Impacts of Energy Efficiency And Renewable Energy On Natural Gas Markets in the Pacific West

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Glossary of Terms

Energy and Power Units

British thermal unit (Btu): basic unit of energy; amount of energy required to raise the temperature of one pound of water by one degree Fahrenheit

Million Btu (MMBtu): 1,000,000 Btu, roughly equivalent to 293 kilowatt-hours of electricity or 8 gallons of gasoline

Quad = quadrillion Btu = 1,000,000,000,000,000 Btu, about 1 percent of current U.S. total energy use on an annual basis; enough energy to heat about 22 million homes for one year or to power 15.7 million cars annually (driving an average of 14,000 miles per year at 27.5 miles per gallon)

Therm = 100,000 Btu

Decatherm = 10 Therms = 1 MMBtu

Watt (W): basic unit of power = 0.74 ft-lbs/sec = 0.0013 horsepower

Kilowatt (kW) = 1,000 Watts

Megawatt (MW) = 1 million Watts

Kilowatt-hour (kWh) = 3,412 Btu

Megawatt-hour (MWh) = 1,000 kWh

Natural Gas Units

Cubic foot (cf): basic unit of natural gas delivery = ~1,030 Btu

Thousand cubic feet (Mcf) = ~ one million Btu

Million cubic feet (MMcf) = ~ one billion Btu

Billion cubic feet (Bcf) = ~ one trillion Btu

Trillion cubic foot (Tcf) = ~ one Quad

Billion cubic feet per day (Bcf/d) = 0.365 Tcf per year = ~375 trillion Btu

Market Terms

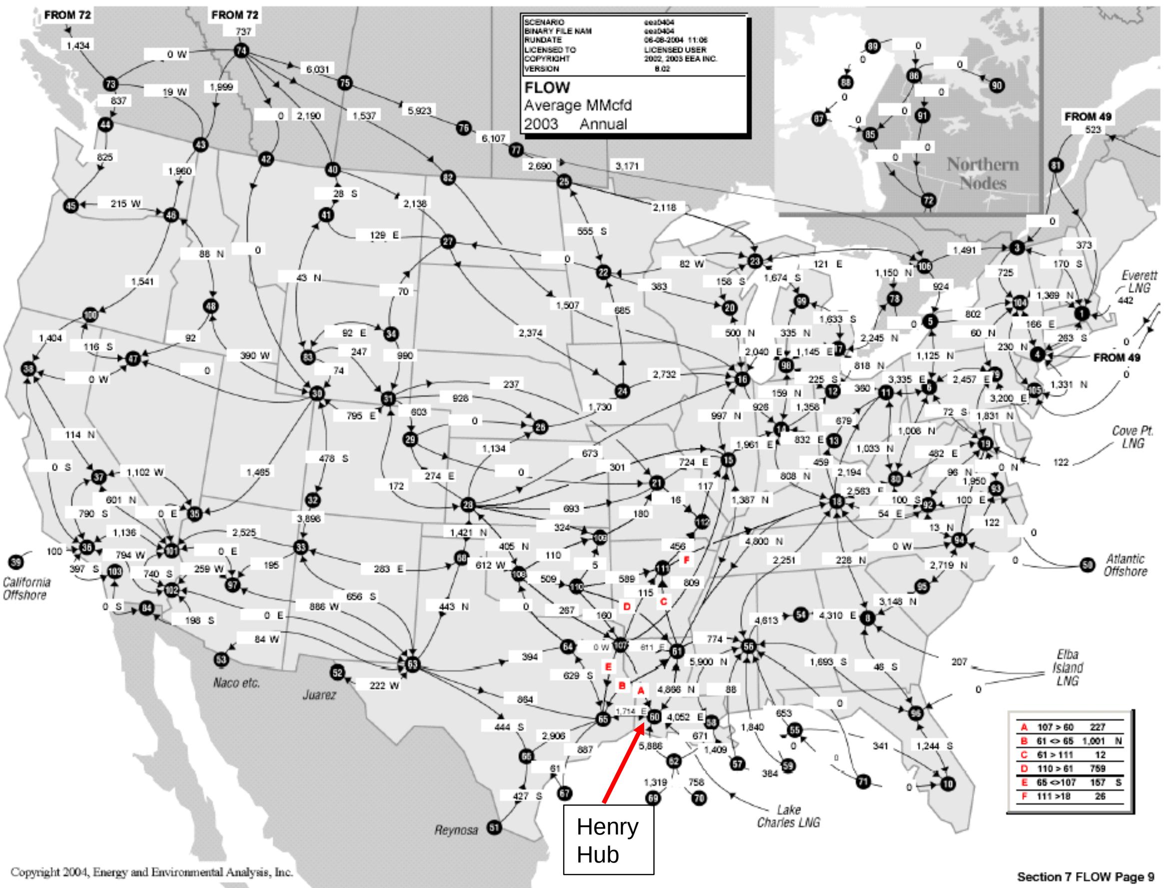
Distributed generation: electric power generation located at or near the point of use.

Renewable generation: electric power generation from a renewable energy source such as wind, solar, sustainably harvested biomass, or geothermal.

Demand destruction: reduction in industrial plant operation or plant closures that result in reductions in energy demand.

Liquefied natural gas (LNG): Natural gas that is chilled to the point that it is a liquid at atmospheric pressure. Used when storing natural gas in distribution locally for extended periods or transporting it for long distances, usually by ship.

Henry Hub: The market price for natural gas is by convention set at the Henry Hub (which is a physical location in southern Louisiana where a number of pipelines from the Gulf of Mexico originate, as shown in the figure below). Futures and spot market contracts for delivery of gas are traded on the New York Mercantile Exchange (NYMEX), with regional wholesale prices set at key hubs where pipelines originate or come together. These prices are set relative to the Henry Hub price with adders for transportation and congestion.



Abstract

ACEEE's updated study of an accelerated energy efficiency and renewable energy investment scenario in the Pacific West states shows that these resources could bring down Pacific West wholesale natural gas prices by up to 38% and retail prices by 20%, saving about $100 billion in gas costs for energy users in the region through 2020, and over $300 billion nationwide. Because new natural gas supply options for the region are limited and will take many years to bring on line, efficiency and renewables are the only resource option available to policy-makers in the near term.

ACEEE used the *North American Gas Markets Model* developed by Energy and Environmental Analysis, Inc. (EEA), the same model used by the National Petroleum Council in its major 2003 study of the nation's natural gas policy future. We developed detailed projections for additional energy efficiency and renewable energy resource acquisitions in the three-state region, which were then used in the EEA model to estimate effects on whole prices, consumption, and other effects.

Realizing the benefits of increased efficiency and renewable investment will require both private and public investment. In the first five years, about $19 billion of direct resource investment will be needed, supported by about $5 billion in public policy and program activity. While ongoing investments beyond year five will be needed to sustain savings at the levels projected in this analysis, we expect that benefits would substantially exceed costs in these out-years. This efficiency and renewables investment scenario would thus be very cost-effective.

The principal policy recommendations are to:

- Increase public benefits funding and deployment program expansion
- Set resource acquisition targets for utilities
- Institute new appliance efficiency standards
- Upgrade building energy codes
- Enhance distribution generation policy support
- Mount new public education and promotion efforts

Acknowledgments

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Introduction

Beginning in 2003, ACEEE issued a series of white papers and reports that explored the relationship between increased energy efficiency and renewable energy investment and the price of natural gas (Elliott et al. 2003a, 2003b). This work has garnered significant attention from the public policy community, supported by statements from public policy leaders, environmental groups, and industry consumers (Principles 2005). Other researchers have explored various aspects of this issue from a theoretical perspective (Laitner 2004), an analytical perspective (UCS 2004a; USPIRG 2005; Wiser, Bolinger, and St. Clair 2005), and a long-term economic modeling perspective (Hanson and Laitner 2004). While ACEEE's original research received favorable critical review, a number of additional questions have been raised. The analysis looked only at the combined impacts of energy efficiency and renewable energy on a near-term, five-year period. Researchers and policy-makers who reviewed our work wanted to know the impacts of energy efficiency alone, plus the longer-term effects of energy efficiency and renewable energy investment on natural gas markets. In April 2005, ACEEE released an updated and expanded report (Elliott and Shipley 2005) that sought to address these questions, while also presenting further insights into the relationship between energy demand and natural gas markets gained in the course of the analysis. We also updated our analysis to reflect market developments that occurred in the past year.

Building on the April 2005 report, we also updated the analysis of a Pacific West scenario from our 2003 study (Elliott et al. 2003b) that examined the impacts of expanded energy efficiency and renewable energy in California, Oregon and Washington on regional and national natural gas markets. This report summarizes the updated analysis. The same efficiency assumptions used in the 2003 study were used again. However, the renewable energy assumptions have been revised to reflect more recent analytical and political developments.

Changes in Natural Gas Markets

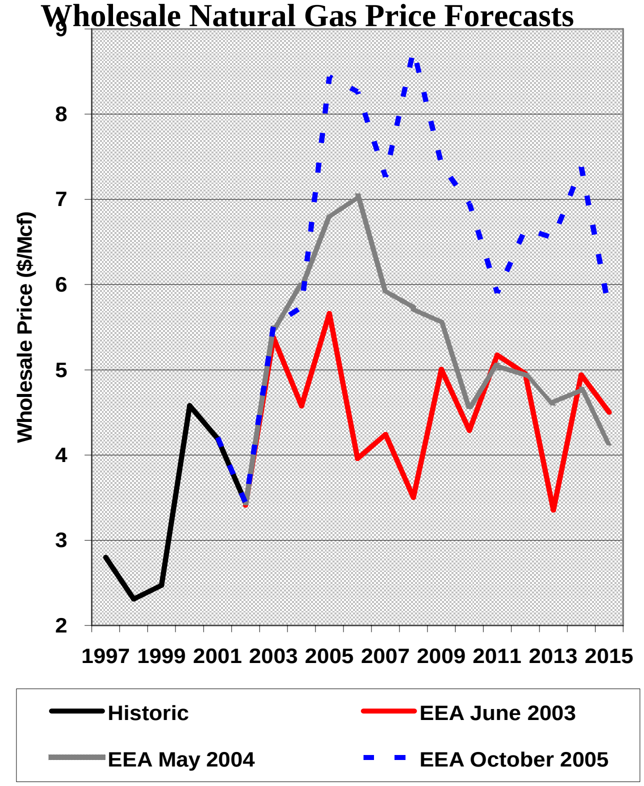
When we began our research in the summer of 2003, natural gas markets in the United States were experiencing a period of unprecedented price volatility resulting from a fundamental imbalance between supply and demand. We discussed these market conditions in detail in a white paper (Elliott et al. 2003a) and a December report (Elliott et al. 2003b). In the intervening years, markets have remained tight, though a relatively warm winter in 2003–04 and an unusually cool summer in 2004 avoided the more serious market disruptions that many market watchers feared. Concerns increased in the fall of 2004 as hurricanes disrupted production of gas in the Gulf of Mexico, global oil prices soared, and forecasts for a colder than normal winter sent natural gas prices to record levels. At that time, ACEEE prepared a market update (Elliott 2004) that looked at prevailing market supply and demand conditions. Since then, natural gas prices declined somewhat (see Figure 1) as a result of an unseasonably warm winter and resulting declines in heating oil prices.

Figure 1. Daily Spot NYMEX Natural Gas Prices

Source: Oilnergy.com 2005

Subsequent to the completion of the modeling analysis for this report, Hurricanes Katrina and Rita, compounded by the effects of a hot August, drove Henry Hub wholesale gas prices to new records, spiking at over $14/Mcf. These price spikes, while they did not strongly affect West Coast markets, are forecast to cause record home heating bills for the winter of 2005–2006. The spikes also serve to reinforce the point that natural gas markets remain fundamentally tight, as reflected in rising long-term price forecasts (see Figure 2). Given the nation's continued heavy reliance on Gulf Coast gas production, and the expected continuation for 10–20 years of the current cycle of increased hurricane frequency, such storm-related gas market impacts are likely to recur.

Figure 2. Comparison among June 2003, May 2004, and October 2005 Average Annual Wholesale Natural Gas Price Forecasts



Source: EEA 2003, 2004, 2005a

Changes in the National Energy Policy Environment

While policy-makers have acknowledged the severity of problems in natural gas markets and have largely agreed with ACEEE's analysis (Elliott et al. 2003b), as well as those by the National Petroleum Council (2003) and others, too few policy measures have been taken. Congress passed omnibus energy legislation in the summer of 2005, but it included relatively few of the energy efficiency measures ACEEE recommended to address the fundamental supply/demand imbalances in natural gas markets. Consequently, state and regional efforts may be needed to help alleviate natural gas price problems. Our analysis shows that regional energy efficiency and renewable energy investments efforts generate more than enough economic benefits to the West Coast states to be worthwhile.

Overview of the Analysis

The analysis presented in this report builds upon ACEEE's 2003 research (Elliott et al. 2003a, 2003b). For details on the methodology and assumptions, the reader is referred to these publications. In this section, we provide an overview of the major assumptions and discuss methodological changes from the previous analysis.

As with the 2003 analysis, in this effort we used the Energy and Environmental Analysis, Inc. North American Gas Market Model.[1] In this case we used EEA's May 2004 natural gas market forecast as the reference case for our analysis rather than the June 2003 forecast used 2003. The differences between these two forecasts can be seen in Figure 2. A description of the changes in the natural gas market that occurred between these two forecasts can be found in Elliott (2004). Since this recent analysis was completed, EEA has released several updated forecasts. EEA's October 2005 forecast (seen in Figure 2) shows dramatic changes in the price forecast due to increases in world oil prices and further tightening in North American markets, exacerbated by the 2004 and 2005 hurricane seasons (see EEA 2005b). Using the October 2005 forecast would not likely change the findings of our analysis. If anything, it would most likely increase the projected price reduction impacts and other economic benefits.

In a significant change from our 2003 analysis, we extended our analysis period from five years (2004–2008) to fifteen years (2006–2020). The reader is cautioned that the uncertainties in long-term forecasts of natural gas markets make the long-term results of this analysis more uncertain. In particular, market effects projected beyond 10 years are based in large part on natural gas supply resource choices that may or may not be made in the next few years and thus should be viewed as speculative.

Methodology

As with our 2003 analysis (Elliott et al. 2003b), ACEEE provided EEA with detailed data on reductions in natural gas and electricity consumption to be used as assumptions in the model. These consumption reductions were provided at a state level of aggregation and were expressed relative to reference forecasts. In addition, ACEEE provided EEA with an alternative forecast of the share of electricity generated from renewable energy in the thirteen electric supply regions in the EEA model that approximate the National Electric Reliability Council's sub-regions. The forecasts used for this analysis were somewhat different than those used in the previous analysis because of the longer time horizon used here. In our 2003

[1] For a more detailed description and history of the EEA model, see http://www.energy.ca.gov/2005_energypolicy/documents/2004-12-16_workshop/2004-12-16_EEA_MARKET_MODEL.PDF.

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analysis we considered a five-year horizon. In this analysis we delayed the start of the analysis period by two years (2004 to 2006) and analyzed the effect of measures for 15 years. In addition, we assumed that renewable energy measures would begin to have an impact in the first rather than the second year of the analysis.

Energy Efficiency Assumptions

In our 2003 analysis we developed projections of the reductions in electricity and natural gas demand achievable from energy efficiency on a state-by-state basis (Elliott et al. 2003a). In the first year, we assumed a behavioral as well as a hardware-investment response from the efficiency programs considered, while in the second year we assumed only the hardware-investment response. Behavioral response is defined as temporary reductions in energy use resulting from changes in use of existing equipment. Hardware investment is defined as replacement or modification of energy-using equipment, while maintaining historical patterns of use.

In this analysis, we continued to assume a behavioral response in the first year and extended the annual hardware-based savings rate used in years 2–5 of our previous analysis to years 2–15. The total achievable savings estimates used in our analysis correspond favorably with both other longer-term analyses and actual program results, as seen in Nadel, Shipley, and Elliott (2004). The state-by-state reductions in end-use electricity and gas are presented in Table 1. The natural gas savings cited in Table 1 are from both reduced electricity demand and direct savings of natural gas in each of the sectors. The savings estimates included in this study are intentionally conservative. These savings levels are readily achievable under current market conditions and would require only moderately increased deployment efforts on the state level. The intention of this was to give a fair representation of the market effects of increased adoption of energy efficiency. The energy savings targets recently adopted in California, for example, would exceed the energy savings assumed in this analysis and would thereby be expected to produce larger natural gas price impacts.

Table 1. Electricity and Gas Consumption Reductions for the Pacific West Region

	Electricity Savings (vs. Baseline)				Natural Gas Savings (vs. Baseline)			
	2006	2010	2015	2020	2006	2010	2015	2020
State	1 year	5 year	10 year	15 year	1 year	5 year	10 year	15 year
California	2.9%	6.0%	10.0%	13.9%	2.3%	5.1%	8.6%	12.1%
Oregon	2.7%	5.2%	8.4%	11.5%	2.3%	5.1%	8.6%	12.1%
Washington	2.2%	4.4%	7.0%	9.7%	2.0%	4.3%	7.2%	10.1%

Renewable Energy Assumptions

While the assumptions for the energy efficiency impacts were extrapolations of our 2003 analysis (Elliott et al. 2003a, 2003b), we made significant modifications to the renewable energy impacts to accommodate the longer analysis horizon. As with the previous analysis, we generated our renewable assumptions for the electric supply regions corresponding to those used by the Energy Information Administration (EIA). The EIA regions for the most part correspond to the National Electric Reliability Council's (NERC) sub-regions. The EEA model used similar regions with the exception of Nevada, which was placed in the same region as California rather than with the upper West as in the EIA and NERC mappings. For a more detailed discussion, see Elliott et al. (2003a).

In the Pacific West region, extrapolating the estimates from our 2003 analysis produced unrealistically high forecasts in the out-years, greater than the most commonly accepted resource estimates. As a result, we used the longer-term targets most widely discussed in those regions and interpolated renewable market share for the intervening years on a linear basis. In particular, we used the targets proposed by Gov. Schwarzenegger (2003, 2004) in California of 20% in 2010 and 33% in 2020 and also used proposed renewable portfolio standard (RPS) targets in Oregon and Washington (UCS 2004b). The renewable share of the electricity market for each region is presented in Table 2. These sub-region estimates were prorated to reflect the electricity sales in the three study states.

Table 2. Renewables as a Percentage of Total Electricity Sales

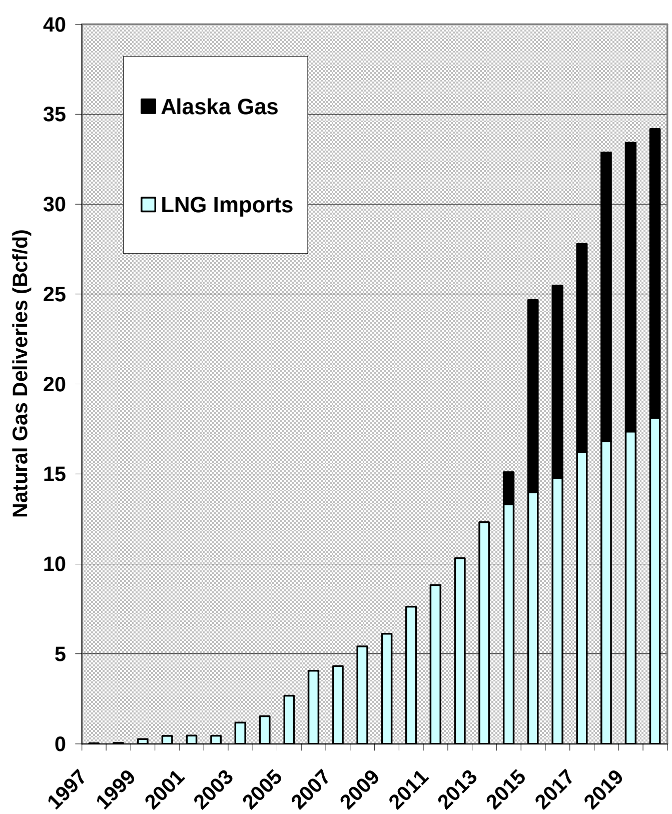
	Year			
EEA Electricity Supply Zone	**2006**	**2010**	**2015**	**2020**
WSCC CA/NV	9.2%	20.0%	26.9%	33.0%
WSCC NW	1.7%	7.8%	14.4%	20.0%

Note: WSSC = Western Systems Coordinating Council.
Assumptions used in EEA model scenarios.

Gas Supply Resource Assumptions in the Pacific West Scenario

We knew in advance that energy efficiency and renewable energy would be insufficient to fully bridge the gap between natural gas demand and the reference forecast for lower-48 gas supply resources. As noted in Elliott and Shipley (2005), we did not make changes to the EEA reference case with respect to determining whether additional resources would be made available. To maintain balance in natural gas markets, we elected to allow the EEA model to select the most economic new gas supply resource available. Liquefied natural gas and the Alaska gas pipeline project were the two principal variable supply options that the model could chose from, as it was assumed that existing lower-48 resources (e.g., Rocky Mountain and outer continental shelf gas) would be cheaper. The Alaska pipeline would be built if it was the most economic choice, and the model varied the amount of LNG imported, depending upon market requirements and the completion date for the Alaska pipeline.

Figure 3. LNG Imports and Alaska Pipeline Deliveries of Gas in EEA Reference Case



In the reference case, LNG is projected to increase from the current level of about 1.5 Bcf/d to over 18 Bcf/d by 2020 (see Figure 3 and Table 3). The Alaska gas pipeline is assumed to begin delivering gas to the U.S. market in 2014, with a full delivery rate of 5.9 Bcf/d reached in 2018.

In the Pacific West scenario, the reductions in demand were not large enough to affect the amount of LNG or Alaska gas required to meet market demand, so those resource levels are the same as in the reference case (see Figure 3**Error! Reference source not found.**).

Modeling Results

As with the 2003 analysis (Elliott et al. 2003b), the results show that energy efficiency and renewable energy can have a significant impact on both the wholesale and retail prices of natural gas. Compared to the 2003 analysis, the near-term impacts appear more pronounced because of a further tightening of natural gas markets in the intervening year, reflected in the higher near-term reference price forecast shown in Figure 2. In the longer term, the forecasts converge and the price effects of the energy efficiency and renewable energy scenario diminish. These longer-term effects reflect the high likelihood that markets will balance as resource commitments, on both the supply and demand sides, resolve the problems in current market fundamentals.

Table 3. Assumptions about Alaska Pipeline and LNG Resources in EEA Model (Bcf/d)

	2003	2004	2005	2006	2010	2015	2020
LNG Imports[a]	1.2	1.5	2.7	4.1	7.6	14.0	18.1
Alaska Gas[b]	—	—	—	—	—	3.9	5.9

Notes: [a] Net of U.S. LNG imports and exports (includes a small amount of LNG exports from Alaska)
[b] Net flow of gas on last leg of Alaska pipeline

Also, as was seen in the 2003 analysis, energy efficiency and renewable energy deployed at the regional level had national impacts on wholesale natural gas prices, albeit more modest impacts than those of the national level scenarios (see Elliott and Shipley 2005).

Pacific West Energy Efficiency and Renewable Energy Scenario

We examine energy efficiency and renewable energy policies only in the Pacific West region, defined as three states: California, Oregon, and Washington. Consumption in this region represents about 12% of total national natural gas consumption and almost 13% of total electricity consumption (EIA 2002). This region is of importance because of its relatively large share of national energy consumption and its significant distribution constraints for the delivery of both electricity and natural gas. These states, especially California, have a history of rapidly and effectively deploying energy efficiency programs to the public. This is an important factor in eliminating the price volatility that tight natural gas markets can produce.

Impacts on Consumption

Table **4**bles 4, 5, and 6 show the reductions (from the base case forecast consumption) that result from energy efficiency efforts in the Pacific West energy efficiency scenario.

Table 4. Pacific West Cumulative Percent Reduction in Electricity Consumption from Base Case

	Residential				Commercial				Industrial			
	1 year	**5 year**	**10 year**	**15 year**	**1 year**	**5 year**	**10 year**	**15 year**	**1 year**	**5 year**	**10 year**	**15 year**
California	2.8	5.7	9.2	12.8	3.4	6.7	10.9	15.1	2.2	5.4	9.5	13.5
Oregon	2.8	3.9	5.4	6.9	2.4	4.7	7.7	10.7	1.5	3.8	6.6	9.5
Washington	2.0	5.6	10.1	14.7	3.4	6.8	11.0	15.3	2.4	6.0	10.4	14.9

Table 5. Pacific West Cumulative Percent Reduction in Natural Gas Consumption from Base Case

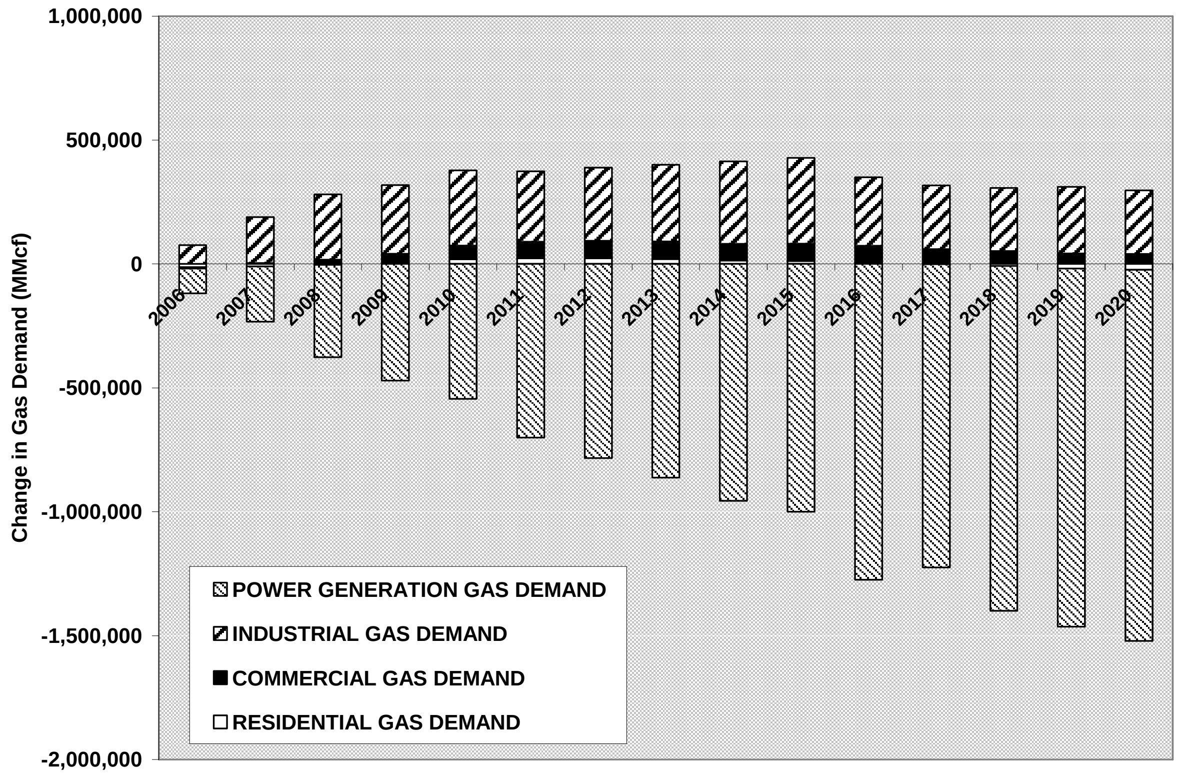
	Residential				Commercial				Industrial			
	1 year	**5 year**	**10 year**	**15 year**	**1 year**	**5 year**	**10 year**	**15 year**	**1 year**	**5 year**	**10 year**	**15 year**
California	2.6	5.1	8.3	11.5	2.4	4.8	7.8	10.9	2.1	5.2	9.1	13.0
Oregon	2.2	4.4	7.2	10.0	2.0	4.0	6.5	9.0	1.5	3.6	6.4	9.1
Washington	2.6	5.2	8.4	11.6	2.3	4.7	7.6	10.6	1.8	4.5	7.9	11.3

This energy efficiency investment scenario markedly reduces market congestion and prices in the Pacific West. As a result, net demand relative to the base case scenario increases in the industrial and commercial sectors. This is a result of increased economic activity in these sectors relative to the base case. Figure 4 displays the net effects of the increased energy efficiency investment scenario. Even though net demand is higher in some sectors, it is clear that the overall effect of the efficiency scenario will be a significant reduction in overall natural gas use, primarily because of the major reductions in gas used in the utility sector.

Impacts on Energy Prices and Expenditures

The energy efficiency and renewable energy investment scenario results in significant wholesale price moderation, as seen in Figure 5. Wholesale prices would drop by more than 20% in both California hub markets in every study year from 2009 forward, as shown in Table 7. These wholesale price reductions translate into significant retail price reductions, as shown in Table 8. Average retail prices for the region are projected to fall by as much as 20% in 2020; Table 8 shows projected price reductions for each state and sector.

Figure 4. Change in Net Natural Gas Demand for the Pacific West Scenario by End-Use Sector



These retail price reductions, combined with reduced consumption, result in major decreases in consumer natural gas spending in the study scenario, as illustrated in Figure 6, This figure shows that although gas usage in the industrial and commercial sector may increase slightly, falling prices will still reduce net expenditures, and that consumers in all sectors will spend less on natural gas than in the base case scenario. By 2009, annual cost savings for all consumers in the region would exceed $5 billion annually; through 2020, these savings would total about $100 billion. The Pacific West efficiency and renewables scenario also affects gas markets nationwide; national savings would exceed $300 billion through 2020. It is important to again note that projections of 10 years and beyond are subject to substantial uncertainly, as other market forces beyond the scope of this study could have large effects on market prices.

Table 6. Change in Natural Gas Demand (MMcf) Resulting from Energy Efficiency and Renewable Energy Scenario in the Pacific West Region

	2006	2007	2008	2009	2010	2015	2020
RESIDENTIAL GAS DEMAND							
CA	-12,392	-14,633	-16,594	-17,763	-18,254	-34,449	-54,618
OR	-1,126	-1,340	-1,556	-1,747	-1,941	-3,883	-6,485
WA	-1,682	-2,004	-2,316	-2,599	-2,891	-5,810	-9,717
PacWest	-15,200	-17,977	-20,467	-22,108	-23,086	-44,143	-70,820
COMMERCIAL GAS DEMAND							
CA	-5,463	-5,872	-5,852	-5,008	-3,155	-9,948	-21,409
OR	-722	-754	-760	-722	-657	-1,628	-3,162
WA	-915	-962	-960	-912	-836	-2,096	-4,075
PacWest	-7,099	-7,588	-7,572	-6,641	-4,648	-13,671	-28,646
INDUSTRIAL GAS DEMAND							
CA	7,059	16,027	13,695	11,364	16,830	16,191	-20,801
OR	271	949	1,062	1,622	1,459	-919	-1,606
WA	355	1,259	1,449	2,254	1,979	-1,606	-2,934
PacWest	7,686	18,236	16,206	15,240	20,268	13,665	-25,341
POWER GENERATION GAS DEMAND							
CA	-127,830	-201,243	-278,865	-358,902	-438,298	-704,763	-919,824
OR	-16,310	-27,451	-35,804	-41,488	-46,215	-117,892	-208,699
WA	-5,930	-9,466	-12,579	-13,693	-15,446	-41,866	-69,228
PacWest	-150,069	-238,160	-327,248	-414,082	-499,958	-864,522	-1,197,752
R/C/I/P GAS DEMAND							
CA	-138,626	-205,721	-287,616	-370,307	-442,876	-732,970	-1,016,652
OR	-17,886	-28,597	-37,059	-42,335	-47,353	-124,322	-219,952
WA	-8,171	-11,172	-14,406	-14,949	-17,195	-51,379	-85,955
PacWest	-164,682	-245,490	-339,080	-427,591	-507,424	-908,671	-1,322,559

Figure 5. Change in SoCal Hub Wholesale Price Resulting from Energy Efficiency and Renewable Energy Scenario

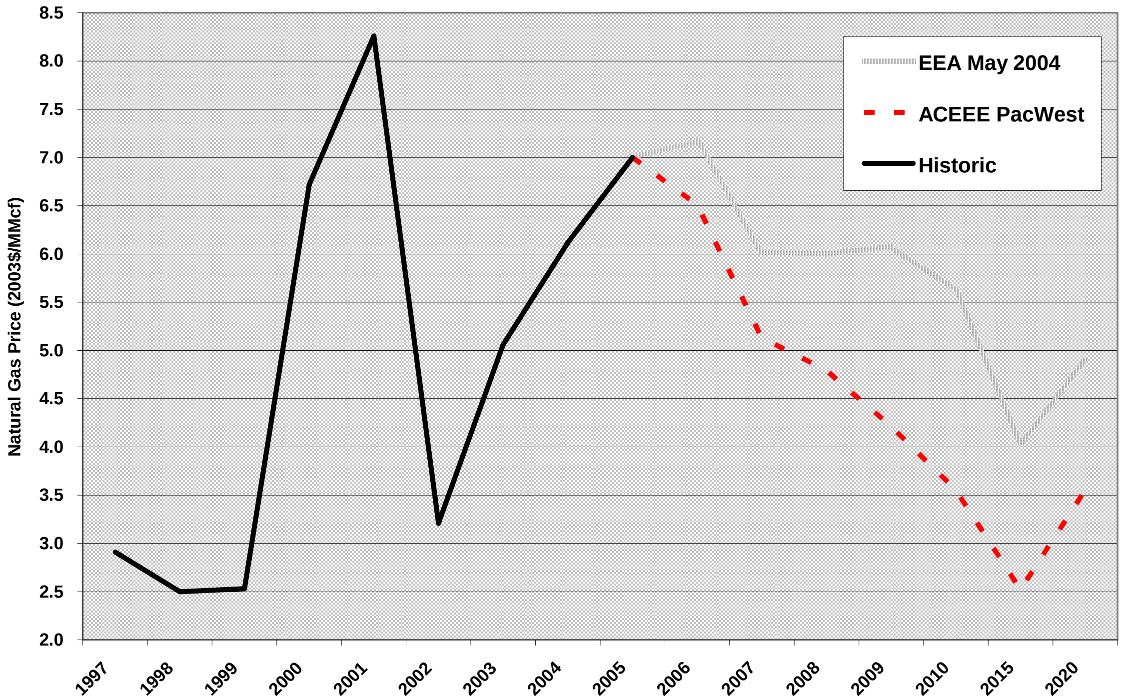


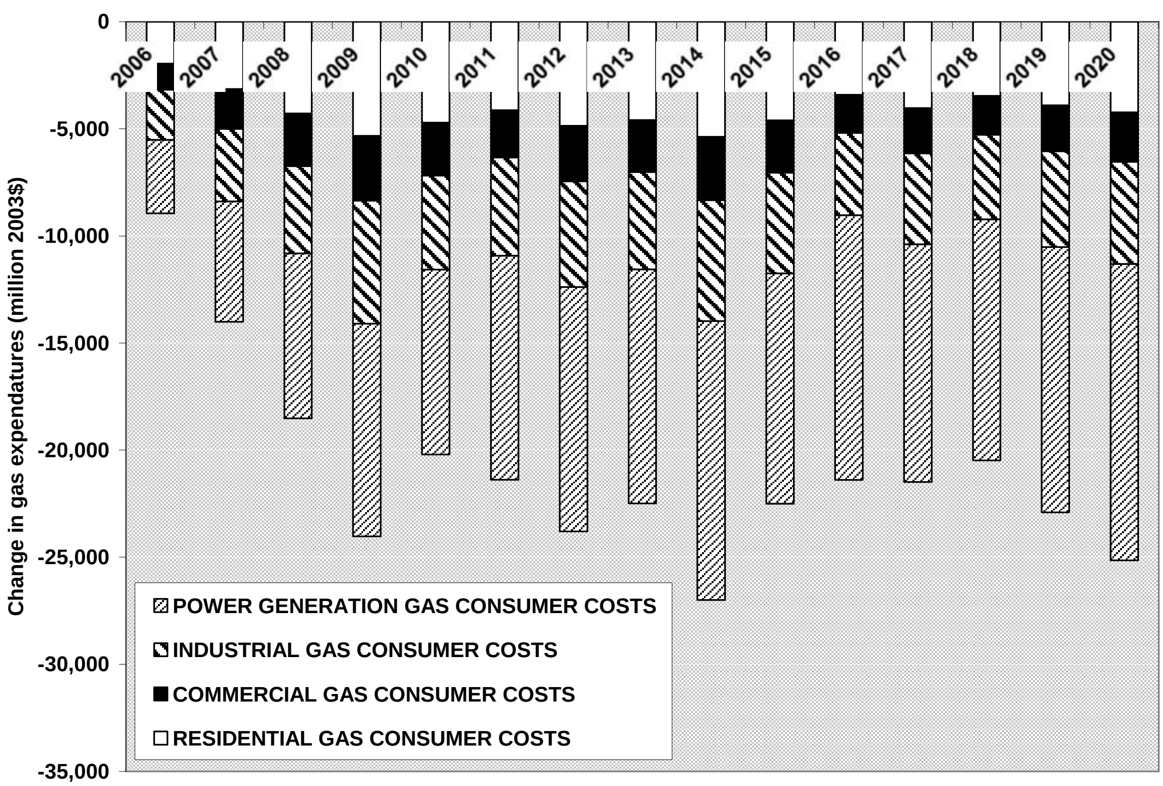
Table 7. Change in Wholesale Gas Prices Resulting from Energy Efficiency and Renewable Energy Scenario in the Pacific West Region
($/Mcf)

Henry Hub	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2015**	**2020**
EEA May 2004	6.78	7.04	5.94	5.72	5.55	4.57	4.14	4.90
ACEEE PacWest	6.78	6.64	5.27	4.95	4.59	3.87	3.53	4.32
Difference	-	-6%	-11%	-13%	-17%	-15%	-15%	-12%
SoCal Hub								
EEA May 2004	7.00	7.17	6.02	6.00	6.08	5.62	4.05	4.88
ACEEE PacWest	7.00	6.51	5.13	4.79	4.21	3.55	2.52	3.55
Difference	-	-9%	-15%	-20%	-31%	-37%	-38%	-27%
NoCal Hub								
EEA May 2004	6.62	6.93	5.92	5.79	5.64	4.80	4.02	4.83
ACEEE PacWest	6.62	6.36	5.08	4.75	4.19	3.54	2.51	3.55
Difference	-	-8%	-14%	-18%	-25%	-27%	-37%	-26%

Table 8. Change in Retail Natural Gas Prices Resulting From Energy Efficiency and Renewable Energy Scenario in the Pacific West Region
($/Mcf)

	2006	2007	2008	2009	2010	2015	2020
Residential							
CA	-0.46	-0.51	-0.89	-1.30	-1.29	-1.34	-1.18
OR	-0.38	-0.63	-0.87	-1.02	-0.90	-0.42	-0.61
WA	-0.39	-0.67	-0.89	-1.01	-0.89	-0.32	-0.63
Commercial							
CA	-0.52	-0.53	-0.93	-1.34	-1.28	-1.39	-1.22
OR	-0.41	-0.66	-0.89	-1.04	-0.91	-0.52	-0.69
WA	-0.42	-0.70	-0.90	-1.03	-0.90	-0.40	-0.68
Industrial							
CA	-0.58	-0.69	-1.03	-1.50	-1.46	-1.47	-1.28
OR	-0.51	-0.75	-0.92	-1.10	-0.90	-0.80	-0.88
WA	-0.51	-0.77	-0.92	-1.08	-0.87	-0.60	-0.78
Power Generation							
CA	-0.57	-0.65	-1.02	-1.46	-1.40	-1.37	-1.20
OR	-0.15	-0.53	-0.40	-0.64	-0.50	-0.30	0.09
WA	-0.22	-0.68	-0.60	-0.86	-0.74	-0.38	-0.21

Figure 6. Change in Regional Net Natural Gas Expenditures



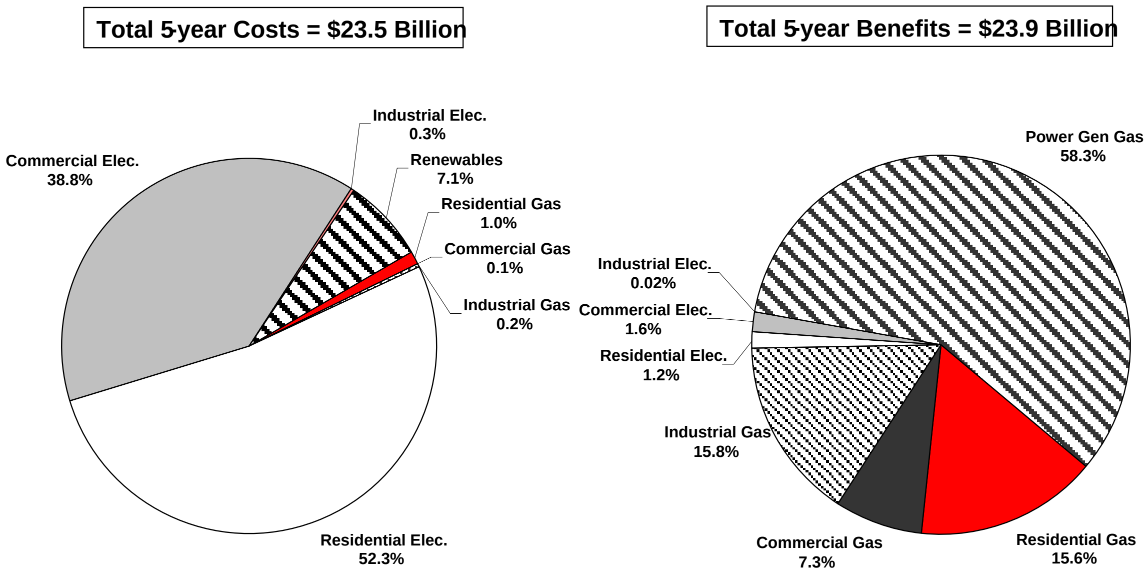
Benefits and Costs

The efficiency and renewables investments in this scenario would result in about $100 billion in energy expenditure reductions for energy consumers in the region through 2020, of which $24 billion would be realized during the first five years. Reductions in natural gas expenditures account for 97% of the reductions, as can be seen in Figure 7, with savings in gas purchased for power generation accounting for over 58%. These reductions in expenditures come from a combination of reductions in consumption of gas and electricity as a result of the energy efficiency and renewable energy investments, and from the reductions in the price of natural gas that result from rebalancing of the market. The analysis does not consider any reductions in electricity prices, but assumes that the reductions in natural gas expenditures by the electric power generation sector will likely be passed along to retail consumers in the forum of reduced electric prices.

During the first five years of the study period, about $23 billion in energy efficiency and renewable energy investment would be required to achieve the impacts covered in this analysis. Of these, $19 billion or 81% would be private direct measure investments, while $4 billion or 19% would be for public program and administrative costs associated with encouraging these investments. Ongoing expenditures would also be needed to sustain the savings through 2020. As can be seen from Figure 7, more than half of the investments would be for electric efficiency in the residential sector, with slightly more than a third for commercial electric efficiency measures but less than 1% for industrial electric efficiency. In total, over 91% of the investments are in electric efficiency measures. Additional renewable energy investments over the next five years would account for about $1.7 billion, or about 7% of the total.

This analysis shows that the net benefits of this investment scenario are positive over a five-year period, and that net benefits are even larger over the long term. Over 15 years, benefits will greatly exceed costs, as expenditure savings average well over $5 billion a year through 2020, and substantially lower levels of public and private investment will be needed to sustain those out-year savings. We did not perform a specific15-year benefit-cost analysis for this study, because the uncertainties related to longer-term market forces make it difficult to assign high confidence levels to long-term prices, and because we did not consider it realistic to project public policies beyond five years.

Figure 7. Five-Year Costs and Energy Expenditure Benefits from Energy Efficiency and Renewable Energy Scenario in the Pacific West Region



While the five-year benefit-cost assessment shows relatively small positive net benefits, the five-year timeframe does not capture the full long-term benefits from these investments. These energy efficiency and renewable energy investments will continue to reduce consumers' energy expenditures for at least another decade without any additional investment. Moreover, this analysis does not consider any benefits to the state's electric power system from the avoided investments needed to meet growing electric demand that result from the efficiency and renewable energy investments. In summary, the efficiency and renewables investment scenario more than pays for itself in the first five years and returns much greater economic benefits over 15 years.

Summary of Policy Recommendations

The basic policy recommendations that we propose are essentially the same as we proposed in our 2003 analysis. In some cases, the detailed form of the recommendations has been refined (see Nadel, Elliott, and Langer 2005). Policy-makers at the state and federal level could take a number of concrete actions to realize the benefits that would result from expanded energy efficiency and renewable energy resources. No single policy strategy would achieve the results outlined in this or our previous analysis (Elliott et al. 2003b). Rather, a portfolio of strategies would be most likely to achieve quick and sustained savings from energy efficiency and renewable energy resources.

Energy Efficiency Public Benefits Funds and Performance Targets

One of the leading sources of energy efficiency savings are incentive and technical assistance programs focused on utility customers and operated by utilities, state agencies, and other parties. These programs are most commonly funded through public benefits funds collected through small charges on utility bills. About 20 states currently offer these programs, spending about $1.3 billion annually. At crucial times, these programs can provide significant price relief and market stability. For example, these programs reduced peak electric demand by 11% and electricity sales by 6% during the 2001 California electricity crisis. Other leading states are achieving regular savings on the order of 1% of total electricity sales each year. Public benefits funds could be established in more states and at the federal level to expand the impacts of these programs.

Public benefits funds typically establish funding levels; however, more and more states are basing efficiency programs on savings targets first and make funding considerations secondary. California has recently completed a new electricity plan that sets overall energy efficiency resource targets and continues public benefits funding levels, and has approved an additional $2.1 billion in new spending to support attainment of the efficiency resource targets. Oregon’s Energy Trust is using public benefits funds for energy efficiency programs. In Washington, investor-owned utilities operate demand-side management programs in a more traditional regulated resource planning context. In addition, the Northwest Power Planning and Conservation Council (NWPCC), Bonneville Power Administration and its customer public utilities, and the Northwest Energy Efficiency Alliance plan and operate several regional efficiency programs.

Since our analysis uses energy efficiency impact assumptions comparable to those in resource plans developed in California and by the NWPCC, one would expect that vigorous implementation of these plans would create significant benefits in natural gas markets, along the lines of those estimated in this report.

Expanded Funding for Energy Efficiency/Renewable Energy Implementation Programs

If Americans are called upon to take action, government and public institutions must be prepared to provide people and businesses with direction and resources that target their interests. The federal government should expand funding for existing energy efficiency and renewable energy programs at the U.S. Department of Energy (DOE) and Environmental Protection Agency (EPA). These agencies should be encouraged to partner with state and local governments, existing programs run by the public sector and utilities, and the private sector to leverage the agencies’ funding for maximum impact.

The experience from the California response to the blackouts of 2001 dramatizes the crucial role that such programs can play in reducing energy prices and stabilizing markets (Kushler and Vine 2003). California’s decision to spend an additional $2.1 billion on efficiency in the 2006–2008 period will greatly expand the state’s deployment programs.

Appliance Efficiency Standards

Appliance standards have been one of the greatest energy policy successes over the past decade, transforming the energy use of many consumer and commercial products. While developing new standards from scratch takes a number of years, several important standards are waiting in the wings that could result in important energy savings in the mid term (see Nadel, Elliott, and Langer 2005). At the federal level, the 2005 energy bill includes standards on sixteen products that will go into effect in the next few years. Consensus standards on five additional products could be added. In addition, several federal rulemakings are underway that should move forward as quickly as possible; additional rulemakings are behind legislatively mandated schedules and should begin soon.

California has long led the nation in state development of appliance efficiency standards. It and other states continue to develop standards for products not covered by federal law. Federal law should continue to allow states this flexibility in developing appliance standards to help meet their energy needs.

Insuring More Efficient Buildings through Codes

As with appliance standards, buildings codes represent an energy efficiency success story. These regulations, administered at the local level, define how new residential and commercial buildings are constructed and in some cases what upgrades need to be made when major renovations take place. The International Code Council and other bodies have developed model building codes that represent the current state of the art in design and construction practice. Buildings built to these codes have reduced heating and cooling requirements, and commercial office buildings require much less electricity for lighting (Prindle et al. 2003). Some localities have already adopted these codes, but others need to be encouraged to move quickly to implement them.

The Pacific West states have developed some of the most stringent and well-enforced building energy codes in the nation. They should continue to advance the stringency and effectiveness of these codes, to keep the energy impact of new buildings to a minimum.

Support of Clean and Efficient Distributed Generation

One of the challenges faced by many renewable energy resources, as well as other clean distributed generation systems, is the interconnection and tariff practices of some utilities across the country. The federal government should work with state regulators to establish consistent interconnection standards and procedures, and reform anti-competitive tariffs and "exit fees" that act as disincentives to the development of new distributed resources (Brown and Elliott 2003). Establishing output-based emissions standards would also help to encourage cleaner and more efficient generation.

State and federal governments should continue to review and streamline their policies to accelerate the interconnection of clean distributed energy technologies and should increase customer incentives for renewable generation (such as solar and small wind generators) and clean distributed generation (such as combined heat and power systems). These incentives could take the form of tax credits or customer incentives (Elliott 2001).

Renewable Portfolio Standards and Incentives

Renewable portfolio standards (RPS) are market-based policies that increase the diversity of our electricity supply by establishing a minimum commitment to generate electricity from renewable resources. The experiences of the 18 states, including California, that have implemented renewable portfolio standards have proven them an effective means of reducing market barriers and encouraging the installation of renewable energy technologies.

In addition, tax credits, grants, and financing can play an important role, as has been demonstrated for wind energy (Elliott 2001). It is important that the existing production tax credits for renewable energy sources be extended through at least 2007. Grants and loans for renewable energy were part of the Farm Bill of 2002 passed by the 107th Congress, and it is important that funding for future years be continued. Other tax credits and grants at both the state and federal levels for other renewable technologies should also be implemented, as has been proposed in the Senate Energy Bill. Several states, including Oregon and California, have public benefits funds that are used to support renewable energy projects.

Public Awareness Campaign by State and National Leaders

State and regional leaders are in a unique position to raise public awareness of energy efficiency and renewables, and mobilize action to aid in the implementation of the strategies mentioned above. The window of opportunity to affect significant savings is limited, however, as was learned in the Northwest in 2002 (see Elliott et al. 2003b). Once a market has adapted to higher electricity prices it is difficult to motivate public action. The lesson learned is that policy-makers must quickly mobilize the resources needed to support the public's actions, as they were in California (Kushler and Vine 2003), if maximum results are to be achieved.

Summary and Conclusions

The value of investing in energy efficiency and renewable energy resources as our best resource for reducing natural gas prices has grown in the last two years, as various factors have led to further tightening of natural gas markets. Our analysis demonstrates that readily achievable levels of resource investments in energy efficiency and renewable energy technologies can have profound near- and mid-term impacts on energy prices and on the nation's economic health, particularly in the most vulnerable sectors (energy-intensive manufacturing companies, farmers, and low-income residential consumers). The policy recommendations ACEEE made in 2003 remain the same, and the case for implementing these policies has only become more compelling in the intervening period as the economic impact of high natural gas prices has increased.

Market experts agree that a 15–20 year period of low energy prices has ended, and almost all forecasts suggest that future prices will remain much higher than those of the 1990s. We should not be deluded by temporary, modest declines in energy prices from their current very high levels. Even at somewhat lower energy prices, the wealth transfer from energy consumers to producers, both domestic and foreign, would have a major debilitating impact on the U.S. economy.

Energy efficiency and renewable energy are the only available near-term policy solutions to the natural gas problem. They would both reduce energy prices and create substantial economic benefits. Policy leadership is needed in the Pacific West region as well as nationally to realize the benefits these clean energy resources could bring.

References

Barton, Joe. 2001. *Electric Supply and Transmission Act.* HR-3406. Washington, D.C.: U.S. House of Representatives.

Beck, Fredric, Damian Kostiuk, Tim Woolf, and Virinder Singh. 2001. *Powering the South: A Clean & Affordable Energy Plan for the Southern United States*. http://www.poweringthesouth.org/figure/pts_repp_book.pdf. Washington, D.C.: Renewable Energy Policy Project.

Brown, E. and R.N. Elliott. 2003. *State Opportunities for Action: Update of States' Combined Heat and Power Activities*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Daschle, Thomas and Jeff Binghaman. 2002. *Energy Policy Act of 2002.* S.1766. Washington, D.C.: U.S. Senate.

Donovan, Deborah, Steven Clemmer, Alan Nogee, and Peter Asmus. 2001. *Powering Ahead: A New Standard for Clean Energy and Stable Prices in California*. http://www.ucsusa.org/publication.cfm?publicationID=385. Boston, Mass.: Union of Concerned Scientists.

[EEA] Energy and Environmental Analysis, Inc. 2003. *June 2003 Natural Gas Market Forecast*. Arlington, Va.: Energy and Environmental Analysis, Inc.

———. 2004. *May 2004 Natural Gas Market Forecast*. Arlington, Va.: Energy and Environmental Analysis, Inc.

———. 2005a. *October 2005 Natural Gas Market Forecast*. Arlington, Va.: Energy and Environmental Analysis, Inc.

———. 2005b. *Hurricane Damage to Natural Gas Infrastructure and its Effect on the U.S. Natural Gas Market*. Arlington, Va.: Energy and Environmental Analysis, Inc.

[EIA] Energy Information Administration. 2002. *Electricity Annual: 2001, Volume I*. Washington, D.C.: U.S. Department of Energy.

Elliott, R.N. 2001. *Federal Tax Strategies to Encourage the Adoption of Combined Heat and Power*. Washington, D.C.: American Council for an Energy-Efficient Economy.

———. 2004. *ACEEE Fall 2004 Update on Natural Gas Markets.* ACEEE White Paper. http://aceee.org/energy/fall04ngmkt.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

Elliott, R. Neal and Anna Monis Shipley. 2005. *Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets: Updated and Expanded Analysis.*

http://www.aceee.org/pubs/e052full.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

Elliott, R. Neal, Anna Monis Shipley, Steven Nadel, and Elizabeth Brown. 2003a. *Natural Gas Price and Availability Effects of Aggressive Energy Efficiency and Renewable Energy Policies: A Methodology White Paper*. http://aceee.org/energy/natlgaswhite.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

———. 2003b. *Natural Gas Price Effects of Energy Efficiency and Renewable Energy Practices and Policies*. http://www.aceee.org/pubs/e032.htm. Washington, D.C.: American Council for an Energy-Efficient Economy.

[ELPC] Environmental Law & Policy Center. 2001. *Repowering the Midwest: The Clean Energy Development Plan for the Heartland.* http://www.repowermidwest.org/repoweringthemidwest.pdf. Chicago, Ill.: Environmental Law & Policy Center.

Greene, Nathanael. 2003. "2013 Renewable Potential for the RPS." June 26 Memorandum. New York, N.Y.: Natural Resources Defense Council.

Greenspan, A. 2003. "Testimony of Chairman Alan Greenspan on Natural Gas Supply and Demand Issues before the Committee on Energy and Commerce, U.S. House of Representatives, June 10." http://www.federalreserve.gov/BoardDocs/testimony/2003/20030610/default.htm. Washington, D.C.: Federal Reserve.

Hanson, D. and J. (Skip) Laitner. 2004. "An Integrated Analysis of Policies That Increase Investments in Advanced Energy-Efficient/Low-Carbon Technologies." *Energy Economics*, 26, 739–55.

Kushler, M. and E. Vine. 2003. *Examining California's Energy Efficiency Policy Response to the 2000/2001 Electricity Crisis: Practical Lessons Learned Regarding Policies, Administration, and Implementation.* http://www.aceee.org/pubs/u033.htm. Washington, D.C.: American Council for an Energy-Efficient Economy.

Kushler, M. and P. Witte. 2001. *A Revised 50-State Status Report on Electric Restructuring and Public Benefits.* http://www.aceee.org/pubs/u003.htm. Washington, D.C.: American Council for an Energy-Efficient Economy.

Kushler, M, D. York and P. Witte. 2005. *Examining the Potential for Energy Efficiency to Help Address the Natural Gas Crisis in the Midwest*. http://www.aceee.org/pubs/u051.htm. Washington, D.C.: American Council for an Energy-Efficient Economy.

Laitner, J. (Skip). 2004. *The Impact of Efficiency Technologies on Natural Gas Prices: A Review of the Theory and Recent Modeling Analysis.* Washington, D.C.: Northeast-Midwest Institute.

Marston, Jim (Environmental Defense). 2003. Personal communication to N. Elliott. July.

Nadel, S., R.N. Elliott, and T. Langer. 2005. *A Choice of Two Paths: Energy Savings from Pending Federal Energy Legislation.* http://www.aceee.org/pubs/e051.htm. Washington, D.C.: American Council for an Energy-Efficient Economy.

Nadel, Steven, Anna Monis Shipley, and R. Neal Elliott. 2004. "The Technical, Economic and Achievable Potential for Energy Efficiency in the U.S.—A Meta-Analysis of Recent Studies." In the *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings*. http://aceee.org/conf/04ss/rnemeta.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

National Petroleum Council. 2003. *Balancing Natural Gas Policy—Fueling the Demands of a Growing Economy: Volume I, Summary of Findings and Recommendations. http://npc.org/reports/ng.html.* Washington, D.C.: National Petroleum Commission.

[NCEP] National Commission on Energy Policy. 2003. *Increasing U.S. Natural Gas Supplies: A Discussion Paper and Recommendations*. http://64.70.252.93/newfiles/Final_Report/IV_Supply/IV.1.d%20-%20Increasing%20US%20Nat%20Gas%20Supplies.pdf. Washington, D.C.: National Commission on Energy Policy.

Nielsen, John (Western Resource Advocates). 2003. Personal communication to N. Elliott. July.

Oilnergy.com. 2005. Web site reporting current and historic NYMEX natural gas prices. http://www.oilnergy.com/1gnymex.htm. Austin, Tex.

[Principles] Multiple signers. 2005. "Solving America's Natural Gas Crisis through a Balanced Portfolio of Policies: Principles that Should Guide Congress and the Administration in Dealing with the Nation's Natural Gas Crisis." Open letter to Congress and the President. http://aceee.org/energy/natgasprinciples.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

Prindle, W., Nikolaas Dietsch, R. Neal Elliott, Martin Kushler, Therese Langer, and Steven Nadel. 2003. *Energy Efficiency's Next Generation: Innovation at the State Level*. http://www.aceee.org/pubs/e031.htm. Washington, D.C.: American Council for an Energy-Efficient Economy.

Schwarzenegger, Governor Arnold. 2003. *Action Plan for California's Environment*. http://www.schwarzenegger.com/en/news/uptotheminute/0921_env_action_policy.pdf. Sacramento, Calif.: Office of the Governor.

———. 2004. Letter to the Honorable Michael R. Peevey, President of the Public Utility Commission. Sacramento, Calif.: Office of the Governor.

Shimshak, Rachel (Renewable Northwest Project). 2003. Personal communication to N. Elliott. July.

[UCS] Union of Concerned Scientists. 2004a. "Renewable Energy Can Help Ease Natural Gas Crunch." Fact Sheet. http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=1370. Boston, Mass.: Union of Concerned Scientists.

———. 2004b. *Clean Energy Update*. http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=1576. Boston, Mass.: Union of Concerned Scientists.

[USPIRG] U.S. Public Interest Research Group. 2005. *Redirecting America's Energy: The Economic and Consumer Benefits of Clean Energy Policies*. Washington, D.C.: U.S. Public Interest Research Group.

Wiser, R., M. Bolinger, and M. St. Clair. 2005. *Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency*. Report LBNL-56756. http://eetd.lbl.gov/EA/EMP. Berkeley, Calif.: Lawrence Berkeley National Laboratory.