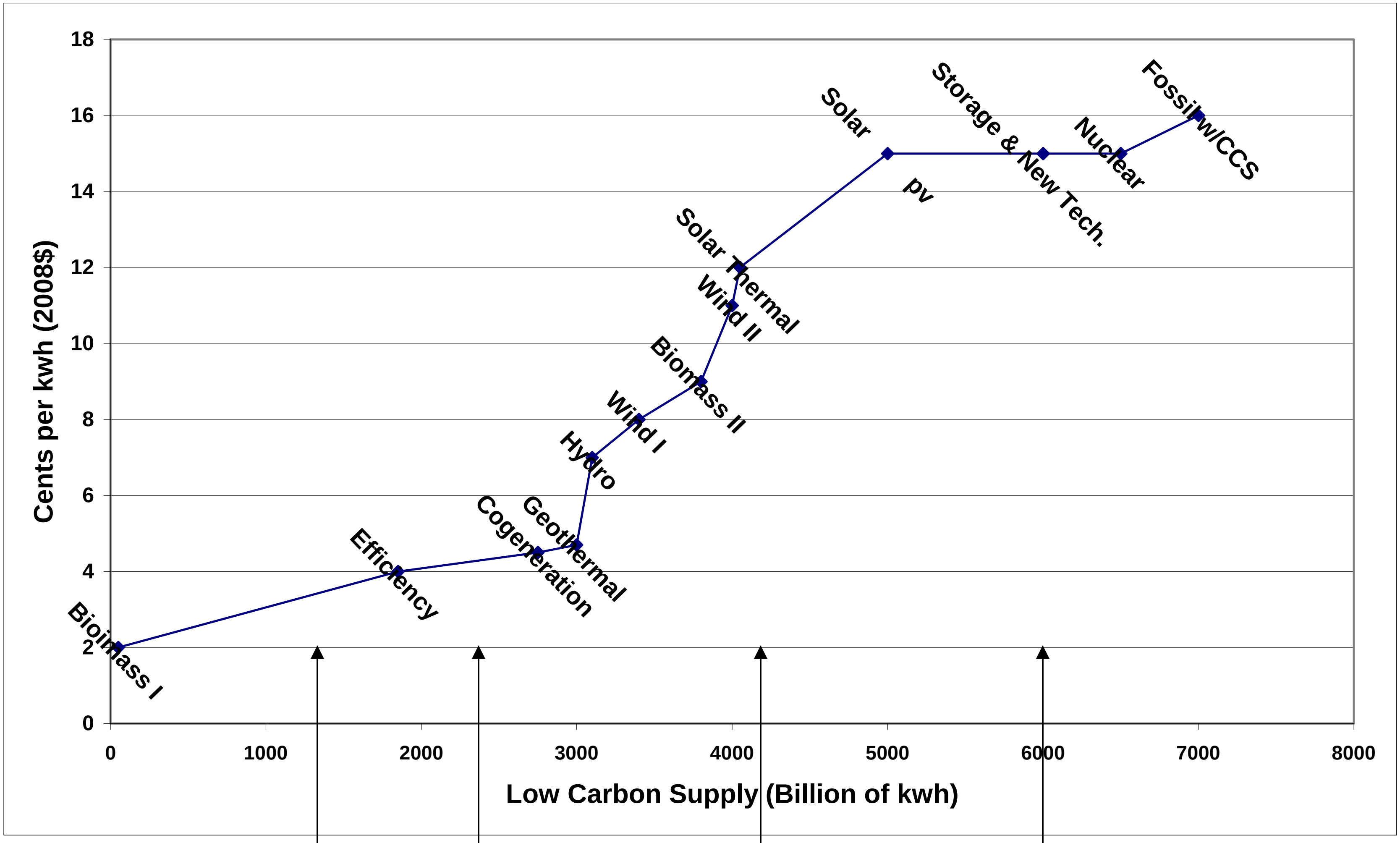
Sources: Wyandotte Municipal Services Optimization Plan, Michigan Public Service Commission, Case No. U-18558, p. 6.; Ecotope, Inc., American Council for an Energy Efficient Economy, Tellus Institute, Inc., *Energy Efficiency and Conservation Measure Resource Assessment,* (Energy Trust of Oregon Inc., January 2003), p. 9; Southwest Energy Efficiency Project, *The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest,* November 2002, p. 3-13; R. Neal Elliot, et al. *Potential for Energy Efficiency and Renewable Energy to Meet Florida's Growing Energy Demands* (American Council for an Energy Efficient Economy, June 2007), p. 9, 12.; American Council of an Energy Efficient Economy, et al., *Shaping Ohio's Energy Future,* March 2009, p.13, 15, 17; American Council of an Energy Efficient Economy, et al., *Energyzing Virginia: Efficiency First,* September 2008, p. 14, 16, 18.; Tom Rooney, et al., *Estimating the Potential for Cost Effective Electric and Peak Demand Savings in Connecticut,* 2004 ACEEE Summer Study on Energy Efficiency in Buildings, 2004. Optimal Energy Inc, et al., 2003, *Energy Efficiency and Renewable Energy Resource Development Potential in New York State,* August 2003.

Exhibit ES-2: Cost of Alternatives by Technology



Sources: Joel Klein, Comparative Costs of California Central Station Electricity Generation Technologies (Cost of Generation Model), ISO Stakeholders Meeting Interim Capacity Procurement Mechanisms, California Energy Commission, October 15, 2007; Lazard, 2008, Levelized Cost of Energy Analysis—Version 2.0, June 2008, p. 10; Lovins Amory, and Imran Shiekh, and Alex Markevich, 2008b, Nuclear Power: Climate Fix of Folly?, December 31, 2008; Moody's, 2008, New Nuclear Generating Capacity: Potential Credit Implications for U.S. Investor Owned Utilities, May 2008, p. 15; Standard and Poors, 2008,The Race for the Green: How Renewable Portfolio Standards Could Affect U.S. Utility Credit Quality, March 10, 20008, p. 11; Kaplan, Stan, 2008, Power Plants: Characteristics and Costs, Congressional Research Service, November 13, 2008.

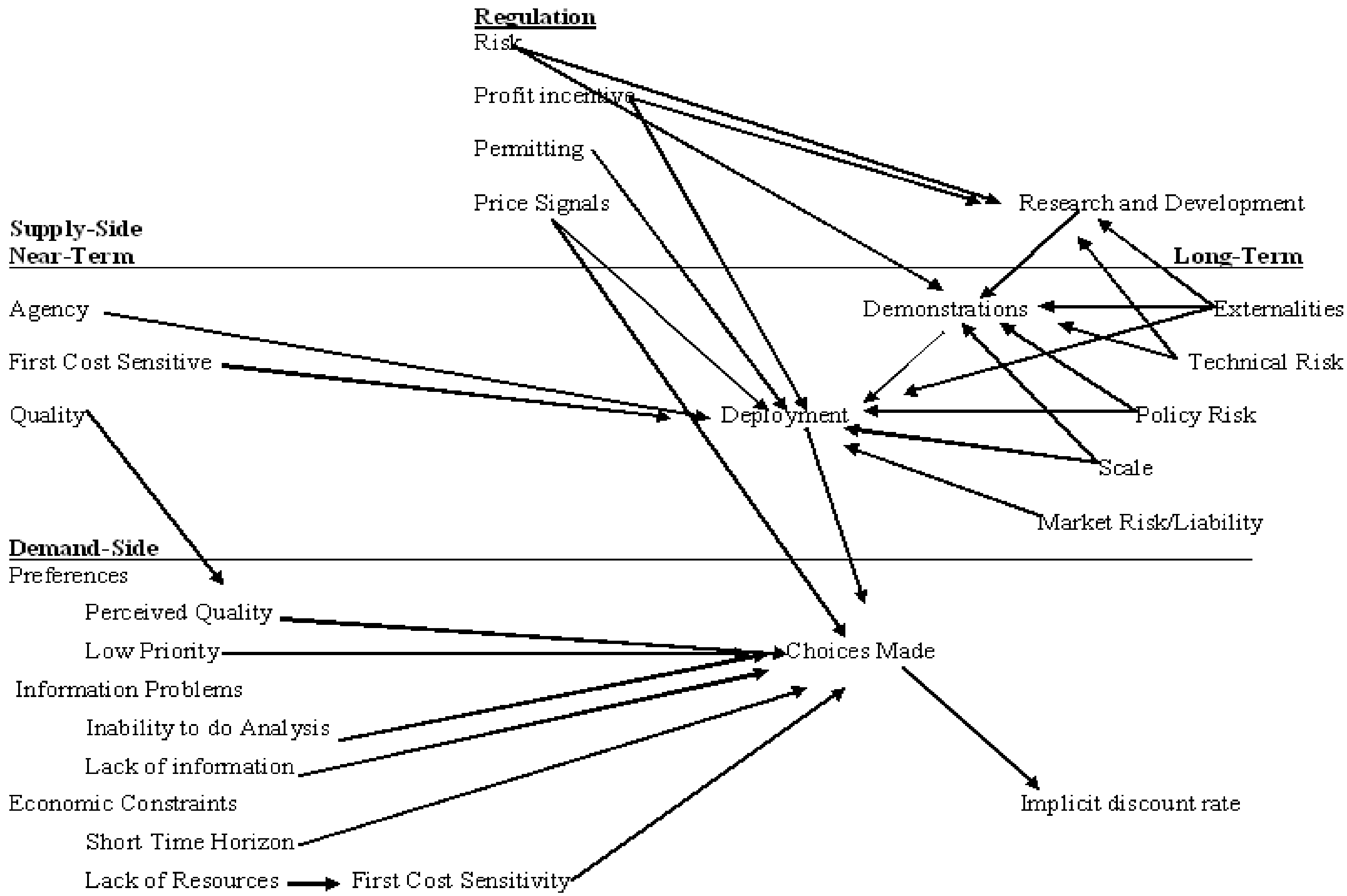
Exhibit ES-3: Electricity Supply Curve in a Carbon Constrained Environment



WAXMAN-MARKEY TARGETS 2020 2030 2040 2050

Source: Calculated by Author

ExhibitESV-4: Imperfections Affecting Electricity Markets



Source: Derived from Raymond J. Kopp and William A Pizer, *Assessing U.S. Climate Policy Options* (Washington, D.C.: Resources for the Future, November 2007); Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? – McKinsey and Company for the Conference Board.

I. INTRODUCTION

The Important Role of Energy Efficiency and Renewable Energy Standards

This paper analyzes the impact of the integrated Energy Efficiency Resource Standard and the Renewable Energy Standard (EERS-RES) contained in the American Clear Energy and Security Act of 2009 as circulated in the initial draft Waxman-Markey bill. It concludes that the aggressive EERS-RES is technologically feasible and economically practicable, yielding the lowest cost approach to a low carbon electricity sector.

- Efficiency is the lowest cost, cleanest way to meet America's need for electricity, and renewables are less costly than other options to reduce carbon emissions.
- By 2030 the aggressive EERS and RES policies in the draft bill would save consumers over $200 billions dollars per year compared to the costs that would be incurred if investor owned utilities are left to pursue their preference for expensive central station generation units.
- However, utilities prefer to build more expensive, large, central station power plants because they make more money by expanding their rate base. That is why they resist and downplay the potential for efficiency to meet consumers' needs.
- If Congress passes cap and trade legislation the utility preference for expensive central stations facilities like nuclear power and carbon sequestration and storage, will be reinforced.
- The marketplace cannot correct this bias because it is riddled with imperfections.

The need to understand the relative costs and the utility preferences was underscored recently when a senior executive for the major trade association of investor owned electric utilities (IOUs) was quoted as opposing the energy efficiency resource standard (EERS) and the renewable energy standard (RES) included in the Waxman-Markey discussion draft for climate change legislation. The article pointed out that "his members worry that the two provisions are "overly ambitious and will simply raise the cost of generating electricity without producing any additional emissions reductions."[1] The IOU argument is exactly backwards. This paper shows that not only would an EERS and RES lower the future cost of electricity, but also it would be more important, not less, to put these standards in place if Congress passes a cap and trade program to reduce greenhouse gas emissions.

To appreciate why the efficiency and renewables should be the primary vehicles to achieve a low carbon future in the electricity industry, we need to ask, and answer five questions:

- Are efficiency and renewables low cost options?
- Can efficiency and renewables reach the targets in the legislation without driving their cost up?
- Are efficiency and renewables lower in cost than the approaches the utilities prefer?

- Do the utilities have an incentive to pursue more costly alternatives?
- Are there obstacles that prevent less costly options from overcoming the utility preference for costly alternatives?

This paper shows that the answer to all five questions is a simple and emphatic YES. As a result, the policy conclusion is also clear. Energy efficiency and renewable energy standards require utilities to rely on lower cost alternatives to meet national energy and environmental policy goals, alternatives they will not choose if left to follow their financial interests. Therefore, whether Congress passes energy legislation or climate change legislation, an Energy Efficiency Resource Standard and a Renewable Energy Standard should be a cornerstone of our energy/environmental policy.

This analysis focuses on the EERS/RES originally proposed in the Waxman-Markey draft legislation, rather than the negotiated compromise, for two reasons.

- First, if the aggressive EERS/RES mandates in the original draft bill are found to be beneficial for consumers, less aggressive mandates will certainly be beneficial. Indeed, less aggressive mandates will actually leave considerable consumer savings on the table.
- Second, the agreement to relax the near-term 2020 target does not affect the long-term 2030-2050 targets. Soon enough, utilities will be looking for a substantial increase in ways to meet the need for electricity without emitting greenhouse gasses. The consumer gains that were left on the table in the first decade will have to be picked up and cashed in to ensure that the reduction in emissions is accomplished in the least cost manner possible.

Outline of the Paper

The paper is organized as follows: the remainder of Section I describes the EERS provisions of the Waxman-Markey draft as introduced to which the IOU spokesman was referring.

Section II analyzes the cost of energy efficiency.

Section III discusses the amount of energy that can be saved with aggressive efficiency policies, addressing the issue of how the cost of energy savings might respond to aggressive goals. It also reviews the natural gas component of the program, which seems to be less controversial, in part, because the target is lower and in part, because the benefits are higher.

Section IV discusses the cost of a wide range of technologies used to generate electricity in comparison to the cost of energy savings. This section also addresses the question of whether renewables are low cost resources and whether the targets set in the Waxman-Markey bill are achievable.

Section V describes the incentives utilities have to choose more expensive generation technologies over less expensive efficiency (and renewable options), which supports the conclusion that even with a cap and trade program, an EERS and RES are in the consumer interest. It also explains why the marketplace will not correct the problem.

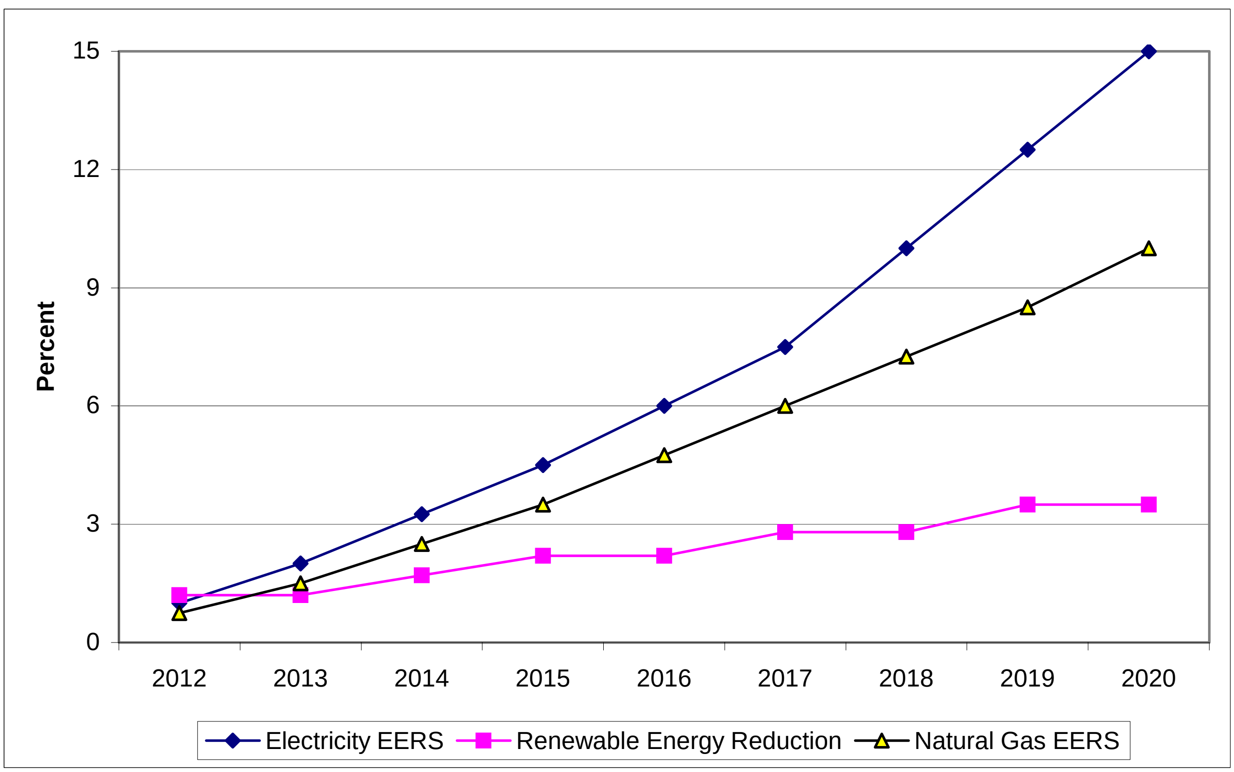
Section VI estimates the stakes for consumers.

The Waxman-Markey Approach to an Integrated EERS-RES

At the outset, it is important to understand the approach to combining the EERS and the RES in the Waxman-Markey climate change bill about which the IOUs are complaining. There are two components of the integrated EERS/RES.

The core of the proposal is an increasing cumulative level of energy savings, as described in Exhibit I-1. Utilities must meet energy savings targets and report their savings each year. The baseline is the average level of consumption for the previous two years. Waxman-Markey also allows the utility to reduce its renewable energy target by one-fifth if it meets its efficiency target.

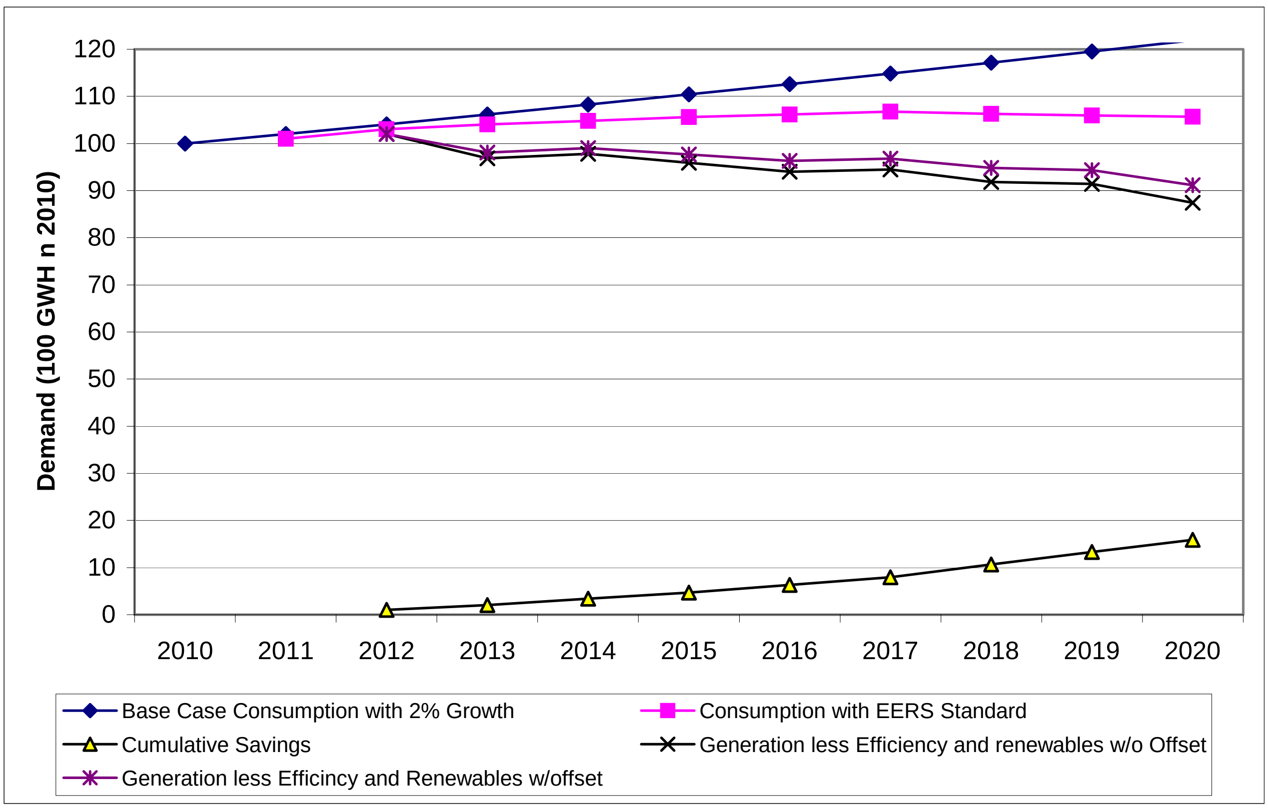
Exhibit I-1: EERS Standards and Renewable Offset



Source: Calculated by author

While the percentage targets are straightforward, the calculation of the actual energy savings involves some complexity because of the moving average base year. Exhibit I-2 shows a model of the Waxman-Markey bill for electricity assuming an underlying growth rate of 2 percent per year, which is driven by population and economic growth. The base year savings for 2012 would be calculated as the average consumption in 2010 and 2011. If we assume a 100-gwh system in 2010 growing at 2 percent per year, consumption in 2011 would be 102 gwh (100 * 1.02). The 2-year moving average for 2012 would be 101 gwh ([100 +102)/2=101]). The mandatory savings would be 1 percent of that or 1.01 gwh. If there were no EERS program, consumption in 2012 would have risen to 104.04 gwh (102*1.02). The EERS reduces that by 1.01 gwh, so the actual consumption in 2012 is 103.03 gwh. The base year consumption for 2013 would be the average of consumption in 2011 and 2010, or 102.52 ([102+103.03/2]). The mandatory savings in the second year would be 2 percent, or 2.05. Over the eight years for which the EERS targets are in force, the EERS offsets about three-quarters of the underlying growth of demand.

Exhibit I-2: Energy Savings, Consumption and Non-Renewable Generation in the Waxman-Markey Bill including Economic Growth and Maximum Efficiency Contribution



Source: Calculated by author

Exhibit I-2 shows the effect of the renewable standard given the existence of the EERS. Since the RES is stated as a percentage of moving average generation and the EERS is stated as a percentage of moving average consumption, declining demand reduces the amount of generation needed and lowers the amount of renewables needed. At the same time, allowing the utility to reduce the contribution of renewables by one-fifth if it meets the EERS. This lowers the amount of renewables needed and allows more non-renewable generation to remain in the mix. This approach provides an incentive to meet the efficiency target.

As Exhibit I-2 shows, the integrated EERS/RES with maximum reliance on efficiency results in a modest decline in the absolute level of non-renewable generation resources over the eight-year period for which energy efficiency standards are established. I include the level of non-renewable generation not only to understand what the environmental impact will be, but also, and perhaps more importantly for this analysis, to understand what the impact on utilities will be. If there were no change in policy, utilities would add nonrenewable generation to meet growing demand and to replace aging generation capacity. The EERS-RES changes that behavior. It requires reduce demand and add renewables, which force them to cut back on the addition of nonrenewable generation. An important question is how much of nonrenewable generation is squeezed out of the mix.

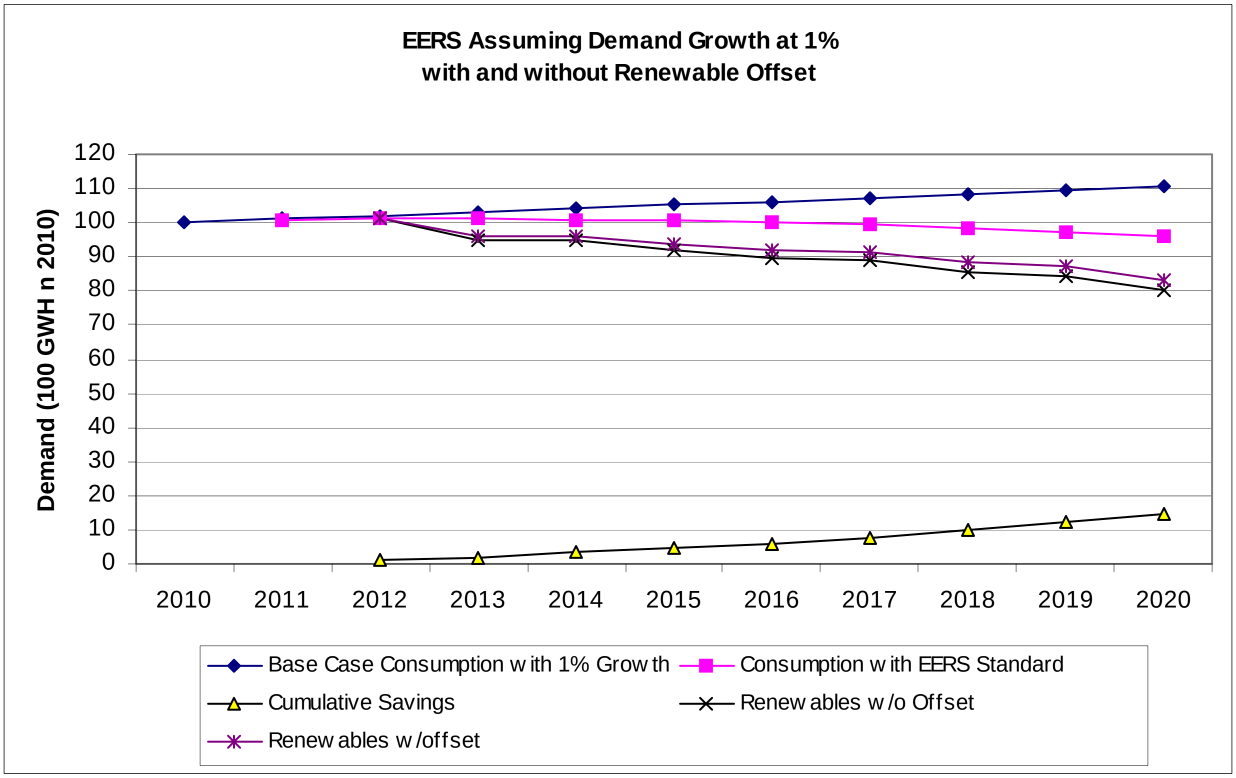
The level of reduction of non-renewable generation caused by the EERS-RES, as estimated in Exhibit I-2, is about 10 percent over the eight-year period. The rate of reduction of non-renewable generation would be about 1.3 percent per year. The EIA base case Energy Outlook projects a rate of additions plus retirements of about 1.1 percent per year. Thus, the EERS-RES obligations could be handled by the utilities by not replacing fossil fuel plants that are retired and not adding new fossil fuel plants. The utilities would only have to accelerate the retirement of fossil fuel plants slightly.

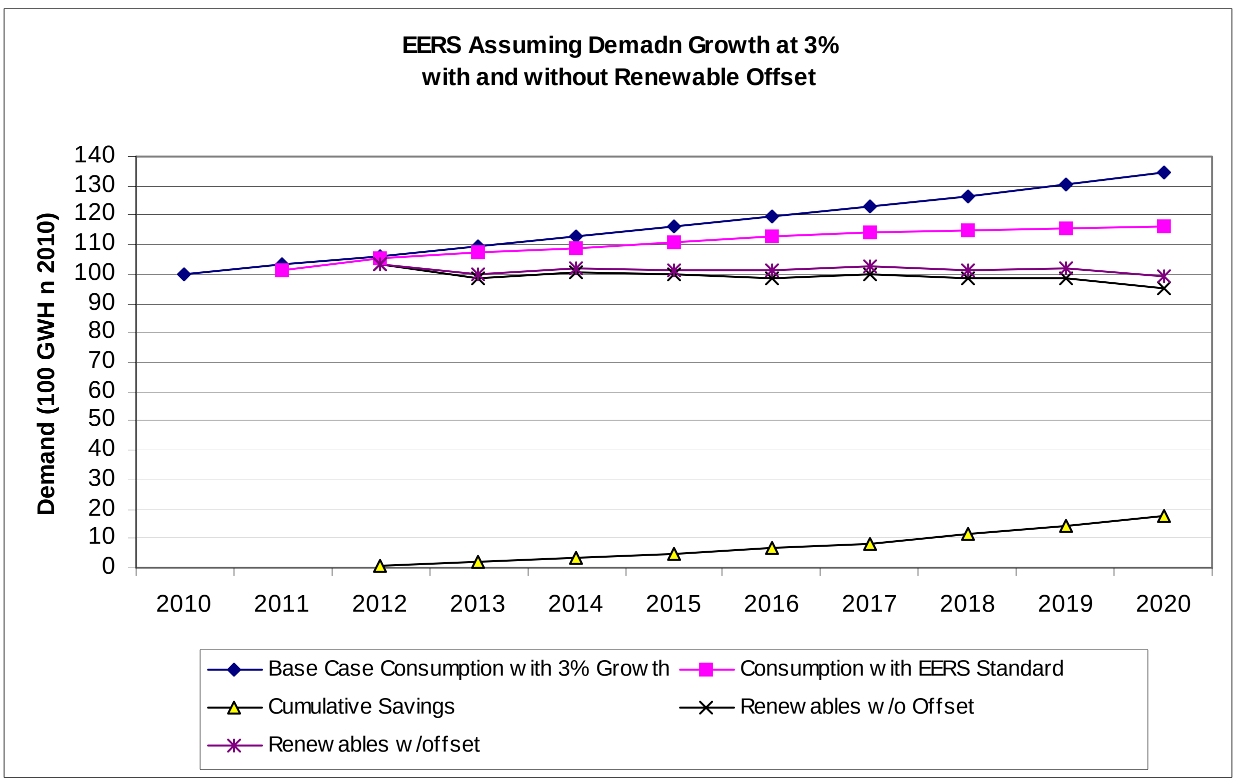
The two percent per year growth rate used in the above analysis is about the national average for the past couple of decades, but the EIA projects less than a one percent growth rate over the next two decades.[2] Assuming lower or higher growth rates does not change the analysis significantly, as shown in Exhibit I-3. At assumed lower underlying growth rates, the EERS pushes consumption growth down. At a one percent underlying growth, it mandates a slight decline in consumption. The decline in non-renewable generation would be about 2.4 percent per year more challenging for utilities. At an underlying growth rate of 3 percent, the integrated EERS/RES cuts the growth rate in half and requires no reduction in non-renewable generation. Over the past two decades, three quarters of the states had electricity growth between one percent and three percent.

This analysis of the integrated EERS/RES in the Waxman-Markey bill sets up several of the key questions analyzed in this paper.

- Are the levels of efficiency mandated by the standard achievable?
- Does the discretionary contribution of energy efficiency to the renewable standard offer meaningful flexibility to utilities and the possibility of lower cost for consumers?
- What are the implications of the standard for non-renewable generation?

Exhibit I-3: The Impact of Integrated EERS/RES at Various Levels of Assumed Growth





Source: Calculated by Author

II. THE COST OF ENERGY EFFICIENCY

Since the first oil price spike in the early 1970s, the cost of conserving energy has been a major topic of investigation.[3] Interest has ebbed and flowed with the price of energy. With recent rising prices, increasing volatility and growing concern about climate change in the past decade, interest and analysis has increased. There are two approaches to the analysis. One looks at historical data to ascertain what has been achieved. The second is to project what can be achieved based on the technical and economic potential for energy saving.

In both cases, the approach is to estimate how much energy will be reduced by including specific technologies in buildings and appliances that reduce energy consumption. These additional technologies cost money; so one can calculate the cost per unit of energy saved by dividing the expenditure by the amount of energy saved.

Both the backward and forward looking analyses indicate that the cost of saving electricity is in the range of 3 cent/kwh to 5 cents/kwh, or $30 to $50 per MWh.

Historic Analysis

Exhibit II-1 shows a graph that summarizes the results of analyses of the cost of efficiency in sixteen states over various periods covering the last twenty years. The data points are the annual average results obtained in various years at various levels of energy savings. The graph demonstrates two points that are important for the current analysis.

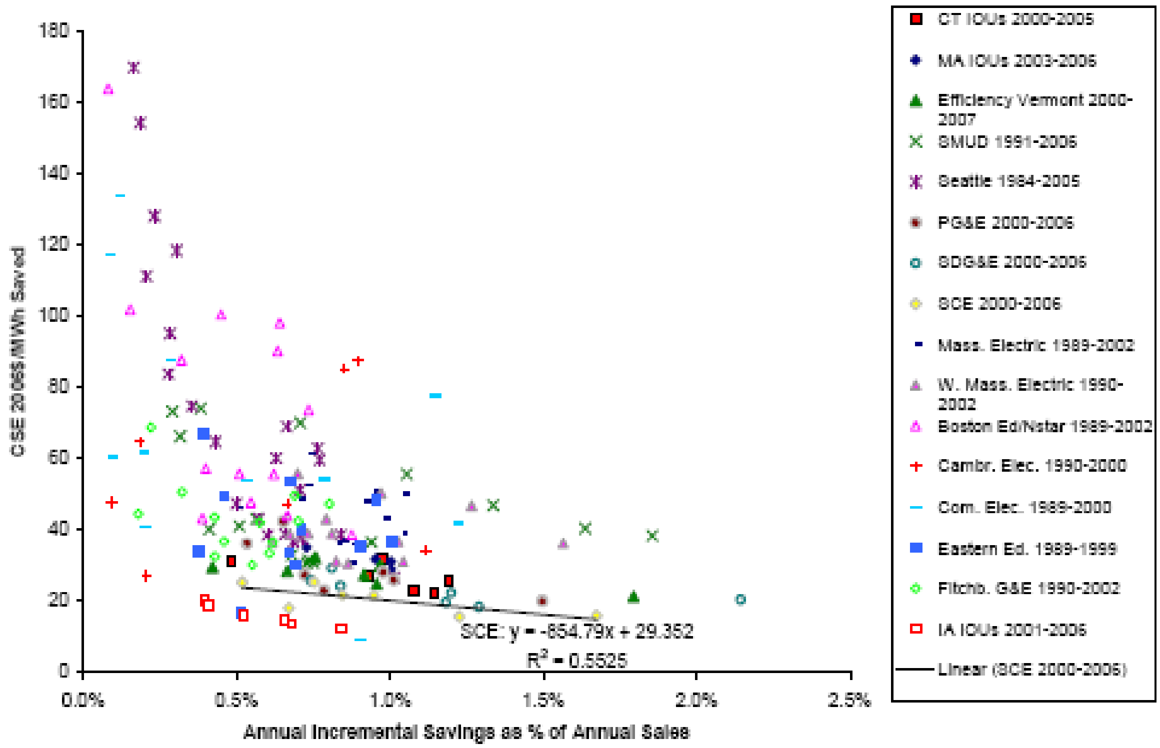
- First, the vast majority of costs fall in the range of $30/MWh to $50/MWh.
- Second, the higher the level of energy savings, the lower the level of costs. There is certainly no suggestion that costs will rise at high levels of efficiency.

While the aggregate data appear to suggest a very strong downward trend, the data for individual utilities suggest a moderate downward trend. Exhibit II-1 shows the trend line for one individual utility. The trend is very slightly negative. It is among the weakest of the downward trends observed in individual states, however.

An explanation for declining costs for higher levels of efficiency is needed. The authors suggest that economies of scale, learning and synergies in technologies may account for the declining costs.[4] As utilities do more of the cost effective measures, costs decline. Also, if technical potential is much higher than achievable savings, economies of scale and scope and learning could pull more measures in and lower costs.

Exhibit II-1:

Figure 2. Utility Cost of Saved Energy (2006$/MWh) vs. Incremental Annual Savings as % of Sales

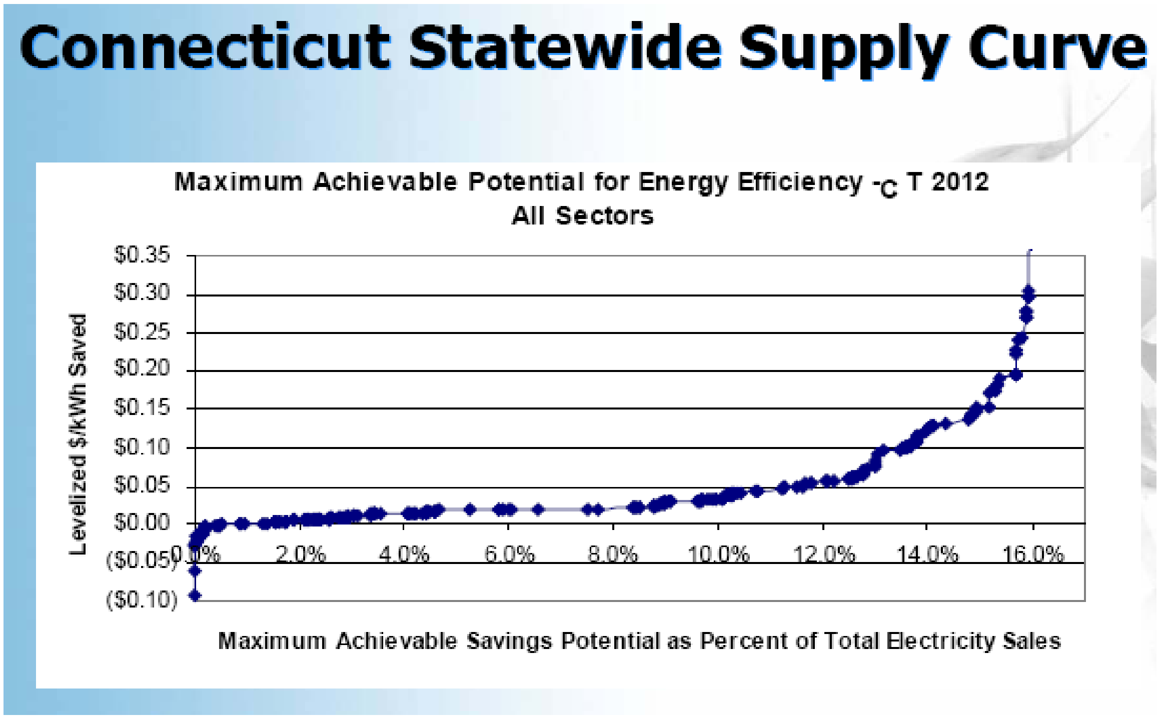


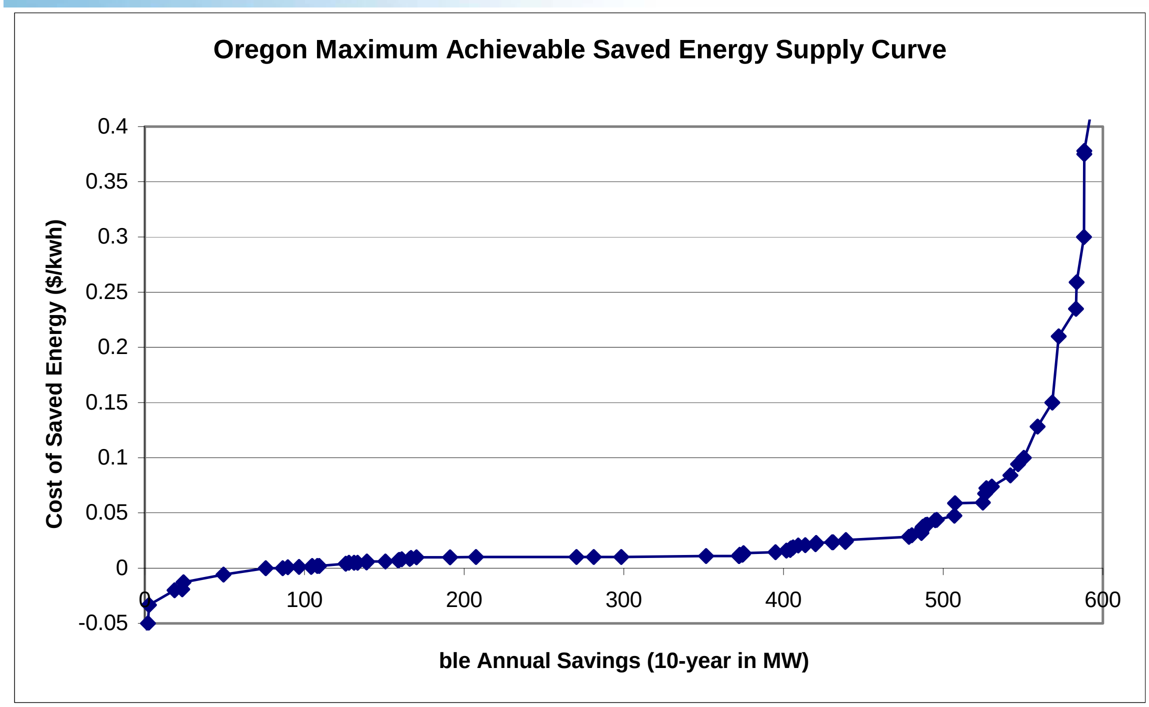
Source: Kenji Takahasi and David Nichols, "Sustainability and Costs of Increasing Efficiency Impact: Evidence from Experience to Date," ***ACEE Summer Study on Energy Efficient Buildings*** **(Washington, D.C., 2008), p. 8-363.**

Projected Future Savings Potential

The analysis of potential future savings identifies a set of energy savings measures and estimates the cost and quantity of saved energy. The analysis essentially calculates a potential supply curve of saved energy by plotting the cost against the quantity. Exhibit II-2 presents a published potential supply curve calculated for Connecticut and the potential supply curve we have calculated for Oregon from a published study. These analyses include all three sectors: residential, commercial and industrial. The Connecticut potential supply curve is presented in terms of the percent of the base case consumption that could be supplied by efficiency investments. The Oregon supply curve is presented as the annual number of megawatts that would be offset by efficiency investments.

Exhibit II-2



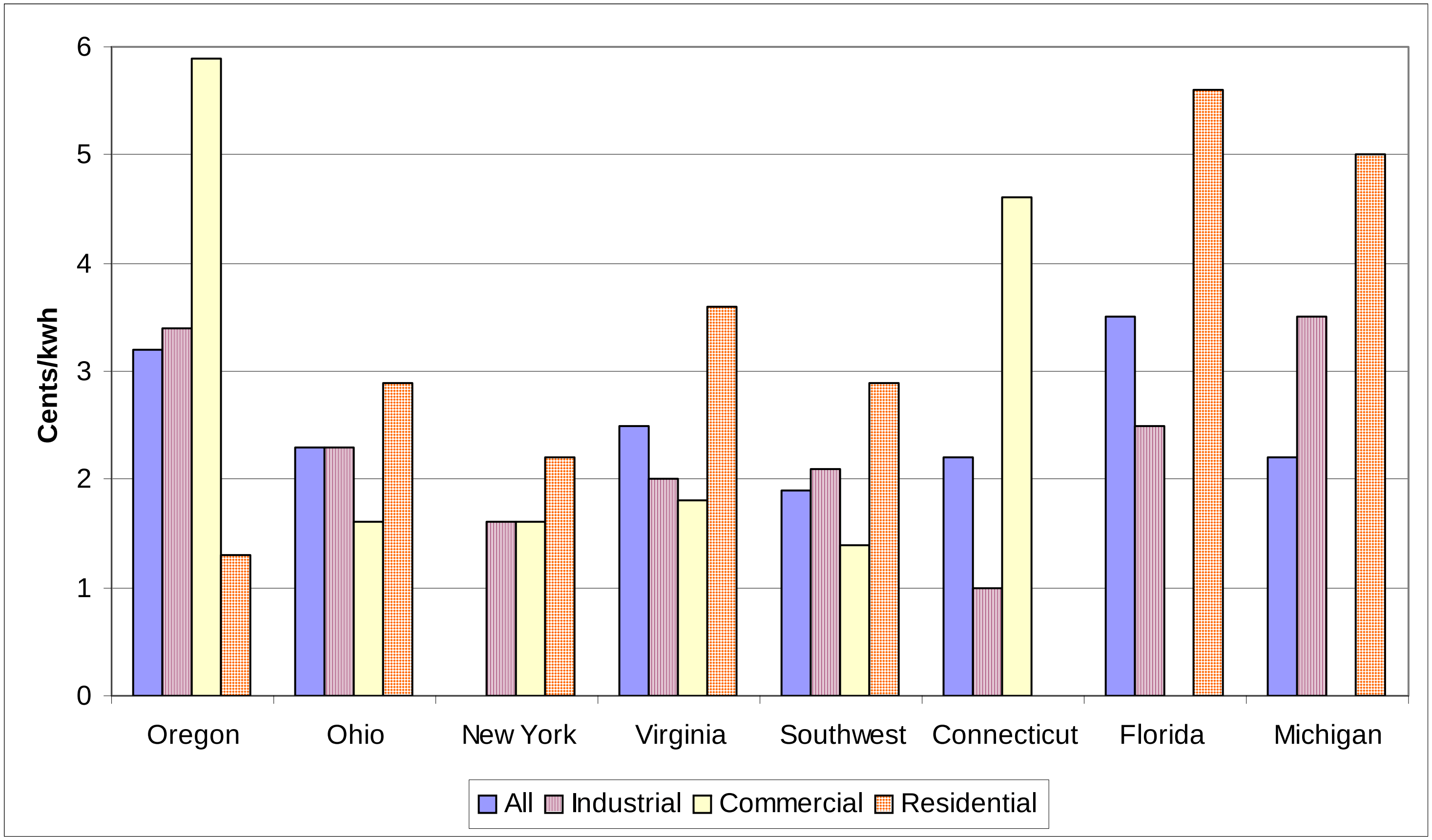


Source: **Tom Rooney, et al.,** ***Estimating the Potential for Cost Effective Electric and Peak Demand Savings in Connecticut,*** **2004 ACEEE Summer Study on Energy Efficiency in Buildings, 2004; Ecotope, Inc., American Council for an Energy Efficient Economy, Tellus Institute, Inc.,** ***Energy Efficiency and Conservation Measure Resource Assessment,*** **(Energy Trust of Oregon Inc., January 2003)**

These supply curves have the typical shape and costs that are generally found in such studies. There are a small number of negative cost options and a small number of high cost options and a large number of options that fall in the moderate range: 1 cent/kwh to 5 cents/kwh. In the case of the Oregon supply curve, 83 percent of the savings occurs at less than 4 cents/kwh and 85 percent of the savings occurs at less than 5 cents/kwh.

Exhibit II-3 presents the average cost of potential saved energy from eight recent analyses with the results for the industrial, commercial and residential sectors shown separately. These analyses show costs in the same range: 1-5 cents/kwh for all three sectors. As we shall see below, these studies also estimate a quantity of potential savings that will carry energy efficiency to levels high enough to easily meet the legislative Waxman-Markey targets within the flat section of the cost curve. In other words, a cost per kwh saved of 5 cents would be a very cautious estimate of the costs that will be incurred to meet the goals at the margin.

Exhibit II-3: Average Cost of Saved Energy By Sectors



Wyandotte Municipal Services Optimization Plan, Michigan Public Service Commission, Case No. U-18558, p. 6.; Ecotope, Inc., American Council for an Energy Efficient Economy, Tellus Institute, Inc., *Energy Efficiency and Conservation Measure Resource Assessment,* (Energy Trust of Oregon Inc., January 2003), p. 9; Southwest energy Efficiency Project, *The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest,* November 2002, p. 3-13; R. Neal Elliot, et al. *Potential for Energy Efficiency and Renewable Energy to Meet Florida's Growing Energy Demands* (American Council for an Energy Efficient Economy, June 2007), p. 9, 12.; American Council of an Energy Efficient Economy, et al., *Shaping Ohio's Energy Future,* March 2009, p.13, 15, 17; American Council of an Energy Efficient Economy, et al., *Energyzing Virginia: Efficiency First,* September 2008, p. 14, 16, 18.; Tom Rooney, et al., *Estimating the Potential for Cost Effective Electric and Peak Demand Savings in Connecticut,* 2004 ACEEE Summer Study on Energy Efficiency in Buildings, 2004.

III. HOW MUCH ENERGY CAN BE SAVED?

Having established the cost of saved energy to be quite low, we next consider how much energy can be saved at those cost levels. We examine how an aggressive EERS affects costs and savings.

Potential Energy Savings

As with the estimate of costs, there are two approaches to ascertaining the potential quantity of energy savings. One approach is forward looking and analyzes the technical potential to reduce demand. The second approach looks backward and analyzes what has been achieved in the past, particularly in the most aggressive and highest performing states. Both approaches indicate that there is a significant potential to save energy with efficiency.

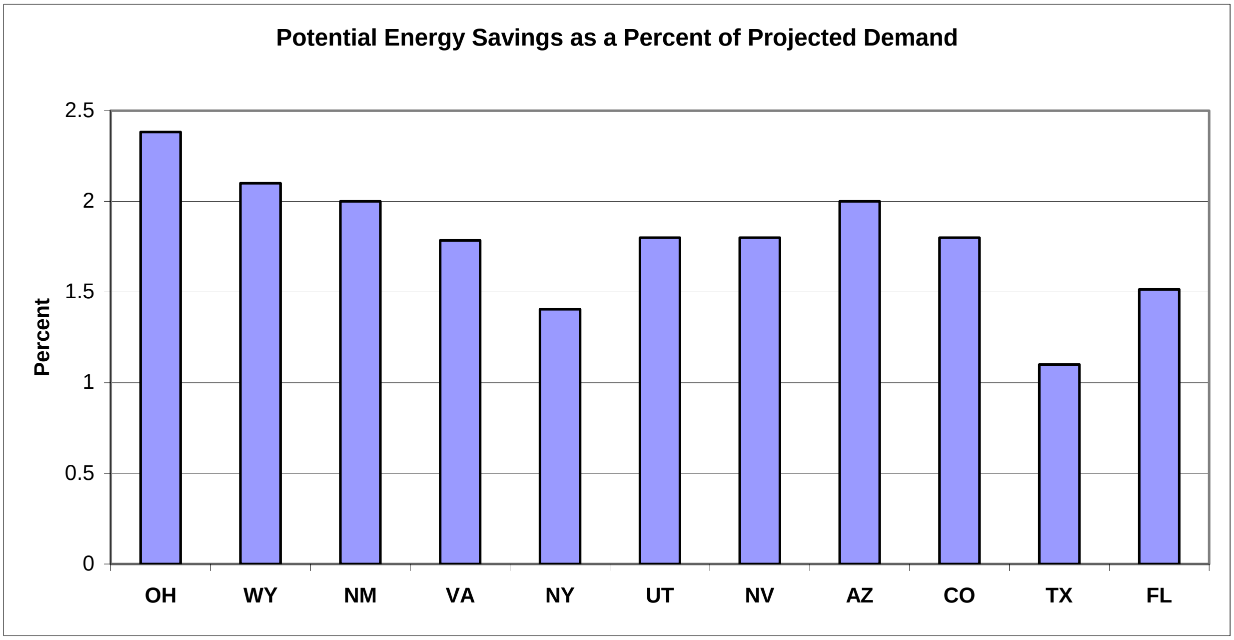
State-by-state studies covering many parts of the country show that there is a large potential for energy efficiency to reduce consumption over the next twenty years. These studies base their estimates on technology assessments of current practices compared to best practices. The studies provide highly detailed analyses of the various options that are available for achieving the goal of reduced energy consumption. They take cost into account so that the efficiency scenarios they build are technologically feasible and economically practicable. The individual state studies listed in Exhibit III-1 have a period running from 10 to 19 years. We have annualized the results for purposes of comparison. The potential savings reported in Exhibit III-1 are economically practicable, with cut off prices generally set at about 5 cents per kwh and average cost per kwh saved of 2 cents. There is considerably more technically potential savings at higher costs. For example, the studies for Connecticut, California and New York, show an average technical potential that is 50 percent higher than the economic savings.

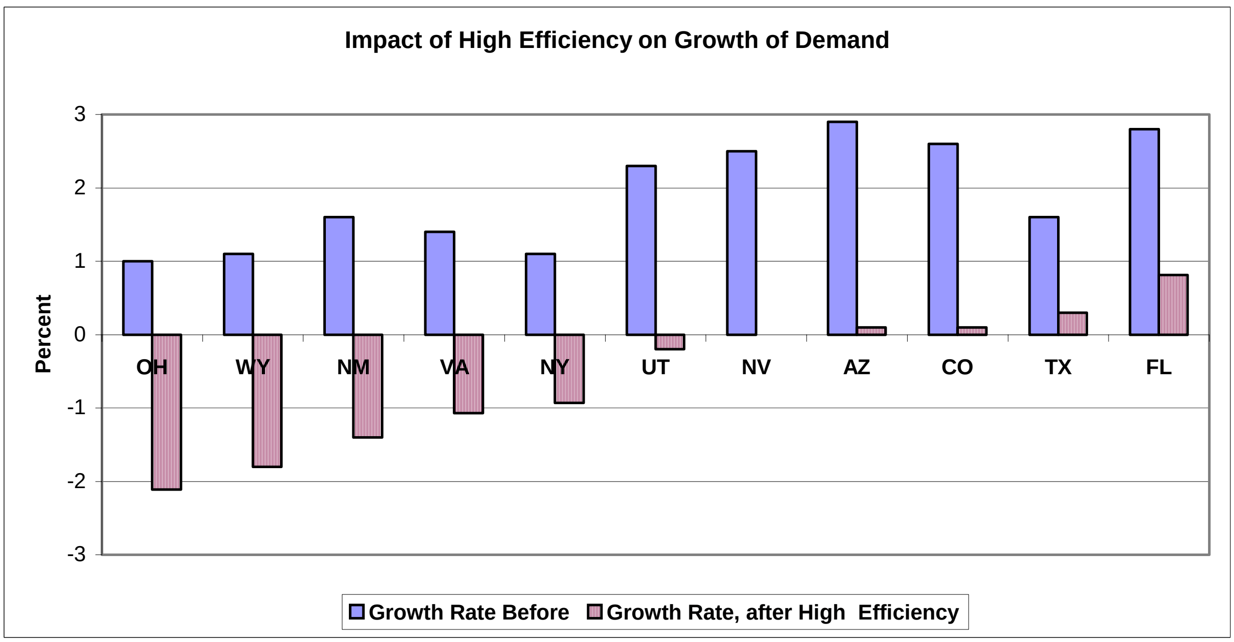
As shown in Exhibit III-1, the potential energy savings varies, from a low of 1 percent per year in Texas to a high of 2.5 percent per year in Ohio. The lower levels of projected energy savings in Texas and New York are the result of more limited potentials in specific sectors compared to the other states. Compared to the other states, the energy savings potential in the industrial sector is projected to be limited in New York, while the commercial sector has lower potential in Texas.

As shown in the lower panel of Exhibit III-1, the efficiency scenarios analyzed can dramatically lower the rate of growth in energy consumption. In half the states, it can lead to a decline in consumption. In the other states, it can flatten demand, with the exception of the very high growth rate in Florida. Given the dynamic treatment of the base year discussed above, the EERS as proposed accommodates even the high growth states. That is, comparing Exhibit II-3 and III-1, even high growth Florida fits beneath the demand ceiling set by the Waxman-Markey EERS.

The descriptive statement of the challenge for Utah captures the essence of what these scenarios mean. As shown in Exhibit III-1, the potential for Utah was an annual reduction in consumption just below the base case rate of growth. Utah was right in the middle of the eleven states included in Exhibit III-1.

Exhibit III-1: Energy Efficiency and Demand Growth





Sources: Ecotope, American Council for and Energy Efficient Economy and Tellus, *Energy Efficiency and Conservation Measure Resource Assessment, Prepared for the Energy Trust of Oregon, Inc.*, January 2003; Optimal Energy Inc, et al. *Energy Efficiency and Renewable Energy Resource Development Potential in New York State,* August 2003; Southwest Energy Efficiency Project, *The New Mother Lode,* November 2002; R. Neal Elliot, et al. *Potential for Energy Efficiency and Renewable Energy to Meet Florida's Growing Energy Demand,* American Council for an Energy-Efficient Economy, March 2007; R. Neal Elliot, et al., *Potential for Energy Efficiency, Demand Response, and Onsite Renewable Energy to Meet Texas' Growing Electricity Needs,* American Council for an Energy-Efficient Economy, June 2007; Howard Geller, et al., *Utah Energy Efficiency Strategy: Policy Options,* November 2007.

> The energy savings standards or targets suggested above are admittedly ambitious. Achieving them will require a very concerted effort on the part of utilities as well as strong support from key parties such as the Governor's office and the state utility regulatory commission. Effectively implementing some of the options described below, such as tax credits for innovative energy efficiency technologies and public education, will help utilities achieve the goals presented above. In addition, the development and commercialization of some new efficiency technologies in coming years should help utilities achieve the standards or targets. While it is impossible to know in advance which new technologies will become available, the pace of technological advance is rapid, and numerous new energy efficiency measures are likely to reach the marketplace during the next 13 years.[5]

Exhibit III-1 shows that there is a large, economic potential energy saving from efficiency. The economically practicable efficiency savings are well in excess of the levels of efficiency that would have to be produced to meet the targets of the EERS and would also be available to capture the efficiency offset under the RES.

Historical Studies

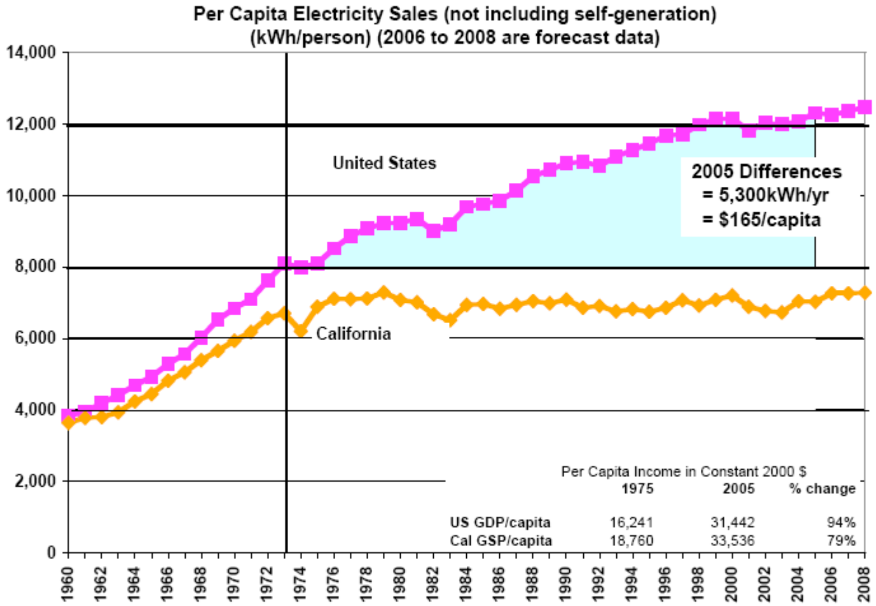
The finding that aggressive efficiency policy can offset baseline electricity demand growth is consistent with past experience. The most prominent case is that of California, where aggressive efficiency policy has been pursued for over three decades. There is a debate about what the California experience means, but the pattern of consumption, as depicted in Exhibit III-2 is impressive. The break in electricity consumption per capita in California compared to the national trend is striking and it is coincident with the uptick in the commitment to efficiency.

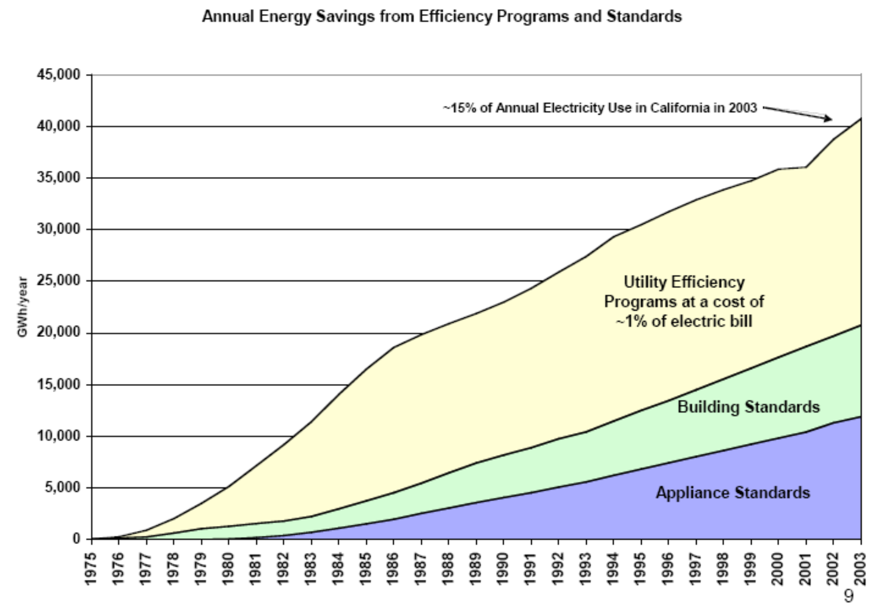
Exhibit III-2 shows annual electricity consumption per capita in California, but population was growing, so there was an increase in total electricity consumption. Between 1970 and 2007, when per capita consumption was flat, total consumption grew by about 1.3 percent per year. In the other states, it grew an average of 2 percent per year. Thus, consumption grew 50 percent faster in the rest of the nation than in California. That performance has attracted a great deal of attention.

The California analysis attributes a little less than half of the energy savings to standards for appliances and buildings. Slightly more than half of the energy savings is attributed to utility-targeted efficiency policy. A variety of challenges have been advanced to rebut the claim that efficiency policy is the key to the outcome in California. A close examination of the data suggests that efficiency policy had a significant impact, although other factors were at work as well.

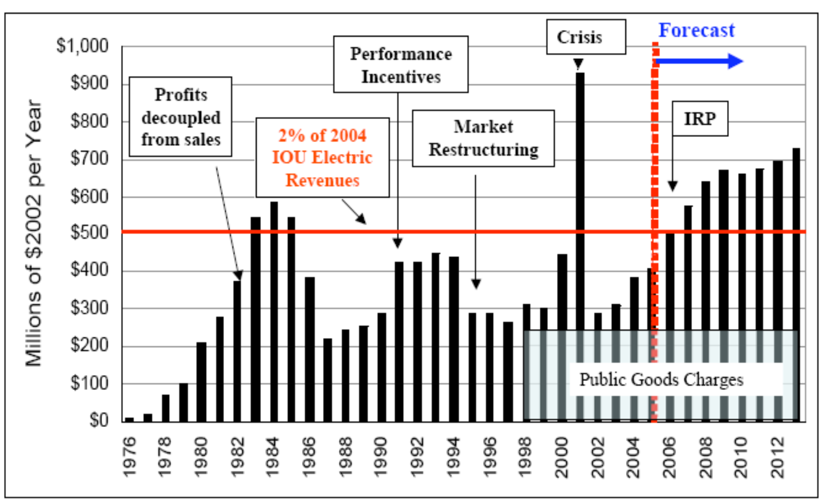
One of the primary uncontrolled factors is the shift in economic activity. If heavy industry leaves the state, electricity consumption will decline. To examine the broader issue, we utilize a database from the Energy Information Administration that allows us to sort out some of these issues. Exhibit III-3 shows the cumulative growth of electricity consumption in the 17-year period from 1990 to 2007 for the residential and industrial customer classes and the total sales for each for the states.

Exhibit III-2: Aspects of the California Success Story



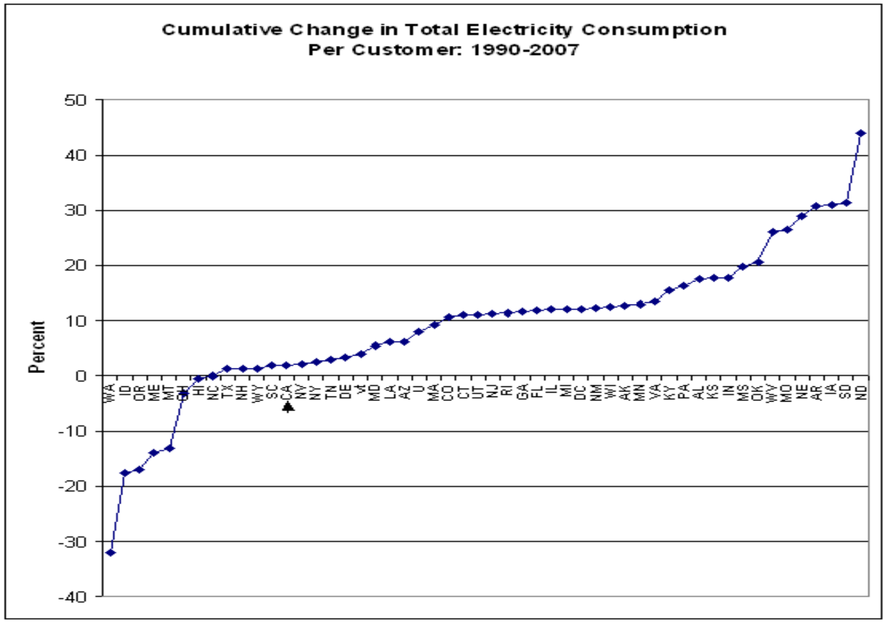


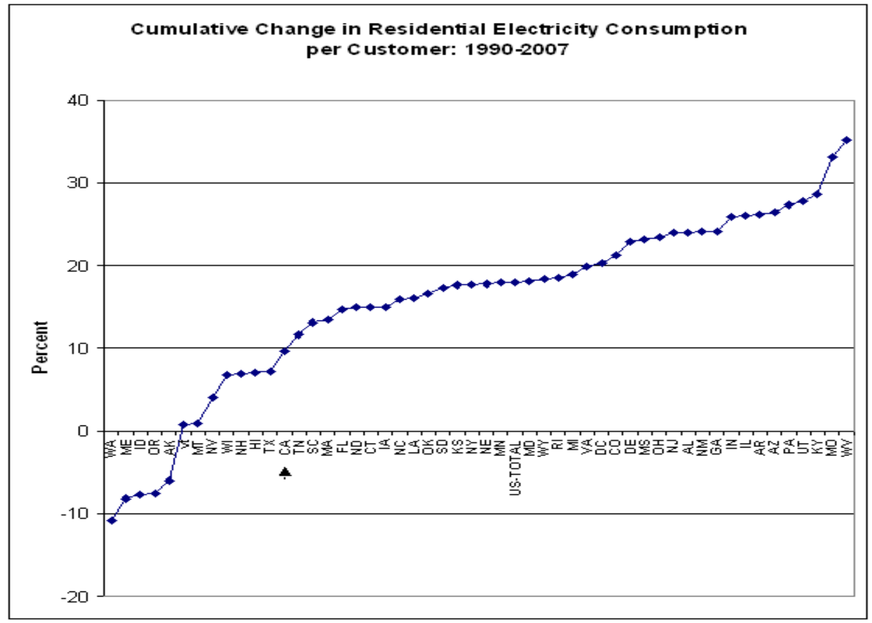
California IOU's Investment
in Energy Efficiency

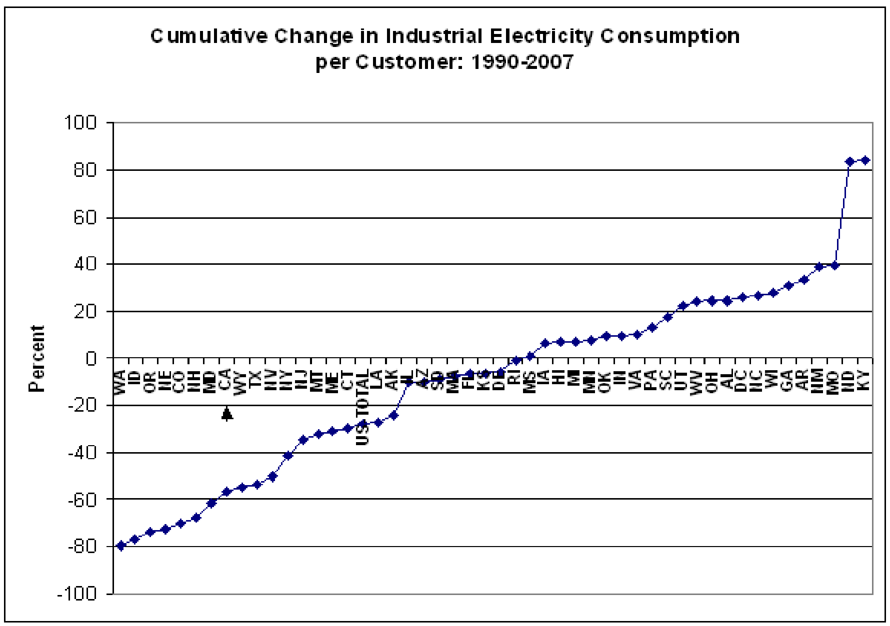


Source: Arthur H. Rosenfeld, *Energy Efficiency: The First and Most Profitable Way to Delay Climate Change*, Pacific Energy Center, San Francisco, May 19, 2008, pp. 8, 9, 18.

Exhibit III-3: Sectoral Increases in Electricity Consumption 1990-2007







Energy Information Administration, Retail *Sales of electricity by State by Sector by Provider*,
http://www.eia.doe.gov/cneaf/electricity/epa/sales_state.xls

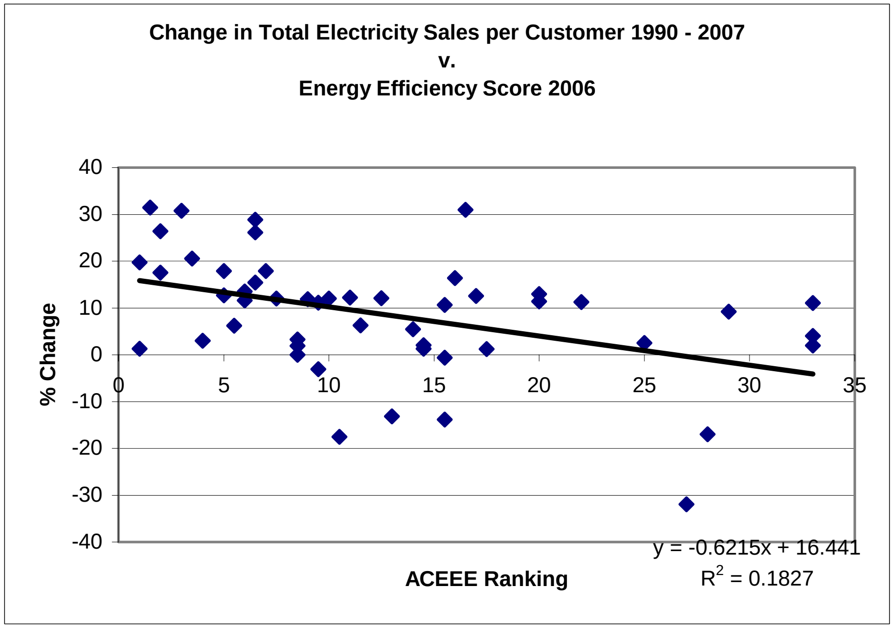
The exhibit shows why analysts might have thought that changes in industrial consumption of electricity could be hypothesized as underlying the apparent performance in California. We note that there is a much greater spread in terms of the increase in consumption in the industrial sector. However, we find that California ranks in the low teens in terms of increase in electricity consumption in each of the customer classes, as well as overall.

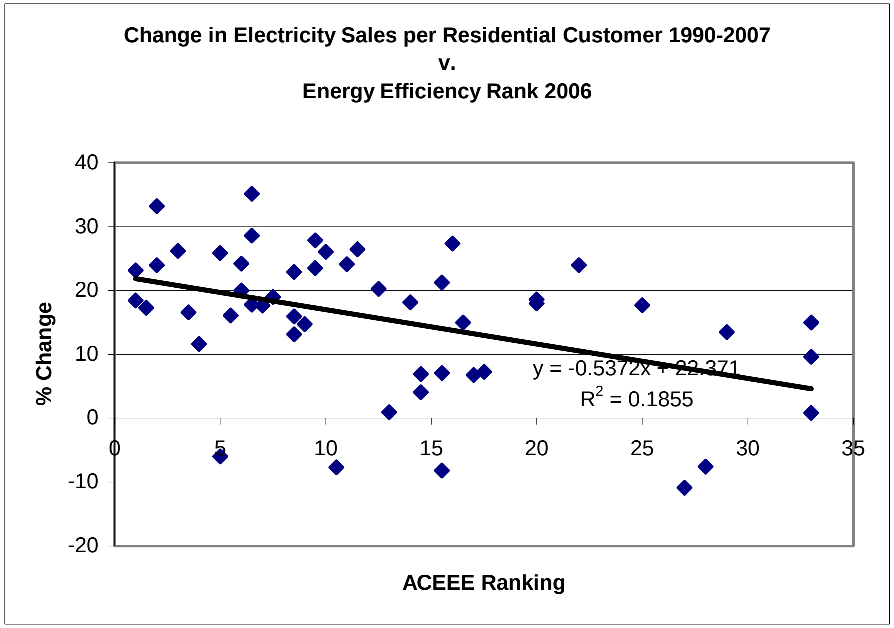
The fact that California only ranks in the low teens suggests that other states may have implemented energy efficiency policies that are as good as or better than California. The California analysis attributes its performance to energy efficiency policy. Combining the EIA database with a scorecard prepared by the American Council for an Energy Efficient Economy, we find that there is a statistically significant correlation between energy efficiency policy and changes in consumption (see Exhibit III-4). Here, we assume that the score represents the long-term practice of efficiency policy in the state over the 17-year period.

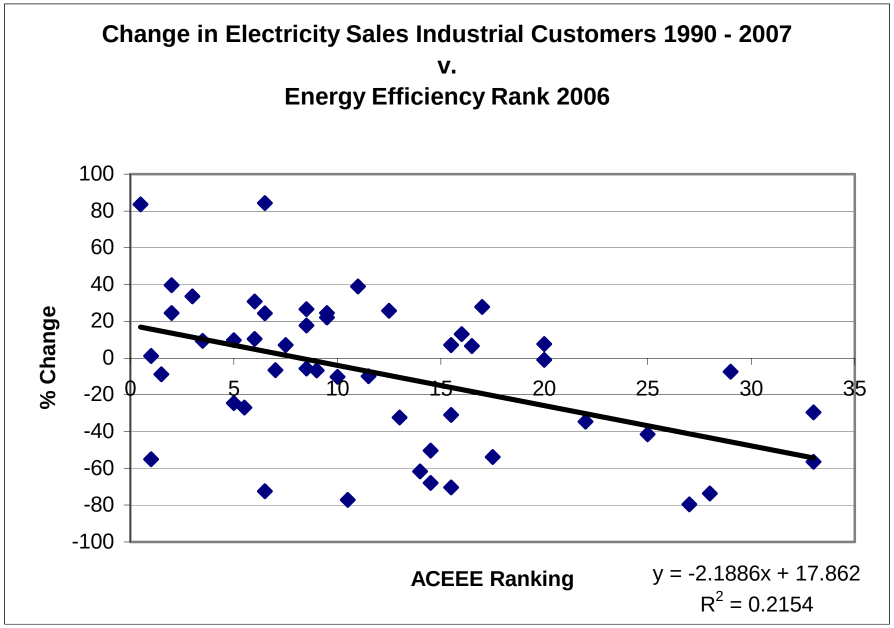
The higher the score on efficiency, the lower the rate of increase in consumption. The correlations for residential and industrial, as well as total consumption are statistically significant, but not large, explaining about one-fifth of the variance in change in energy consumption. Given the large number of factors that affect energy consumption, this should not be surprising.

Because there are large differences between the sectors in their past patterns of consumption and the relationship between efficiency policy and outcomes, Exhibit III-5 reexamines the potential energy savings analysis on a sectoral basis. Exhibit III-5 arrays the states according to their recent history of consumption in the three sectors. Most states have high levels of recent growth in two sectors, which should make them good candidates to lower the growth of consumption with efficiency policy.

Exhibit III-4: Efficiency Policy and Reduced Energy Consumption







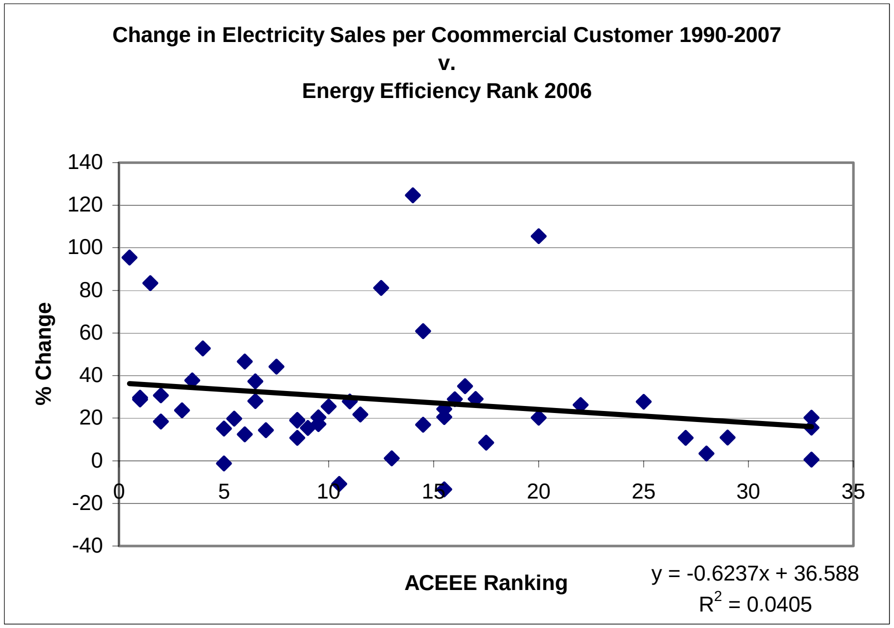


Exhibit III-5:

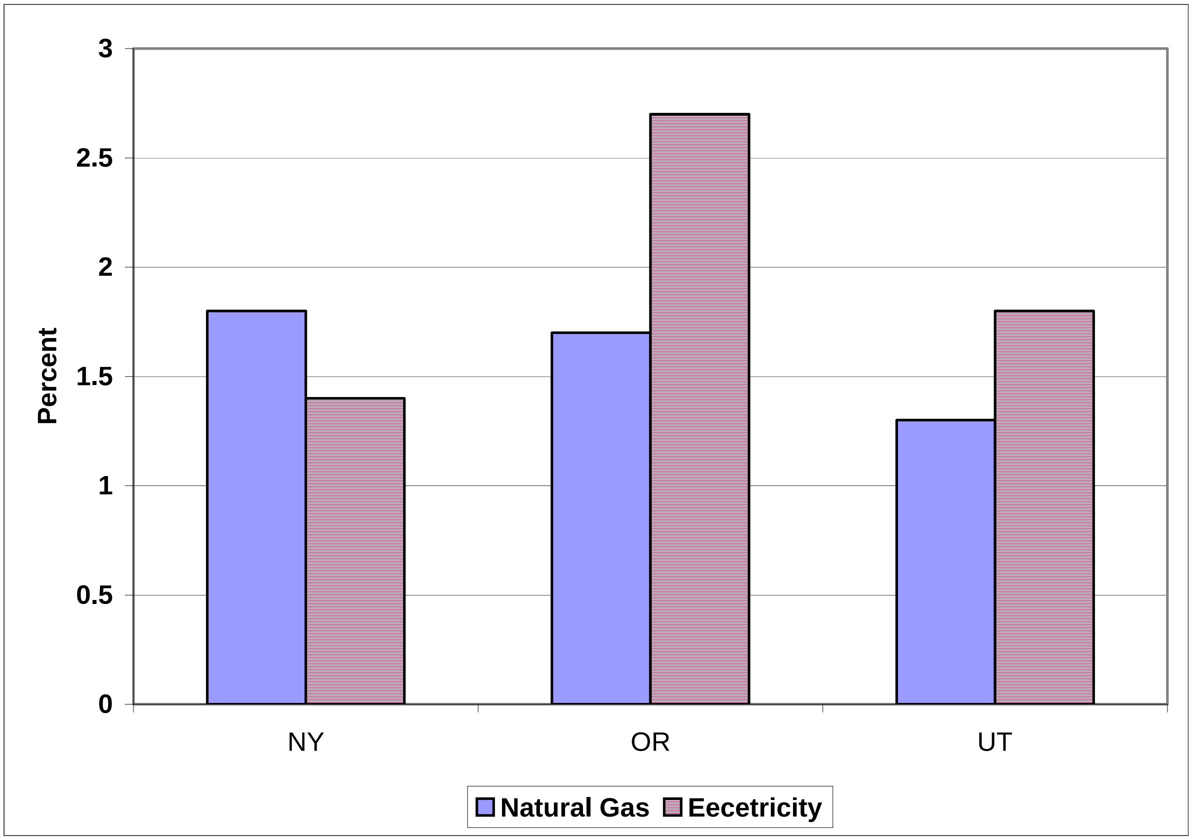
Natural Gas

Natural gas will play an important role in a low carbon future. Natural gas emits about one half as much carbon per kwh as coal. Natural gas can also be operated in a more flexible manner. Natural gas will be a vital generation source to couple with intermittent renewables. Or in combined heat and power applications (SHP). Thus, the efficiency targets for natural gas play a critical role in an integrated EERS/RES policy not only to reduce emissions, but also to couple with renewables.

The natural gas targets included in Waxman-Markey are one-third lower than the electricity targets, but they do not apply to natural gas used to generate electricity. The assumption is that natural gas savings in the electricity sector will result from the energy efficiency standard and the renewable standard. Thus, the target is lower and the base is smaller.

There are fewer detailed studies of natural gas potential energy savings. Of the eleven states included in Exhibit III-6, only three provide a similar analysis for natural gas. The order of magnitude of savings is similar as for electricity. Thus, it appears that the natural gas target in Waxman-Market is readily achievable. The combined effect of the EERS for electricity and natural gas would reduce consumption of natural gas by about 15 percent, freeing up gas to complement renewables of replace coal.

Exhibit III-6: Annual Energy Savings, Natural Gas and Electricity



Reductions in natural gas consumption have an added value to consumers because it is a commodity sold in a national market. A substantial reduction in demand puts downward pressure on commodity prices. This effect should be measured in the long-term and can be modeled as a shift in the demand curve. A recent study by the Rand Corporation suggests the long run supply elasticity is 0.4. That is, a 15 percent reduction in consumption would lower prices by 6 percent. Because natural gas prices clear in the national market, the price reduction applies to all units sold in the market. Under this assumption, cumulatively over the period of the EERS, the value of this price saving would be over $35 billion. Of course, the reduction in consumption mandated by the EERS/RES could be offset by the use of natural gas in other applications. In this case the price effect would not be felt, but the contribution of natural gas to a reduction in emissions would be increased.

IV. ALTERNATIVES: COST AND POTENTIAL

Even without climate change legislation, concern about rising electricity costs has been growing in recent years because the utility industry has worked off its excess capacity and is entering a building phase.[6] While the recession may slow that process down a bit, population and economic growth will shrink reserve margins and trigger a hunt to meet growing needs. Thus, alongside and separate from the burgeoning field of energy efficiency analysis, we have seen a spate of public studies about the cost of alternative generation options. Utilities frequently conduct such studies in the cloistered confines of public service commission rate cases, but the perception of a need for more generation has attracted a broader set of analyses. Of course, growing concerns about climate change also spurred interest, as coal and natural gas, two greenhouse gas-emitting fossil fuels, are the primary energy sources for almost three quarters of current U.S. generation.

The Cost of Alternatives

Unfortunately, the studies oriented to generation options tended not to include efficiency as an option. In Exhibit IV-1a only two of the studies that estimated the cost of a number of alternatives included efficiency. The cost estimates were similar to the estimates we derived above, so there appears to be a consensus on a cost of 2 to 5 cents. The 6 studies included in Exhibit IV-1a, have general agreement on the cost of most of the technologies, as shown in Exhibit IV-1b. The differences on biomass and wind reflect the fact that some studies identify different types of these technologies. There is a wide range of opinion on the cost of nuclear reactors in these studies and, in fact, other studies that focus only on nuclear have much higher estimates of nuclear costs. The carbon capture and storage costs are competitive with the nuclear reactor costs in these studies and substantially higher than the efficiency and renewables. We include the estimates of conventional fossil fuel base load plants for comparison.

Each of the studies makes a variety of assumptions about key factors that could lead to the differences in projecting costs, including capital requirements, construction costs, construction time periods, financial parameters, operating characteristics, plant lives and utilization capacities, etc. It is possible to identify precisely why they vary and offer an opinion about who is right, but that is not the purpose of this paper. The ranges of estimates make four points that are at the heart of the analysis in this paper.

- Even at the marginal cost of 5 cents per kwh, efficiency is far and away the least cost option, generally about half of the fossil fuel costs and a half to a third of nuclear costs.
- There are a variety of renewables (cogeneration, biomass, wind, geothermal, landfill) that are lower in cost than fossil fuel generation, even without considering the impact of carbon abatement costs. In other words, a renewable energy standard would lower consumer costs without a cap and trade program in place.
- Many of the efficiency renewable options are lower in cost than even the conventional base load options.
- The addition of carbon capture costs in a carbon-constrained environment adds substantially to the cost of fossil fuels and makes all of the alternatives more "attractive."

Exhibit IV-1a: Options for Meeting Electricity Needs

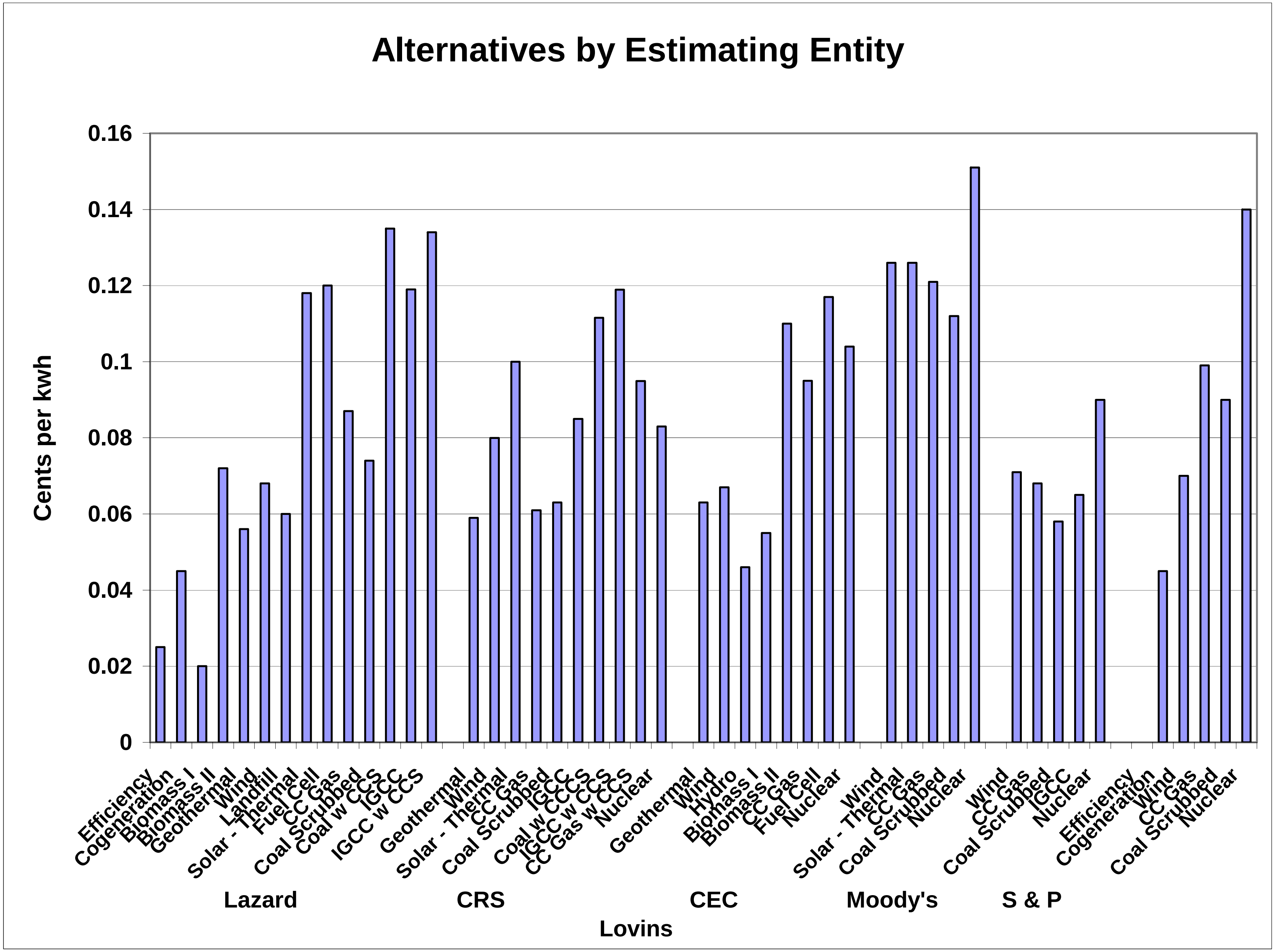
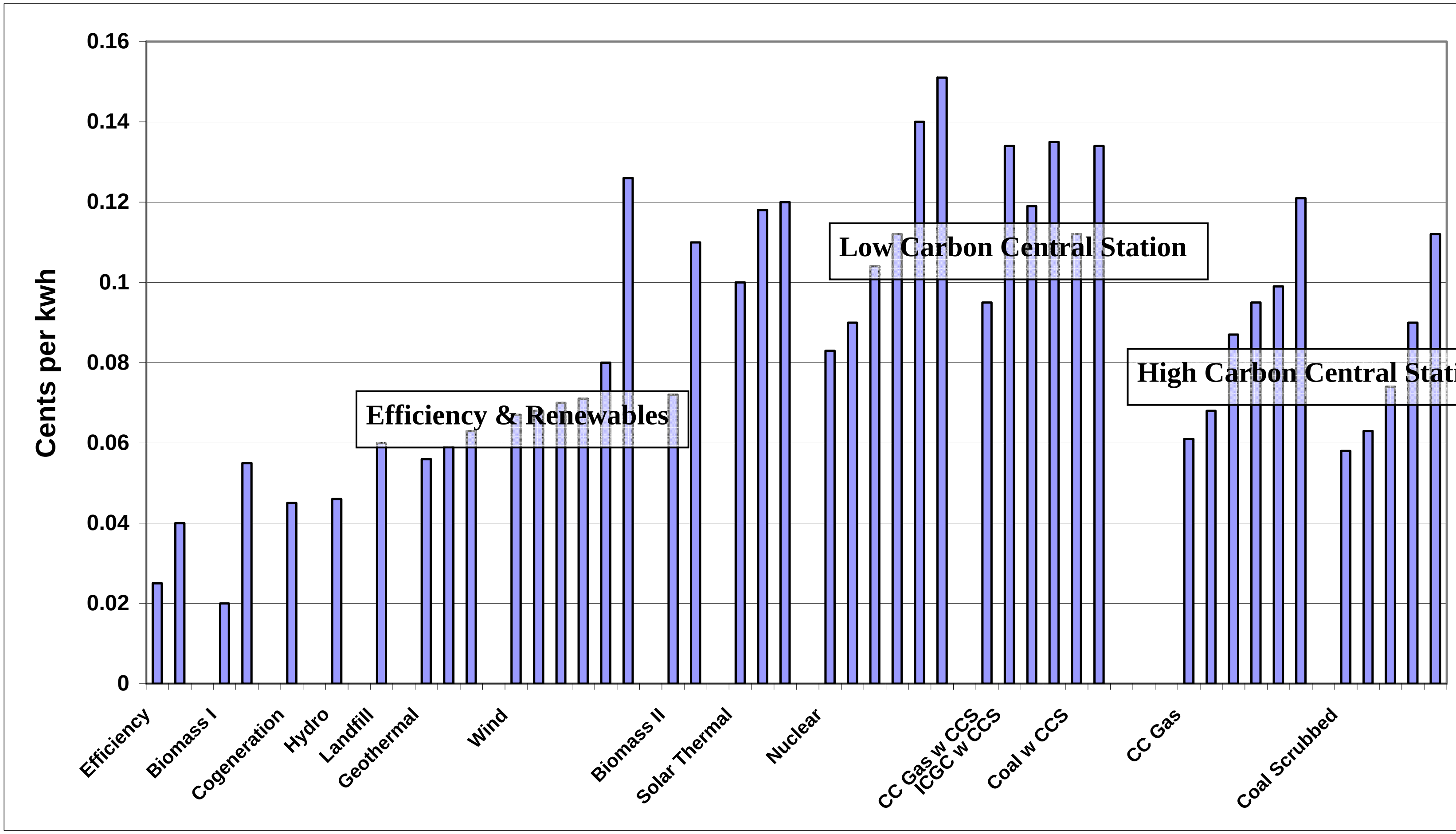


Exhibit IV-1b: Cost of Alternatives by Technology



Sources: Joel Klein, Comparative Costs of California Central Station Electricity Generation Technologies (Cost of Generation Model), ISO Stakeholders Meeting Interim Capacity Procurement Mechanisms, California Energy Commission, October 15, 2007 (CEC); Lazard, 2008, Levelized Cost of Energy Analysis—Version 2.0, June 2008, p. 10; Lovins Amory, and Imran Shiekh, and Alex Markevich, 2008b, Nuclear Power: Climate Fix of Folly?, December 31, 2008; Moody's, 2008, New Nuclear Generating Capacity: Potential Credit Implications for U.S. Investor Owned Utilities, May 2008, p. 15; Standard and Poors, 2008,The Race for the Green: How Renewable Portfolio Standards Could Affect U.S. Utility Credit Quality, March 10, 20008, p. 11; Kaplan, Stan, 2008, Power Plants: Characteristics and Costs, Congressional Research Service, November 13, 2008 (CRS).

The cost advantage of renewables is much smaller than the cost advantage of efficiency. The presence of several renewable options that are equal to (solar thermal) or higher in cost (solar photovoltaics) than fossil fuels makes it important to examine the issue of where renewable targets are set. There is huge debate over the potential for the long term.

The results of the efficiency analysis, demonstrating a potential for the maximum offset suggests that the integration of the two programs provides flexibility in the short term. Moreover, the fact that the renewable program is set up as a federal credit program renders state-by-state analysis less relevant. In theory that the individual utilities would minimize costs by producing the maximum cost-effective efficiency and renewables within their territories and then have recourse to the federal renewables credit market. Thus, the market-clearing price would not be the cost of renewables in individual states, but the market-clearing price in the nation.

There are six renewable technologies that are clearly lower in cost than central station facilities that would be compliant with the climate change goal (i.e. nuclear, central station coal with carbon capture and storage and natural gas with carbon capture and storage). Solar thermal is just cost competitive with large central station facilities. Solar photovoltaics, which much more costly at present, have not been included in Exhibit IV-1 because they are so much higher, they obscure the comparisons with other options. However, it should b noted that some of the analyses included in Exhibit IV-1 believe that the cost of photovolataics will decline sharply over the next decade and become competitive with the other renewables and substantially less expensive than central station options.

Potential

The critical question is, "could efficiency and the six low cost renewables meet the target of the Waxman-Markey bill?" The answer is **efficiency and renewables can go a long way toward meeting the need for electricity at a relatively low cost.** The Rand Corporation has recently drawn a series of supply curves for renewable energy for 2025. The middle case is shown in Figure IV-2.

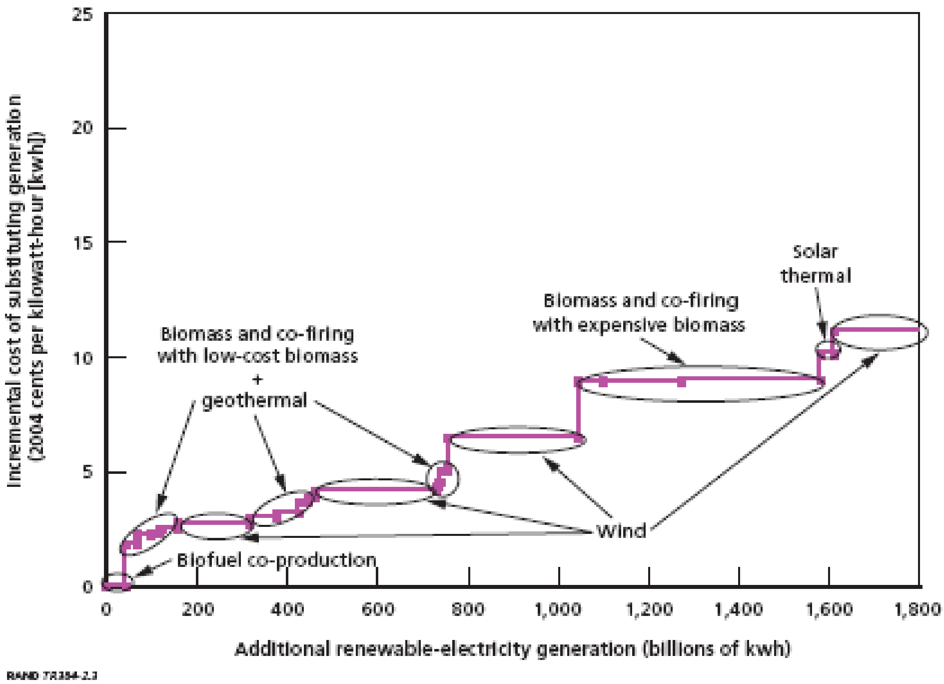
First note that the technologies are arrayed in exactly the same order and at about the same level of cost as in the earlier analysis. Thus, this supply curve is well defined in the literature.

Second, note the quantities that Rand projects can be supplied at these costs. The estimate of 1800 gwh is equal to 35 percent of the Energy Information Administration's 2030 forecast.

Third, as is frequently the case in such supply-side oriented studies, the analysis does not include any efficiency reduction in demand. We have seen that reductions in demand due to energy efficiency are in the 30 percent range based on the detailed studies.

Waxman-Markey EERS target of 15 percent reduction by 2020 and 20 percent for renewables by 2025 (including the efficiency offset) seems to fit within this supply curve.

Exhibit IV-2: A Renewable Energy Supply Curve



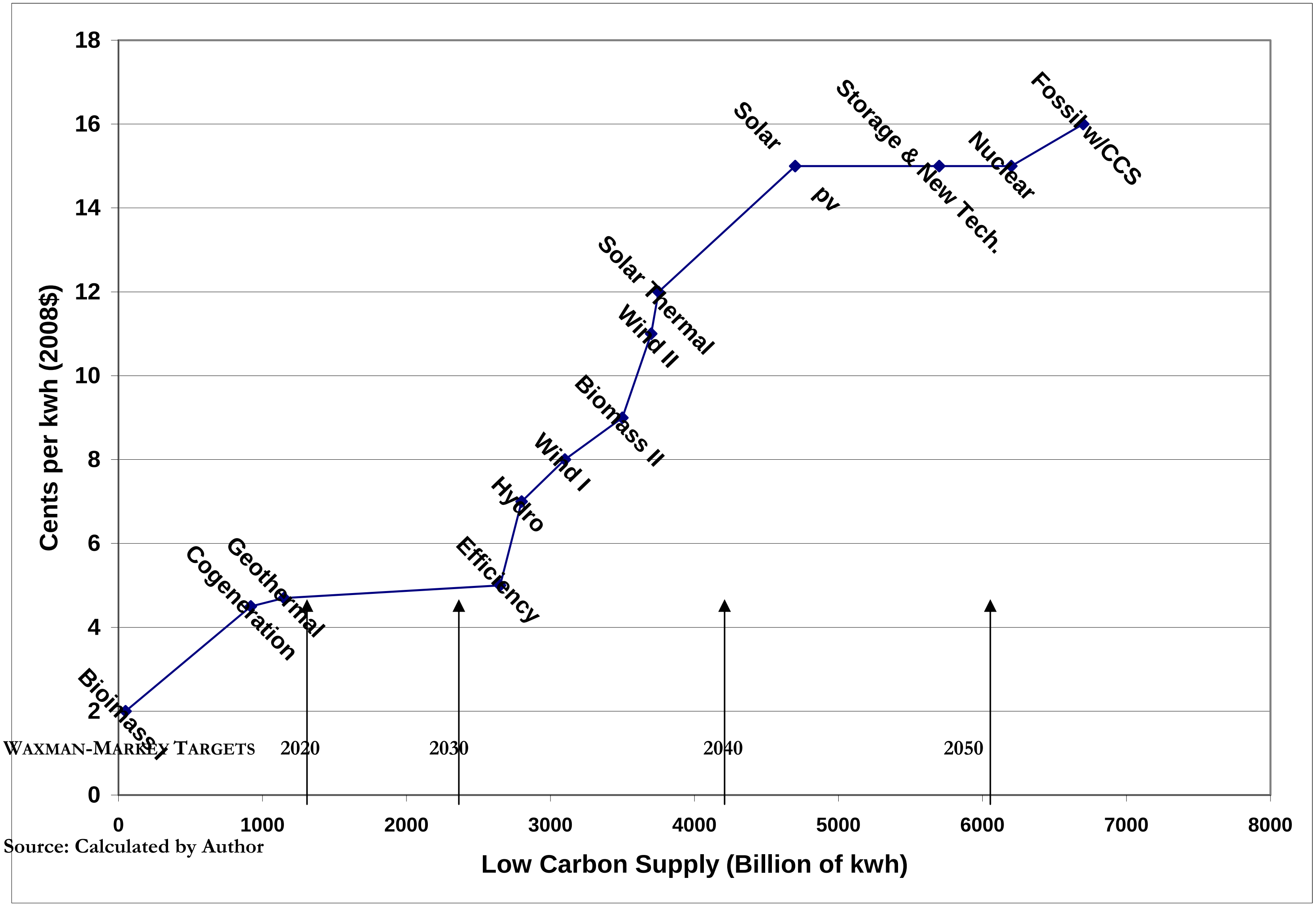
Source: **Tomin, Michael, James Griffin and Robert J. Lempert, 2008, Impacts on U.S. Energy Expenditures and Greenhouse Gas Emission of Increasing Renewable Energy Use, Rand 2008.**

The Markey Waxman bill would require less than half the quantity that could be supplied on this supply-curve. In fact, given the significant quantities of wind projected to enter the supply, it would be necessary to add natural gas, with or without capture and storage to manage the grid. This combination is less costly than the big-ticket central station options (nuclear and coal with capture and storage). Taking the demand-side and supply-side options to the limits of technical feasibility and economic practicability pushes the horizon out to 2040 or beyond. In other words, there is a large potential for efficiency and renewables to meet the need for electricity at costs far below the cost of central station plants.

In the economic studies of the alternatives discussed above, the central station options that the utilities prefer have a cost per kilowatt-hour of between about 12 cents and 17cents,[7] while efficiency has a cost of less than 5/kwh cents and renewables have a cost of 7 to 10 cents.

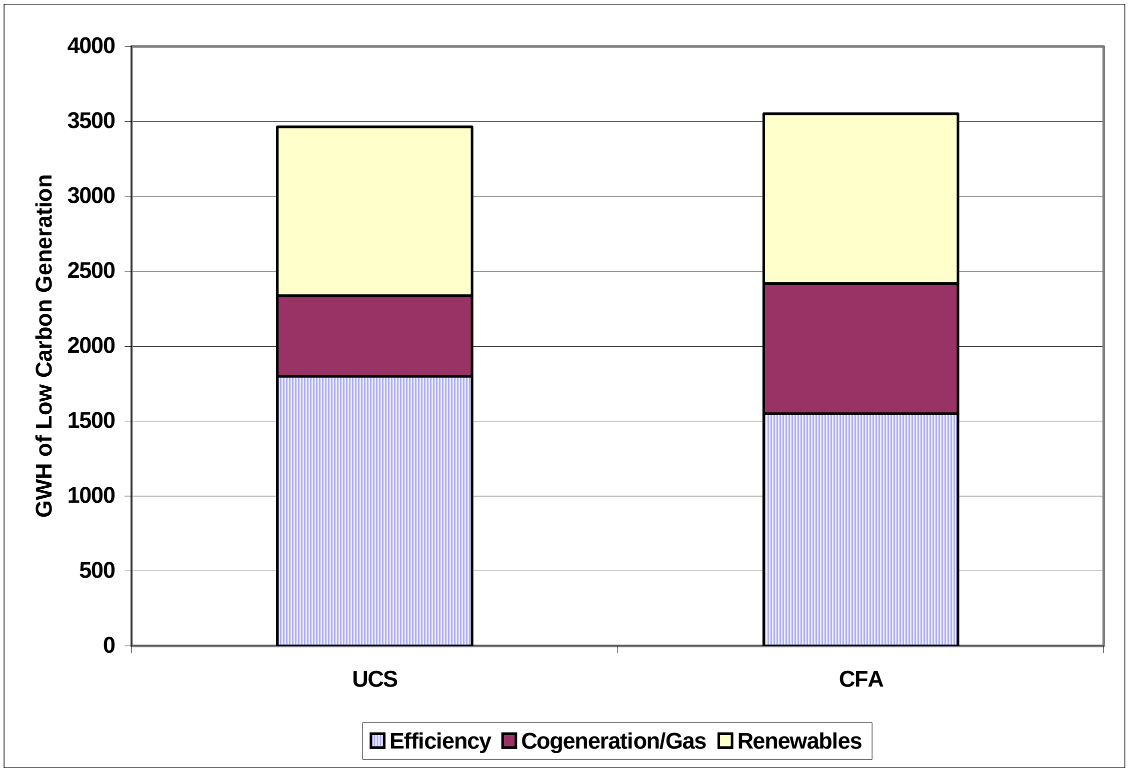
The Union of Concerned Scientists has recently provided an estimate of the supply mix for 2030. Exhibit IV-4 contrasts the UCS supply mix with the mix that occurs at the same level of supply on the supply curve in Exhibit IV-3. The supply mix is quite close.

Exhibit IV-3: Electricity Supply Curve in a Carbon Constrained Environment



Source: Calculated by Author

Figure IV-4: Efficiency and Renewable Meeting 3500 GWH Low Carbon



Source: UCS: "Testimony of Kevin Knobloch, President Unions of Concerned Scientists," before the Subcommittee on Energy and Environment, House Committee on Energy and Commerce, April 22, 2009; CFA: Exhibit IV-3.

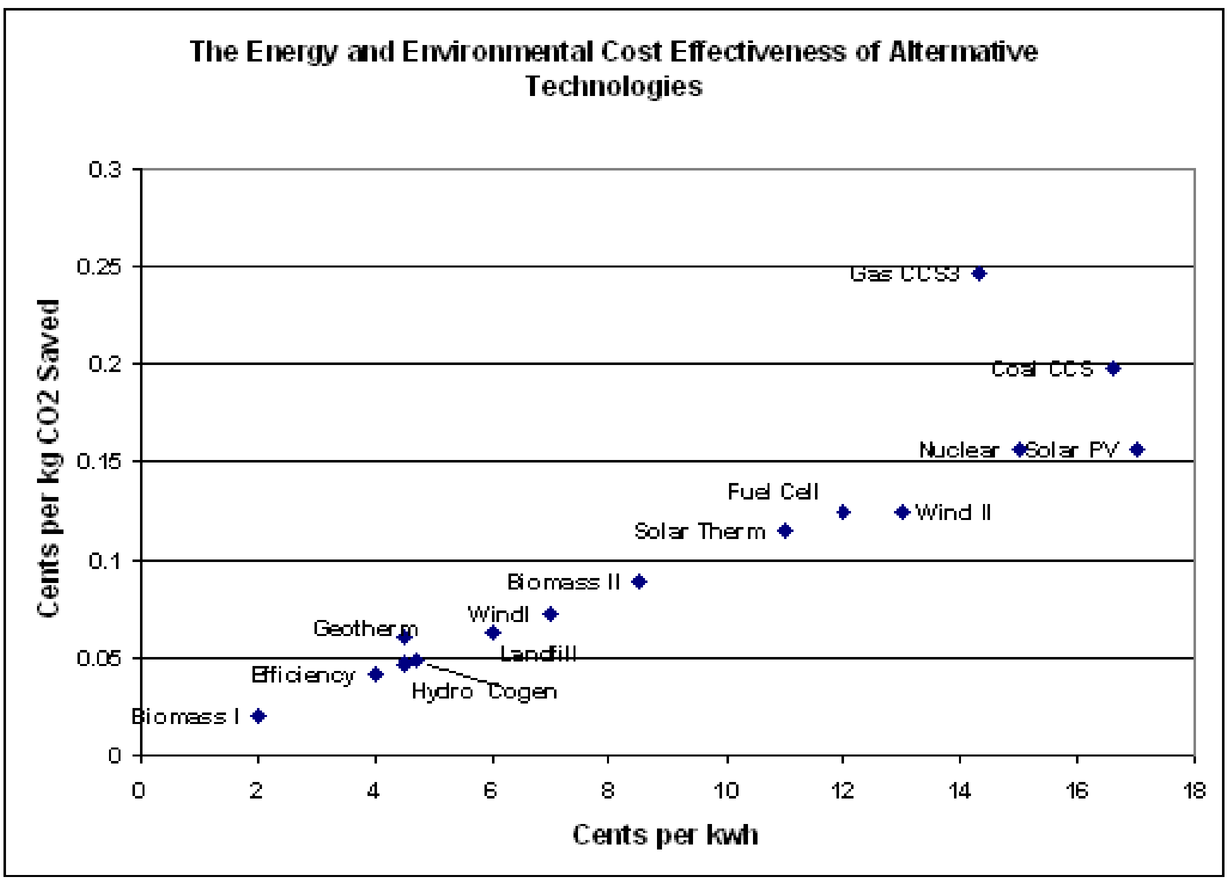
Using the Exhibit IV-3 cost curve based on these studies that includes efficiency the average cost of efficiency and renewables through 3500 TWH of generation are 6 cents. Compared to the central station costs of 12 to 15 cents this creates a huge potential cost difference. Using the low end the more expensive options, a 6-cent difference for 3500 TWH results in cost savings for consumers of over $280 billion per year. Clearly, consumers have a strong interest in an EERS/RES whether or not there is climate change legislation and if there is, the interest is even stronger.

The above analysis looks at the issue from the consumer point of view by calculating the cost of energy and electricity. It is also possible to look at the issue from the point of view of the cost of carbon abatement.

McKinsey and Company have done a number of studies that highlight the critical role that efficiency and renewables can play in policies to reduce greenhouse gas emissions. It draws the supply curve for CO_2 reductions. McKinsey cuts off its detailed analysis for a mid-range estimate of analysis CO_2 reduction at 3 megatons and a marginal cost of $50 per ton. McKinsey considered high range options up to a reduction of 4.5 megatons. The three megaton reduction in the sectors considered would carry the nation past to the 2030 Waxman-Markey goal, which requires a 2.9 megaton reduction by 2030 compared to the EIA base case. The 4.5 megaton reduction would carry the nation to more than three quarters of the ultimate goal of a reduction of 5.8 megatons below the EIA base case projected emissions. This potential reduction is split equally between demand-side (.7 megatons) and supply-side (.8 megatons). The demand-side measures are the dominant the negative and low cost options. Renewables fall in the middle range of cost (from $5 per ton to $35 per ton). Carbon capture and storage are seen as relatively high cost, at close to $50 per ton. The key take away from this analysis is that efficiency and renewables play a critical role in the near and mid-term to not only produce low costs reductions in emissions, but also to buy time for new technologies to develop to achieve the final increment in reduction that is needed.

McKinsey and Company approach the analysis with an assumption about the base cost of electricity, which is how they arrive at a negative cost for carbon abatement for efficiency (which meets the need for electricity at a cost lower than the assumed base). Others have taken a more direct approach. Since they have calculated the cost of producing, or savings electricity, they can calculate cost per kilogram of reduced CO2 emissions, without making an assumption about the underlying cost of electricity (see Exhibit IV-5). . The cost of electricity and the cost of carbon abatement, based on the studies included in Exhibit IV-1

Exhibit IV-5: The Energy and Environmental Cost Effectiveness of Alternative Technologies



Source: Calculated by Author

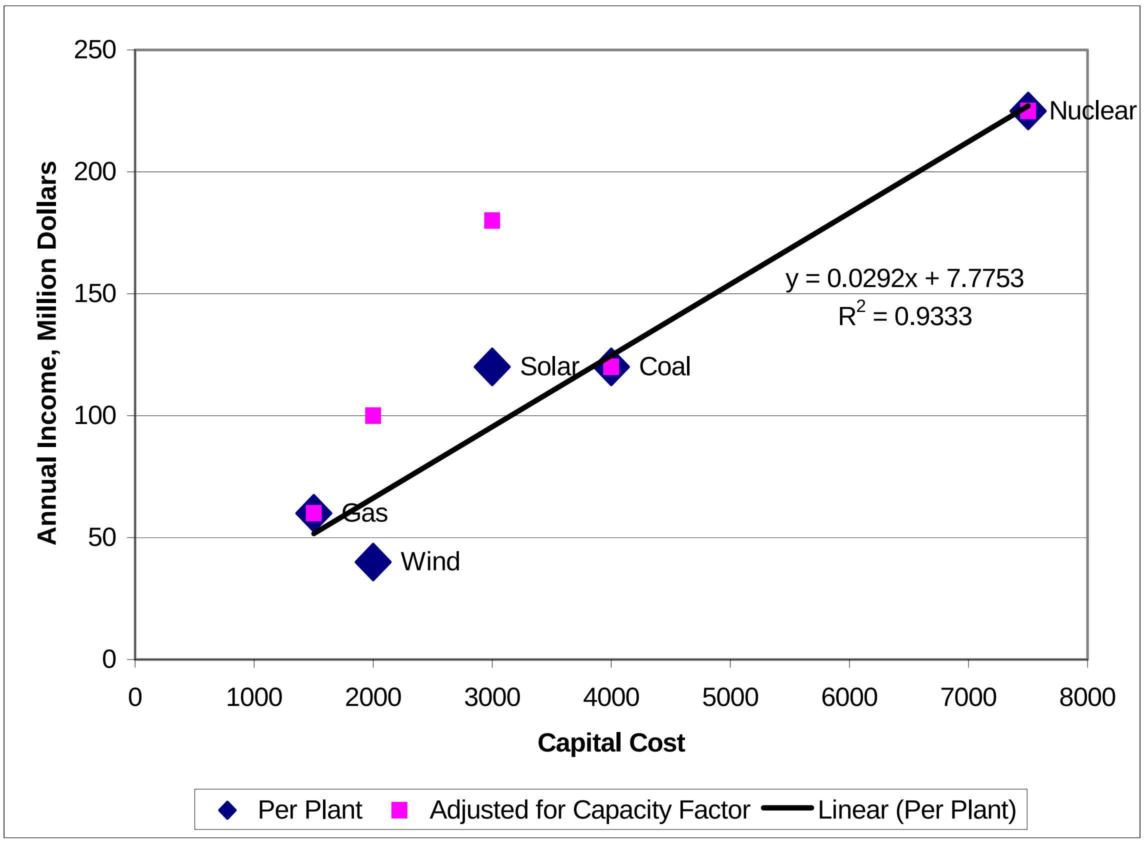
V. INCENTIVES AND MARKET IMPERFECTIONS

Utility Incentives

Utilities have a variety of reasons to refer the central station alternatives, even though they are more costly. They own central station facilities, which gives them a proprietary interest in and control over these facilities. Renewables are more likely to be owned by independent power producers, which means profit goes to those firms. Utilities are more comfortable managing a grid with large central station facilities.

The aspect of the preference for central station facilities that can be quantified is the motivation of investor owned utilities to maximize their profits. They increase their income by increasing the size of their rate base and seeking higher rates of return on the equity they invest to build the rate base. The financial analysis conducted by Moody's provides a way to measure and appreciate the bias that results form the utility income incentive (see Exhibit V-1). It

Exhibit V-1: Capital Costs and Annual Income of Various Generation Alternatives



Source: Moody's

presents the annual income earned in the first year by five different generation alternatives: gas, coal, nuclear, wind and solar, standardized as 1000 MW of capacity. Nuclear power plants would require twice as much capital as coal and generate twice as much income. Nuclear power would require about four times a much capital as gas and wind and generate four times the income on a per megawatt basis and about twice what coal and solar do on a per megawatt basis.

It can be argued that because wind and solar are intermittent, utilities would have to build more facilities, which would increase capital outlays and profits. In fact, as Biewald and others have argued, utilities would integrate gas and solar to achieve an equivalent quantity of power. To model this approach in Exhibit V-1, we have assumed the full cost of the intermittent renewable and a an investment in natural gas of equivalent capacity to raise the combined availability to that of the non-renewable source of generation with the highest load factor, which is nuclear. Even when the capital figures are adjusted for load factors, nuclear is still more capital intensive and generates more profits than solar, and coal would be more capital intensive and yield higher profits than wind.

The Moody's analysis includes only a limited number of options, and the other financial analyses included in Exhibit IV-1, which included more options, do not include a level of detail that would allow us to make a similar profit evaluation. However, the relationship between capital investment and income in the Moody's analysis is sufficiently strong to permit us to use it to predict what the income impact of the other generation alternatives would look like. The upper panel of Exhibit V-2 shows how we will use the Moody's analysis to estimate a capital cost income relationship. We use a linear predictor with the intercept set to zero (no capital expenditure, no income). The fit is quite good.

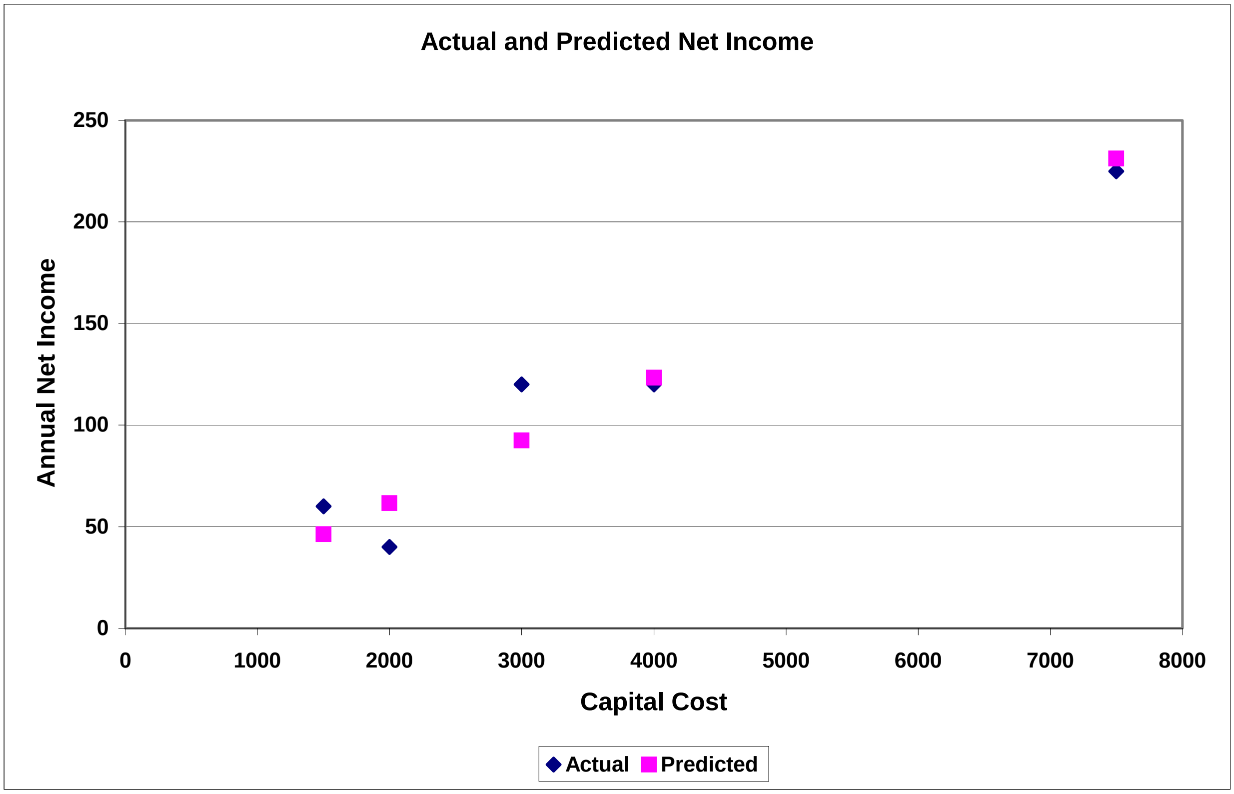
The bottom panel of Exhibit V-2 shows the utility net income estimates for the full set of technologies analyzed by Lazard, which was the most comprehensive set included in any of the analyses we utilized earlier to discuss costs. Note that the intermittent renewables' profits are somewhat affected by the carbon control costs because these costs are incurred by the natural gas plants that would be combined with the intermittent renewables to match the nuclear output level.

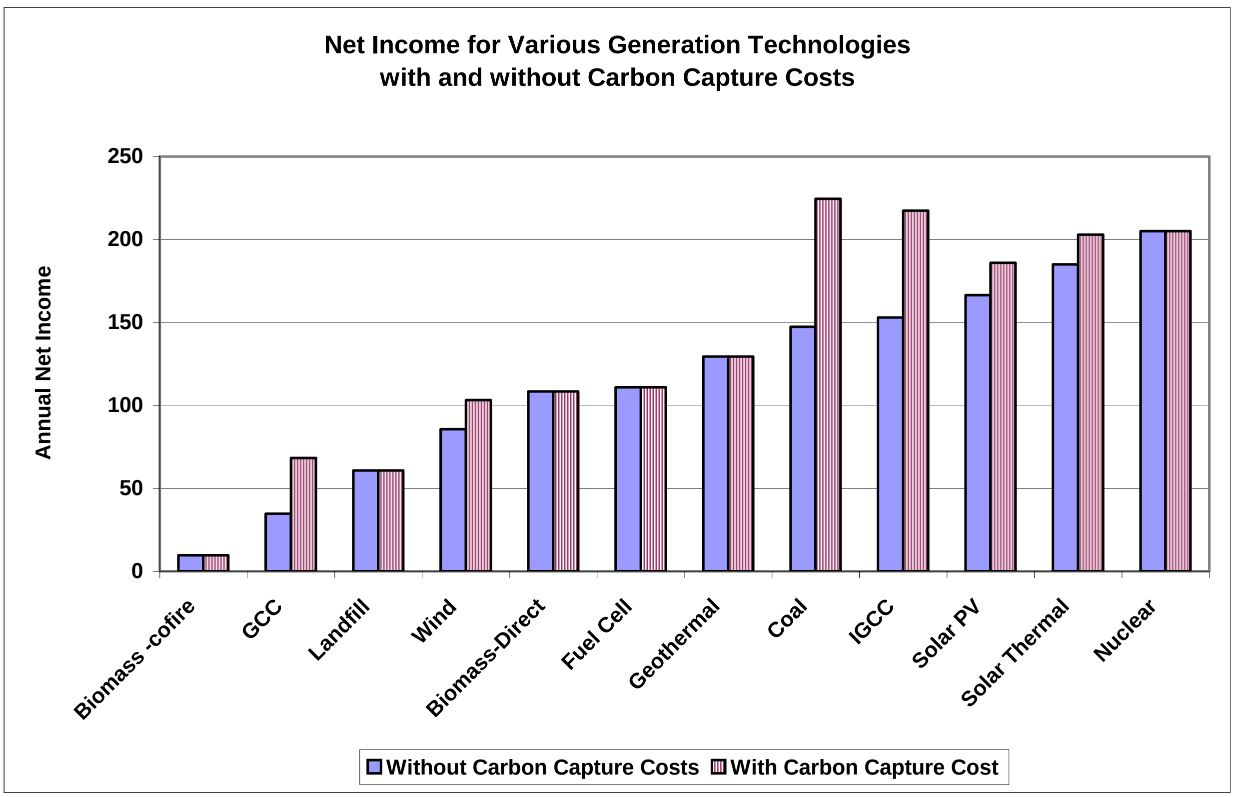
The implications of this analysis are clear. In a carbon cap and trade environment, IOUs have a strong incentive to pursue the capital intensive, central station options because those options dramatically increase their net income.

Exhibit V-2 does not include efficiency since it is difficult to estimate how much investment utilities get to rate base in efficiency programs. Under any reasonable approach to least cost planning and ratemaking, it would entail much smaller utility profits than the central station alternatives since the actual cost of efficiency is one half to one third of the generation alternatives and energy efficiency is likely to be much less capital intensive.

It should also be noted that the utilities are likely to ignore the lower cost renewables because in many cases independent power producers build them, so the returns to capital investment do not accrue to the IOU.

Exhibit V-2: Capital Outlays and Income for Various Generation Technologies





Why The Market Won't Take Care of the Problem

The utility industry claim that once a cap and trade system is put in place we do not need efficiency and renewable standards essentially argues that market incentives are all that is needed to solve the problem. Their profit incentive suggests the industry will pursue a high cost, high return approach. Contrary to their claim, the market cannot correct that bias. There is a plethora of market imperfections that result in market performance that is far from the optimum.

The existence of very low (or even negative) cost options is inconvenient for the simple market solution argument, since it implies major market imperfections, but it is central from the consumer point of view. These are opportunities that appear to reduce energy costs more than they cost to implement but they have not been seized. McKinsey and Company has undertaken the important task of identifying the sources of demand-side market failure,[8] while Resources for the Future has analyzed the sources of supply-side market failures.[9] Exhibit V-3 divides the imperfections into the short-term and long-term, supply-side and demand-side market imperfections.

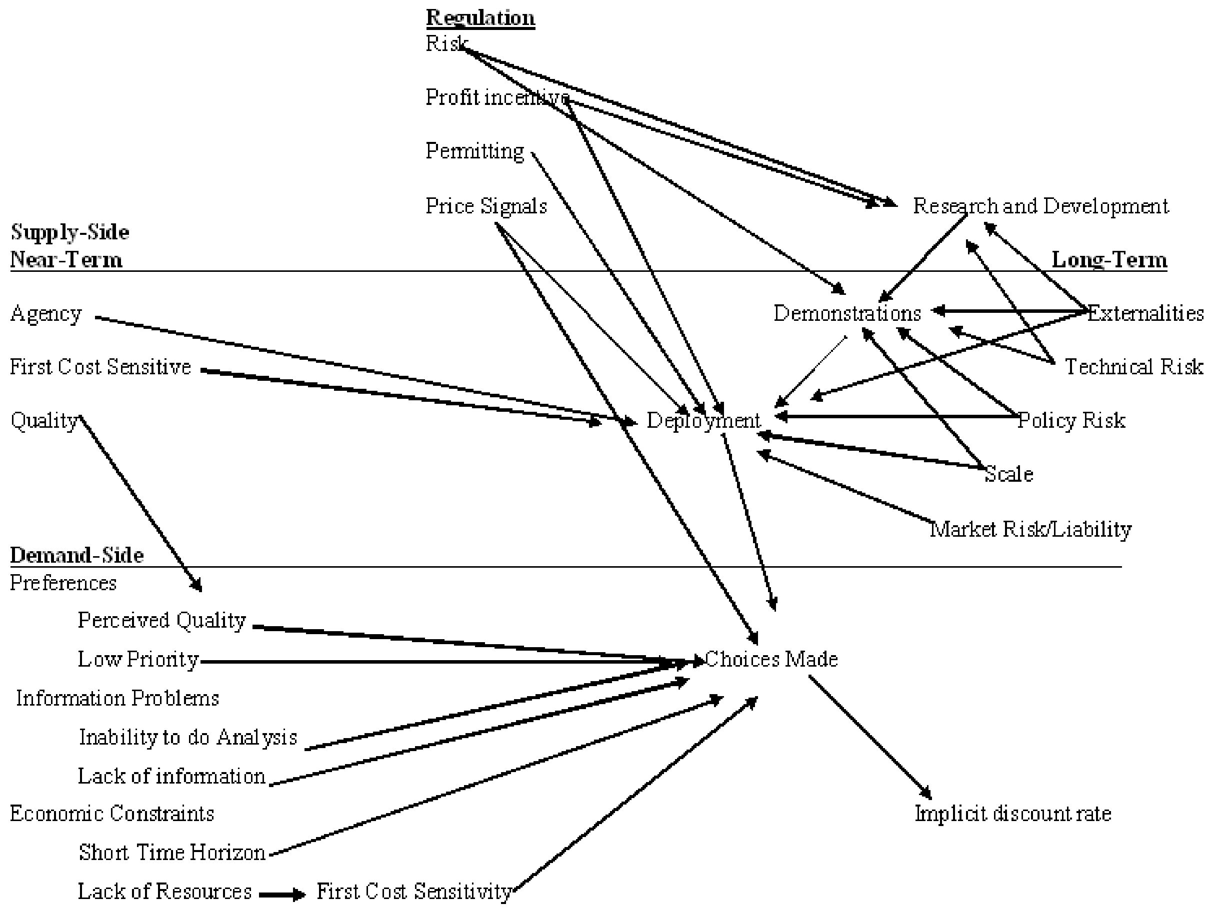
There are imperfections at every stage of the product cycle – research, development, demonstration and deployment. Demand-side efficiency in buildings and for appliances is a matter of deployment, but consumer behavior represents a small part of the overall challenge. Indeed, in the electricity sector many of the decisions are not made by consumers, but are made by builders and utilities acting as the agents for consumers, above all in their choice of appliance and generation facilities.

These observations eviscerate the knee-jerk, economist's attack on standards and mandates and other regulatory policies to target specific measures to reduce greenhouse gases.

- If mandates address market imperfections, they can help accomplish the goal.
- If the options targeted by the mandates are low cost (inframarginal), they are not likely to cause inefficiencies.
- Mandates force utilities to think about, analyze and invest in alternatives that are not their private preference, but are socially preferable.

We view the apparent high discount rate attributed to consumers as the result of other factors not the root cause of the demand-side problem. We do not accept the claim that consumers are expressing irrational preferences for high returns on efficiency investments, irrational because they appear to be a return that is so much higher than they can get on other investments they routinely have available. Rather, we view the implicit discount rate as a reflection of the fact that the marketplace has offered an inadequate range of options to consumers who are ill-informed, unprepared to conduct the appropriate analysis and who lack the resources necessary to make the correct actions. Adding the disconnect between the initial purchase decision and the bill-payer which constrains the choices available to consumers and we arrive at a complex set of imperfections that affect consumer behavior in the market. In short, an apparently irrational discount rate reflects market imperfections and failures, not irrational consumers.

Exhibit V-3: Imperfections Affecting Electricity Markets



Source: Derived from Raymond J. Kopp and William A Pizer, *Assessing U.S. Climate Policy Options* (Washington, D.C.: Resources for the Future, November 2007); Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? – McKinsey and Company for the Conference Board.

Demand-side: Consumers appear to apply high discount rates to energy efficiency investments,[10] are sensitive to first costs[11] and may not give efficiency a high priority in a multi-attribute product.[12] They lack the information necessary to make informed choices[13] and perceive differences in quality and the availability of options.[14] Even when they do consider efficiency investments, they may not find the more efficient appliances to be available in the marketplace.[15]

At the individual level on the supply-side, there is an agency problem – a separation between the builder or purchaser of buildings and appliances and the user.[16] Suppliers may not stock efficient appliances[17] and may not install it properly, as it requires different skills or considerations.[18]

This understanding of the nature of the market failure has important implications for policy choices. A consumer subsidy for efficiency or a performance standard to reduce consumption may contribute more to reduced emissions on the demand-side at a lower cost to society than a producer subsidy or regulatory relief that contributes by expanding supply. The policy needs to recognize both.

The Supply-Side; There are supply-side market imperfections at work in the electricity market as well. The broader range of supply-side market imperfections affects research, [19] development and demonstration, in addition to deployment.[20] Individuals or firms can be expected to make private calculations that minimize their direct cost, but they cannot be expected to recognize the very complex interactions in technologies[21] or to incorporate the value of avoiding some high cost options down the road (particularly when the options impose high costs on a dispersed set of individuals).[22] Similarly, the much lower cost of prefitting the energy efficiency of buildings compared to retrofitting building and production processes[23] may not be reflected in near term decisions.

Individual firms have little incentive to invest in basic research or to deploy enabling technologies because they have difficulty capturing the gains. These are investments, like transmission facilities, that are necessary to support a variety of complementary investments with large and lower cost abatement potentials.[24]

There are other critical technological development/deployment issues that arise at the societal level. Uncertainty about technologies in a space that is a whole new field of endeavor, one that emerges out of a policy concern rather than being the outgrowth of a market driven process, poses a unique challenge.[25] The economic value is contingent upon a continuing commitment to the policy.[26] Cost compression and learning/innovation resulting from economies of scale[27] is a similarly external benefit that policy may promote where individuals cannot.[28] More broadly, knowledge spillovers flow from technological development in a manner that may have much greater social value than individual firms can capture.[29] Similarly, network effects of complex energy systems may create social values that exceed the private value of individual actions. [30]

Regulatory institutions have traditionally played a prominent role in the electric utility sector. The travails of restructuring in the electric utility industry in the past decade ensure that a substantial part of the industry will remain regulated for the foreseeable future. From the point of view of market analysis, regulatory practices generally blunt the effects of market discipline, shielding consumers from price signals and providing utilities with perverse incentives with respect to investments in efficiency and abatement measures.[31] Beyond regulation of utility service, permitting of facilities has become a major area of concern.[32] The transformation of the electricity sector toward different sources of generation will require a transformation of the infrastructure to support it, which means deployment of new transmission capacity and a new set of generation of facilities[33] and new management practices.

There are other routine practices in the marketplace that may result in poor performance when more advanced energy efficiency applications are adopted. Existing regulatory structures may provide an obstacle to energy efficiency improvements in a number of ways. They may dampen price signals,[34] create profit motives to resist efficiency[35] or delay deployment of more efficient alternatives and the problem is not limited to conventional sources.

Conclusion

This paper has shown that there are numerous efficiency and renewable options to meet the mandates of an integrated EERS/RES that have lower cost than the options the utilities will choose if they are allowed to pursue their private profit incentives. Efficiency and renewable standards direct utilities to take actions that they otherwise would not engage in. The stakes for the consumer are huge. While the details of the near term goals of climate change legislation are in flux, the long-term challenge and targets remains the same. A low carbon future requires a fundamental transformation of the way the need for electricity is met. Efficiency and renewables can play a central role not only in meeting he environmental goals of climate change policy but also in mitigating the cost impact on consumers. By emphasizing efficiency and low cost renewables, any price increase can be prevented for decades. Utilities will not go down this low cost route on their own and market imperfections will prevent the low cost options from playing their proper role in the future low carbon resource mix. Consumers have a strong interest in an aggressive EERS/RES whether or not there is climate change legislation and if there is, the interest is even stronger. The mandate forces utilities to pursue options they will not pursue on their own.

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END NOTES

[1] Quoted in Juliet Eilperin, "House Climate Bill Aims to Please Environmental and Business Interests," *Washington Post,* April 1, 2009.

[2] Energy Information Administration, *Annual Energy Outlook 2009,* March 2009.

[3] Steven Stoft, "The Economics of Conserved-Energy "Supply" Curves," *Power,* PWP-028, April 1995, points to Alan K. Meier, *Supply Curves of Conserved Energy,* Lawrence Berkeley Laboratory, LBL-14686, May 1982 and Alan Meier and Arthur Rosenfeld, *Supplying Energy Trough greater Efficiency* (Berkeley, University of California Press, 1983) as well as several dissertations in the preceding five years as the origin of the formal concept.

[4] Kenji Takahasi and David Nichols, "Sustainability and Costs of Increasing Efficiency Impact: Evidence from Experience to Date," *ACEE Summer Study on Energy Efficient Buildings* (Washington, D.C., 2008), p. 8-367.

[5] Howard Geller, et al, *Utah Energy Efficiency Strategy: Policy Options,* October 2007, pp. 8-9.

[6] North American Electric Reliability Corporation, *2008 Long-Term Reliability Assessment: 2008-2017,* October 2008, was considerably more optimistic than the 2007 report, but still shows reserve margins falling below desired levels in five to 10 years even assuming responsive adjustments by utilities.

[7] The Moody's cost for nuclear is $0.151 per kwh; the Moody's costs for coal and natural gas without carbon capture and storage are $0.112/kwh and $0.121/kwh, respectively. The Kaplan study for the CRS develops estimates for carbon capture and storage of $0.048 for coal and $0.033 for natural gas. Thus, $0.12/kwh is a conservative, estimate for to cost of central station approaches to reductions in carbon emissions.

[8] Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? – McKinsey and Company for the Conference Board.

[9] Raymond J. Kopp and William A Pizer, *Assessing U.S. Climate Policy Options* (Washington, D.C.: Resources for the Future, November 2007).

[10] McKinsey, p. 41. "Consumers expect many household investments to have a short, 2- or 3- year payback period, which implies a discount rate of nearly 40 percent… Builders have an incentive to minimize first costs at the expense of operating cost or carbon efficiency (pp. 40…41).

[11] McKinsey, p. 41,"In addition, affordability constraints may reduce the willingness of consumers to invest in measures offering greater efficiency, even if the financial benefits are satisfactory."

[12] McKinsey, p. 40, "Efficiency is not a top priority for consumers."

[13] McKinsey, p. 41, "Customers typically have no accurate information about the energy consumed by any particular application. Consumers, architects, engineers, builders, contractors, installers, and building operators are often not aware of savings potential, or are poorly informed about performance benefits."

[14] McKinsey, p. 41, "Real or perceived quality differences can deter consumers… In some cases, consumers worry that high-efficiency devices (such as some washing machines and dishwashers) will not perform as well as conventional models."

[15] McKinsey, p. 41, "Even when consumers intend to purchase energy efficiency devices, they may have a hard time finding the item, due to a retailer's approach to inventory management and stop optimization."

[16] McKinsey, p. 41, "The owner, operator, occupant and bill-payer (benefit capturer) associated with a building may be separate entities or may not be involved for the full relevant time period; a result,

their interests in supporting energy efficiency and GHG abatement are not aligned."

[17] McKinsey, p. 16, "Even when consumers intend to purchase energy efficient devices, they may have a hard time finding the item, due to a retailer's approach to inventory management and stock optimization."

[18] McKinsey, p. needs to be completed.

[19] Resources for the Future, pp. 118-120, "R&D tends to be underprovided in a competitive market because its benefits are often widely distributed and difficult to capture by individual firms…. economics literature on R&D points to the difficulty firms face in capturing all the benefits from their investments in innovation, which tend to spill over to other technology producers and users."

[20] Resources for the Future, p. 120, "For technology policies to help achieve a given level of emissions reductions at lower overall social cost than an emissions-pricing policy alone, they must be targeted to addressing market problems *other than* emission reductions per se."

[21] Many technologies have competing or multiplicative (rather than additive) impact. The most compelling economics typically reside with the first abatement options in the analytical sequence. Pursuing energy efficiency in electric power, for example, has the potential to reduce the number of new coal-fired power plants needed.

[22] Resources for the Future, p. 120, "The mismatch between near-term technology investment and long-term needs is likely to be even greater in a situation where the magnitude of desired GHG reductions can be expected to increase over time. If more stringent emissions constraint will eventually be needed, society will benefit from near-term R&D to lower the cost of achieving those reductions in the future."

[23] McKinsey, p. 40, "Switching to alternative designs may incur added costs for retrofitting."

[24] McKinsey, p. 25, "Similar sequencing effects occur throughout the power and transportation sector in particular."

[25] Resources for the Future, p. 120, "The problem of private sector under-investment in technology innovation may be exacerbated in the climate context where the energy assets involved are often very-long lived and where the incentives for bringing forward new technology rest heavily on domestic and international policies rather than natural market forces."

[26] Resources for the Future, p. 120, "Put another way, the development of climate-friendly technologies has little market value absent a sustained, credible government commitment to reducing GHG emissions."

[27] McKinsey, p. 25, "Costs and/or yields for some technologies improve according to the scale at which they are pursued. Penetration levels tend to drive the learning rate and can determine whether the technology achieve sufficient scale to propel economic success. Solar photovoltaics, CCS, biofuels, and LED lighting exhibit a broad range of outcomes depending on innovation and cost compression associated with reaching commercial scale."

[28] Resources for the Future, p. 136, "Another potential rationale involves spillover effects that the process of so-called "learning-by-doing" – a term that describes the tendency for production costs to fall as manufacturers gain production experience."

[29] Resources for the Future, "In addition, by virtue of its critical role in the higher education system, public R&D funding will continue to be important in training researchers and engineers with the skills necessary to work in either the public or private sector to product GHG-reducing technology innovations (p. 120)… Generic public funding for research tends to receive widespread support based on significant positive spillovers that are often associated with the generation of new knowledge. (p. 136)."

[30] Resources for the Future, p. 137. Network effects provide a motivation for deployment policies gained at improving coordination and planning – and where appropriate, developing compatibility standards – in situations that involve interrelated technologies, particularly within large integrated systems (for example, energy productions, transmission, and distribution networks). Setting standards in a network context may reduce excess inertia (for example, the so-called chicken-and-egg problems with alternative fuel vehicles), while simultaneously reducing search and coordination costs, but standards can also reduce the diversity of technology options offered and may impede innovation over time.

[31] "McKinsey, p. 60, some plants may be unwilling to make these capital investments, however, because the investments could trigger a requirement to install the best available environmental control technology (e.g. New Source Review), leading to additional – and potentially unrecoverable – investments…Furthermore, fuel costs are often passed through directly to rate payers, though capital investments must be recovered through base-rate increases."

[32] Resource for the Future, p. 136. The successful deployment of new technologies often requires better information and verification methods; infrastructure planning, permitting, compatibility standards, and other supporting regulatory developments; and institutional structures that facilitate technology transfer

[33] McKinsey, p. 61, "Wind also suffers additional challenges related to permitting and public acceptance, which cerate policy and social barriers to full capture of the resource potential."

[34] McKinsey, p. 41, "In many markets, electricity customers do not see the real cost of power, which limits the potential for prices signals to change behavior."

[35] McKinsey, p. 39, "CHP is projected to provide abatement at negative costs, but it faces significant implementation challenges, including costly interconnections with the power grid, lengthy processes for environmental approvals, local zoning restrictions, as well as site infrastructure, such as adequate space and compatible distributive systems."