NATURAL GAS PRICE EFFECTS OF ENERGY EFFICIENCY AND RENEWABLE ENERGY PRACTICES AND POLICIES

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December 2003

Report Number E032

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Acknowledgments

This work was made possible by a grant from the Energy Foundation. The authors express their appreciation to the Energy Foundation and its staff for their guidance and suggestions—in particular David Wooley who was a key participant of the project team. The authors also express their appreciation to Energy and Environmental Analysis, Inc. who undertook the natural gas system modeling that is an integral part of this research. In particular, the authors thank Kevin Petak, Joel Bluestein, and Harvey Vidas of EEA for their help with planning, executing, and interpreting this analysis. In addition, the authors express their appreciation to the advisory group who provided comments and suggestions. Many of these individuals also were important sources of technical information, especially for the renewables analysis. Finally, the authors thank Glee Murray, Bill Prindle, and Renee Nida for their help in making our language and ideas accessible to a broad audience.

About the American Council for an Energy-Efficient Economy (ACEEE)

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- Conducting in-depth technical and policy assessments
- Advising policymakers and program managers
- Working collaboratively with businesses, public interest groups, and other organizations
- Organizing conferences and workshops
- Publishing books, conference proceedings, and reports
- Educating consumers and businesses

Projects are carried out by staff and selected energy efficiency experts from universities, national laboratories, and the private sector. Collaboration is key to ACEEE's success. We collaborate on projects and initiatives with dozens of organizations including federal and state agencies, utilities, research institutions, businesses, and public interest groups.

ACEEE is not a membership organization. Support for our work comes from a broad range of foundations, governmental organizations, research institutes, utilities, and corporations.

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Glossary of Terms

Energy and Power Units

British thermal unit (Btu): basic unit of energy

Million Btu (MMBtu)

Quad = quadrillion Btu = 1,000,000,000,000,000 Btu

Therm = 100,000 Btu

Decatherm = 10 Therms = 1 MMBtu

Watt (W): basic unit of power

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 = ~1030 Btu

Thousand cubic feet (Mcf) = ~ million Btu

Million cubic feet (MMcf) = = ~ billion Btu

Billion cubic feet (Bcf) = ~ trillion Btu

Trillion cubic foot (Tcf) = ~Quad

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.

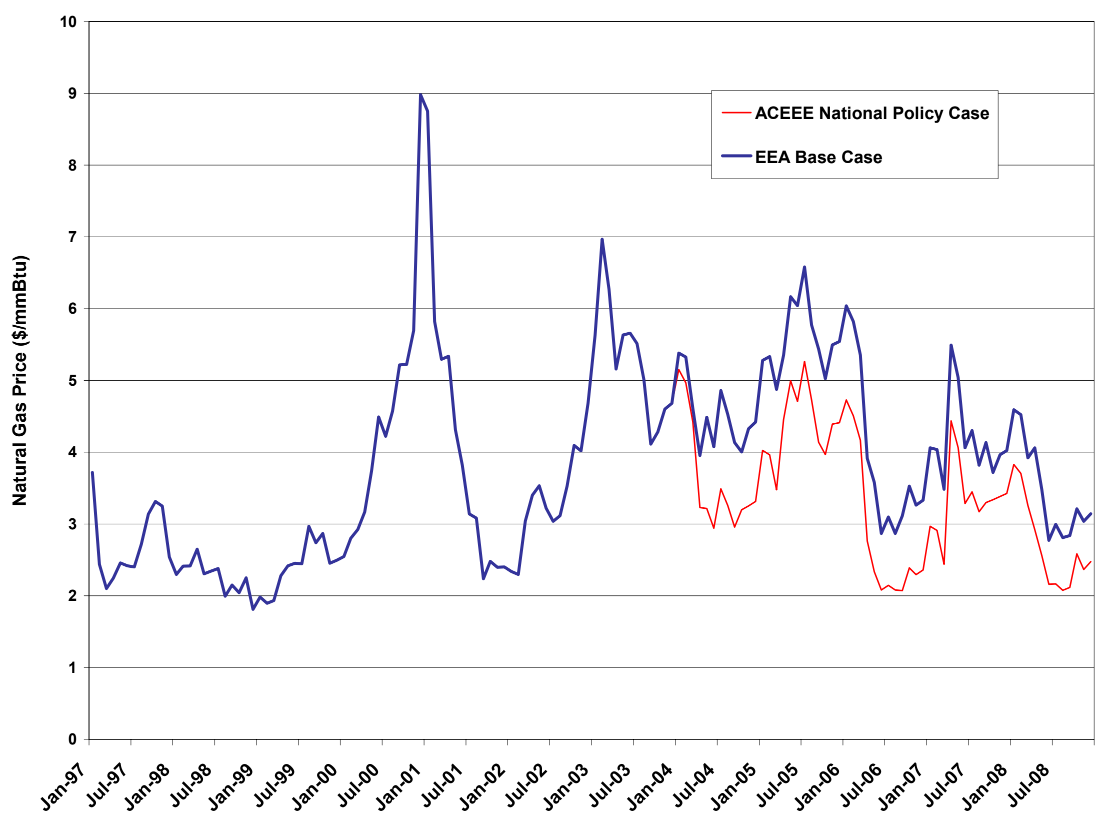
Executive Summary

This analysis, undertaken by the American Council for an Energy-Efficient Economy (ACEEE) (with the modeling assistance of Energy and Environmental Analysis (EEA)), shows that energy efficiency and renewable energy could cost-effectively reduce natural gas prices and volatility, while significantly reducing consumer natural gas expenditures. Much of the recent growth in natural gas use has been fueled by new natural gas-powered electricity generation, so it is important to understand the linkages between the natural gas and electric power sector. The analysis incorporated price, consumption and expenditure effects of aggressive, but readily achievable efficiency programs and renewable energy resources in the lower 48 states.

Summary of Findings

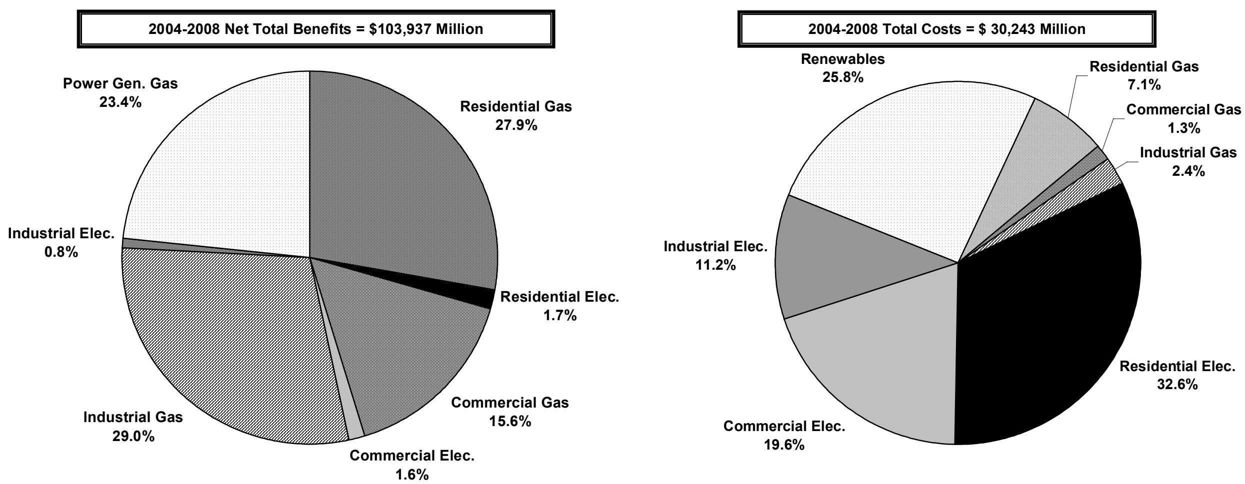
This analysis found that modestly reducing both natural gas and electricity consumption, and increasing the installation of renewable energy generation could dramatically affect natural gas price and availability. In just 12 months, nationwide efforts to expand energy efficiency and renewable energy could reduce wholesale natural gas prices by 20% (Figure ES- 1) and save consumers $15 billion/year in retail gas and electric power costs. Efforts to increase energy efficiency and renewable energy in just one state or region are also found to have significant effects on natural gas prices both regionally and nationally.

Figure ES- 1. Energy Efficiency and Renewable Energy Reduce Wholesale Gas Prices



Over the next five years, the cumulative net savings in natural gas expenditures to residential, commercial, and industrial consumers could exceed $75 billion (Figure ES- 2). In addition, electric power generators would reduce expenditures for natural gas by $24 billion. This reduction would result from the combined impacts of reduced natural gas prices, and reductions in natural gas consumption due to decreased consumer demand and expanded renewable electric power generation. In addition to the natural gas savings, electric consumers would see an additional net benefit of about $4.2 billion over the next 5 years. The net benefits from the efficiency and renewable energy measures over the next 5 years would total $104 billion.

Figure ES- 2. Net Benefits and Implementation Costs from Energy Efficiency and Renewable Energy



Achieving these benefits would require an investment of $30.2 billion over five years (Figure ES-2). This total includes required investment in natural gas and electric efficiency measures and in new renewable electric power generation, along with program costs required to facilitate the implementation of the measures. These measures result in a net benefit/cost ratio of about 3.44 to 1. Nearly two-thirds (64%) of the total expenditures are for electric efficiency measures, with renewable electric generation accounting for about a quarter of the investment. However, almost three-quarters of the benefits accrue to residential, commercial and industrial gas consumers. Thus, one can see that reductions in natural gas consumption by the electric power sector resulting from electric efficiency and expanded renewable power generation are critical to addressing natural gas price pressures. Table ES- 1 summarizes results on the costs and benefits associated with a nationwide efficiency and renewables effort.

Table ES- 1. Summary by Sector and Measure of Net Benefits and Implementation Costs from Energy Efficiency and Renewable Energy

	Natural Gas Expenditure Reduction (Million $)	Electricity Expenditure Reduction (Million $)	Technology Investment (Natural Gas) (Million $)	Technology Investment (Electricity) (Million $)	Program Costs (Million $)
Residential	28,964	1,764	1,684	7,913	561
Commercial	16,196	1,689	331	5,282	83
Industrial	30,151	788	603	2,727	158
Power Generation	24,361	N/A	N/A	N/A	N/A
Renewables	N/A	N/A	N/A	5,851	1,950
Total	**99,672**	**4,241**	**2,618**	**21,773**	**2,752**

What Will This Mean for Consumers?

Recent public concerns about natural gas supplies have been motivated by the price volatility in natural gas markets over the past three years. Consumers have seen prices spike to levels not observed in recent memory. The reasons for the price spikes are complex, though they can be characterized in general terms as a fundamental mismatch between gas supply and demand.

Many residential consumers have not become aware of the increases in natural gas prices that began last fall because customers are on fixed-cost annual contracts. Residential retail prices for 2003 are projected to be $2/thousand cubic feet (Mcf) higher than for 2002, with the higher prices projected to persist for at least the next four years. These residential consumers will begin to experience the price increases this fall with a national average increase of 36% in natural gas bills. If we have another cold winter, the cost could be difficult for many modest-income consumers to handle. However, energy efficiency investments could reduce next year's bills by 9%, saving the average residential natural gas consumer almost $73. These savings would continue, with savings for the next five years averaging $96/year.

Analysis Approach

The savings are the result of reductions in natural gas consumption brought about by changes in state and federal energy policies designed to increase the efficiency of natural gas and electricity consumption, and expansion of renewable power generation. The analysis predicts that in just 12 months efficiency measures could reduce national gas consumption by 1.9% from the base case and reduce electricity consumption by 2.2%. By 2008, we project the U.S. could reduce electricity consumption by 3.2% and natural gas consumption by 4.1%, and increase renewable generation from 2.3 to 6.3% of national generation. These changes would reduce wholesale gas prices by 22%.

The analysis also shows that reducing energy consumption and increasing renewable energy generation in just one state or region could result in dramatic wholesale natural gas price reductions on the order of 5 to 7% in the region. Energy efficiency and renewable energy can be deployed quickly with minimal siting or environmental roadblocks. While energy efficiency and renewable energy cannot address all our nation's future natural gas needs, they are the fastest and surest way to address high natural gas prices. Moreover, energy efficiency and renewable energy are low-cost answers that would be an important part of a solution to rising natural gas and electricity prices.

Electric Efficiency Is Part of the Natural Gas Solution

Electric efficiency will also help the looming natural gas problems that are projected to send consumer gas bills soaring this coming winter. Saving peak electricity is one of the fastest ways to reduce natural gas consumption. Our analysis found that because gas is disproportionately used for peak electricity generation, reducing electricity used for cooling and heating, lighting, and industrial processes could have a significant impact on gas usage and price. In addition, reducing electricity consumption could help relieve overloading the grid, which contributed in part to the blackout that occurred in the Midwest and Northeast on August 14, 2003. Investing now in energy efficiency and conservation would reap huge benefits for American consumers and for the fragile economic recovery. By shaving peak demands for electricity and natural gas, we could reduce prices, make energy bills manageable, avoid costly disruptions to business and to our daily lives, and put the American economy more firmly on the road to recovery.

Renewable Generation Helps Take Pressure Off Natural Gas Markets

Renewable energy resources take pressure off gas-fired electric generation in much the same way as electricity conservation. Electricity generated by wind, solar, and farm-based biomass disproportionately displace electric power production from gas-fired generators, thereby reducing gas demand and making it available at lower prices for other uses. Our analysis showed that modestly increasing renewables over the next five years would significantly reduce natural gas prices nationally. The same is true for renewable energy policy initiatives in states or regions. For example, in New York State we would be able to reduce wholesale natural gas prices in New York City by almost 2% in 2008.

Policy Recommendations

Policymakers at the state and federal level could take a number of concrete actions to realize the benefits that would likely result from expanded energy efficiency and renewable energy resources. No single policy strategy will achieve the results outlined here. Rather, a portfolio of strategies is most likely to achieve quick and sustained savings from energy efficiency and renewable energy resources. These strategies include:

- Energy efficiency performance targets supported by utility fees or system benefits charges
- Expanded federal funding for energy efficiency and renewable energy implementation programs at DOE and EPA including *Energy Star®*
- Appliance efficiency standards at both the federal and state level
- Insuring more efficient buildings through codes
- Support of clean and efficient distributed generation technologies
- Renewable portfolio standards
- Public awareness campaigns by state and national leaders with support for implementation programs

Public and private leaders need to step up to the podium and issue a call to action to implement the policies and programs needed to realize the benefits that will result from increased use of energy efficiency and renewable energy. A window of opportunity may be closing in the near future, so leaders must act now if the full, cost-effective benefits of energy efficiency and renewable energy are to be realized. We have provided some concrete policy recommendations. These policies are relatively low-cost and the measures recommended are cost-effective from the customer's perspective. However, local, state, and federal government must all be prepared to commit resources if this opportunity is to be realized.

Introduction

In this report, ACEEE, with the assistance of Energy and Environmental Analysis, Inc. (EEA), explores the impact of energy efficiency and renewable energy on reducing natural gas prices and volatility. ACEEE developed estimates of reasonably achievable natural gas savings in the 48 continuous United States in the short term. These estimates were entered into a model of natural gas markets developed by EEA (2003). This model projects both regional and national price effects of changes in natural gas consumption from a baseline. The model shows that increased energy efficiency and renewable energy use would significantly reduce natural gas prices for all consumers and put downward pressure on electricity prices.

Small changes in natural gas consumption can have disproportionately large impacts on natural gas prices because they reduce prices at the margin where they are highest. In some regions of the country, demand exceeds the ability of the natural gas infrastructure to deliver gas for brief periods of the year, creating even greater price pressures that modest savings could relieve. Furthermore, reductions in gas prices can have large impacts on natural gas-dependent industries such as fertilizer manufacturing. Reduction in natural gas prices can help these industries and their customers remain in business.

Overview of Analysis

Based on a review of existing literature, ACEEE developed estimates for the 48 contiguous states of the near-term (i.e., 1-year) and mid-term (i.e., 5-year) implementable potential for:

- Energy efficiency and conservation programs targeted at natural gas
- Energy efficiency and conservation programs targeted at electricity

These estimates have been made at the sectorial level for residential, commercial, and industrial consumption and are discussed in more detail in the Methodology section of this report.

Similarly, ACEEE developed implementable potential estimates for renewable resources for the 13 National Electric Reliability Councils (NERC) sub-regions based on a survey of existing research results and interviews with experts.

These ACEEE estimates served as an input matrix to the EEA natural gas model. It evaluates natural gas supply and demand at the national level, producing price projections at 106 points across North America. The model includes an electricity generation module, so reductions in electricity demand can be explored. The model also produced a baseline assessment.

The model was used to analyze four policy scenarios:

Scenarios	Measures Analyzed Electric Efficiency	 Natural Gas Efficiency	 Renewable Resources
National (lower 48)	X	X	X
Pacific West*	X	X	X
Northeast/PJM**	X	X	X
New York State Renewables			X

Notes: *California, Oregon and Washington
** ME, MA, VE, NH, CT, RI, NY, NJ, PA, DE, and MD

In each state or regional scenario, the measures were applied in only the listed states. The model then produced a national projection with estimates of local price impacts at all locations reported. This approach identified the relative impacts of programs in several key gas-consuming regions.

Description of EEA Model

EEA's *Gas Market Data and Forecasting System* is a full supply/demand equilibrium model of the North American gas market. The model solves for monthly natural gas prices throughout North America, given different supply/demand conditions, the assumptions for which are specified by the user. Overall, the model solves for monthly market clearing prices by considering the interaction between supply and demand curves at each of the model's nodes. On the supply-side of the equation, prices are determined by production and storage price curves that reflect prices as a function of production and storage utilization. Prices are also influenced by "pipeline discount" curves, which reflect the change in the basis or the marginal value of gas transmission as a function of load factor. On the demand-side of the equation, prices are represented by a curve that captures the fuel-switching behavior of end-users at different price levels. The model balances supply and demand at all nodes in the model at the market-clearing prices determined by the shape of the supply and curves. Unlike other commercially available models for the gas industry, EEA does significant back-casting (calibration) of the model's curves and relationships on a monthly basis to make sure that the model reliably reflects historical gas market behavior, instilling confidence in the projected results (EEA 2003).

Energy Expenditure Savings and Benefit/Cost Analysis

The output from the EEA model provided changes in natural gas consumption and prices at the state level by sector. These results allowed the calculation of changes in consumer natural gas expenditures. ACEEE then projected the changes in electric expenditures based upon the electric efficiency inputs and projected base-case electric prices by sector and state. Combined, these two analyses produced cumulative savings over the five-year-model period of $103.9 billion.

Based on a review of past program results, ACEEE developed estimates of the investment required to achieve the reductions in natural gas and electricity developed in the input data set, as is discussed in detail in the Investment and Program Cost section. These estimates include projected cost to administer the program on a state-by-state basis. An estimate was also made of the investment required to deploy the addition renewable resources projected, again including administrative costs. Based on this analysis, ACEEE estimates a total cost to achieve the results modeled in this analysis of $24.4 billion over five years.

Based on these analyses, ACEEE projects a national average benefits/costs ratio of 3.44 for the national energy efficiency and renewable energy scenario modeled in this study.

History and Background

Recently, natural gas has begun to receive attention in ways that have not been seen since the 1970s. Over the past few years the price of natural gas has risen, but more importantly, has become highly volatile. The reasons for this natural gas price-response are complex, but have drawn the attention of decision makers not normally associated with energy policy. As Federal Reserve Chairman Allen Greenspan (2003) recently testified:

> *In the United States, rising demand for natural gas, especially as a clean-burning source of electric power, is pressing against a supply essentially restricted to North American production. ...Futures markets project further price increases through the summer cooling season to the peak of the heating season next January. Indeed, market expectations reflected in option prices imply a 25 percent probability that the peak price will exceed $7.50 per million Btu. ...Today's tight natural gas markets have been a long time in coming, and futures prices suggest that we are not apt to return to earlier periods of relative abundance and low prices anytime soon.*

Chairman Greenspan's testimony served as a wakeup call to the Washington policy community. Energy efficiency, conservation, and renewables are now widely being acknowledged as the sole near-term policy options. This is demonstrated by Secretary Abraham's letter to state utility commissions (Abraham 2003), the National Petroleum Council's *Balancing Natural Gas Policy* report (NPC 2003) and the findings of the Speaker's Task Force for Affordable Natural Gas (House 2003). While the role of efficiency, conservation, and renewables is now receiving greater attention, it remains to be seen how effective the policymakers' actual responses will be.

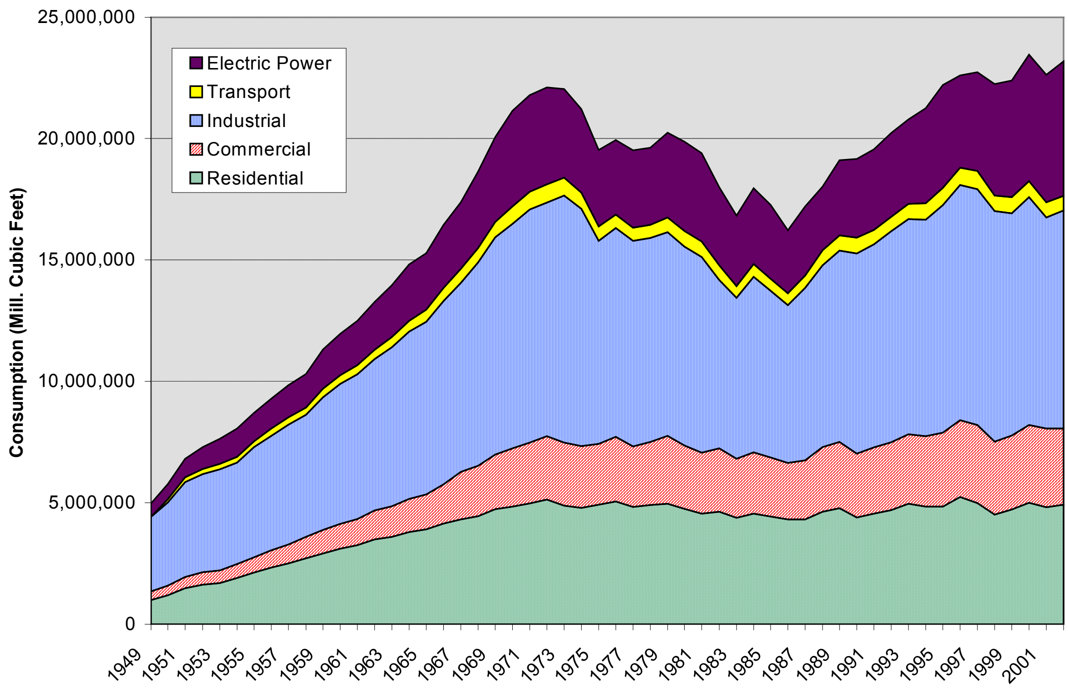
Current Natural Gas Pricing and Availability Environment

Much of the recent concern about natural gas supplies has been motivated by recent price uncertainties. Over the past three years, we have seen prices spike to levels not seen in recent memory. The reasons for the price spikes are complex, though they can be characterized in general terms as a fundamental mismatch between gas supply and demand.

Consumption

Since World War II, natural gas has played an increasingly important role in the U.S. energy picture. All energy-using sectors expanded their use of gas, with the industrial and residential sectors leading the growth (see Figure 1). Total gas usage peaked in the early 1970s at roughly four times the 1950 level. With the price increases and energy crises of the 1970s, industrial and utility gas consumption declined until 1987 when falling gas prices spurred another rise in consumption. Thereafter, all consuming sectors experienced an increase but the most dramatic increases occurred in the industrial and power-generation sectors that had been discouraged from using gas during much of the late 1970s and early 1980s because of regulation and price.

Figure 1. Natural Gas Consumption by End-Use Sectors (Source: EIA/AER 2003)



Price Trends

Real (i.e., inflation-adjusted) natural gas prices were steady through much of the 1960s, but began increasing with the energy crisis in 1973 (see Figure 2). Average natural gas prices peaked in 1983, and began to fall to an inflation-adjusted low in 1995. Prices then again began to increase around 1999.

Historically, natural gas prices fluctuate seasonally. The prices in all sectors except residential have fluctuated with demand: the highest prices correspond to the months of highest consumption during the winter (see Figure 3). The very cold winter of 1996-97 resulted in a significant consumption-induced price spike also seen in Figure 3. Average residential prices, however, are counter-cyclic, driven by fixed service charges with the highest prices corresponding to periods of lowest consumption during the summer.

Following the price spike in January of 1997, wellhead, industrial, and utility prices quickly fell to low levels. This price pattern was disrupted beginning in the spring of 2000 as prices began to rise and continued to rise to near record levels the following January. Prices then rapidly fell back to more normal levels in the summer of 2001. However, the unusually warm winter of 2001-02 saw winter prices fall to low levels in February of 2002. Prices then began a climb that has, for the most part, continued until recently (see Figure 3). Retail prices did begin to moderate in the summer of '03 but have increased with the fall as heating demand increases (EAI/SEO 2003).

Figure 2. National Average Annual Real Prices of Natural Gas by End-Use Sectors (Source: EIA/AER 2003)

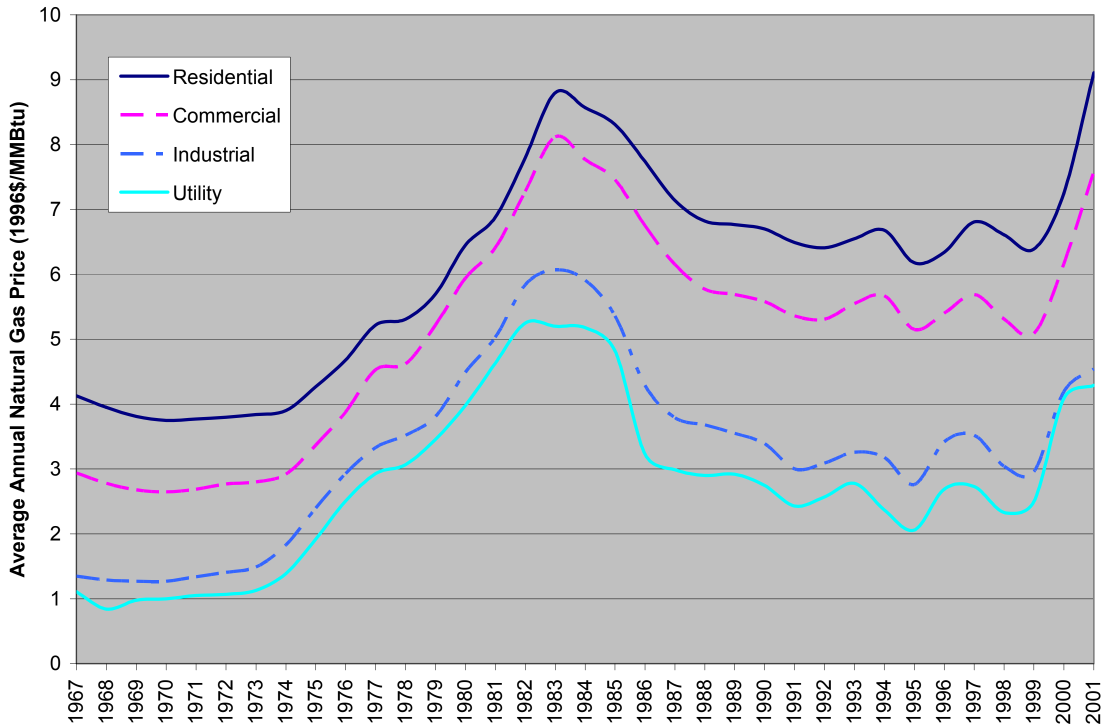
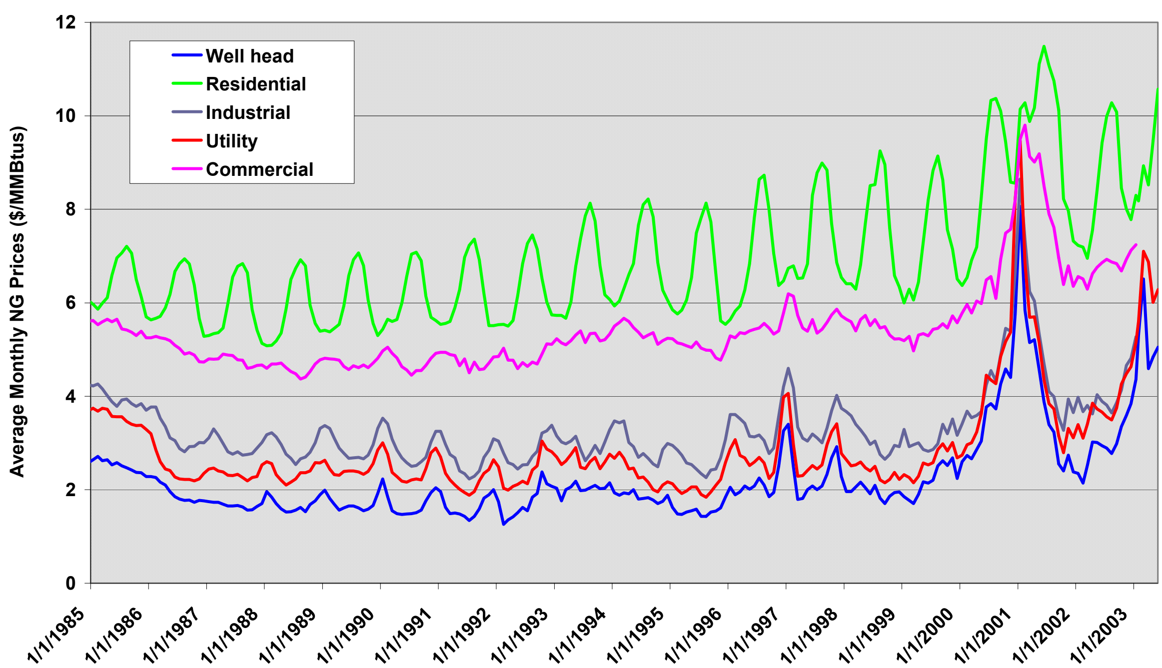


Figure 3. National Average Nominal Monthly Prices of Natural Gas by End-Use Sectors and at the Wellhead (Source: EIA/MER 2003)



Reasons for Current Market Instability

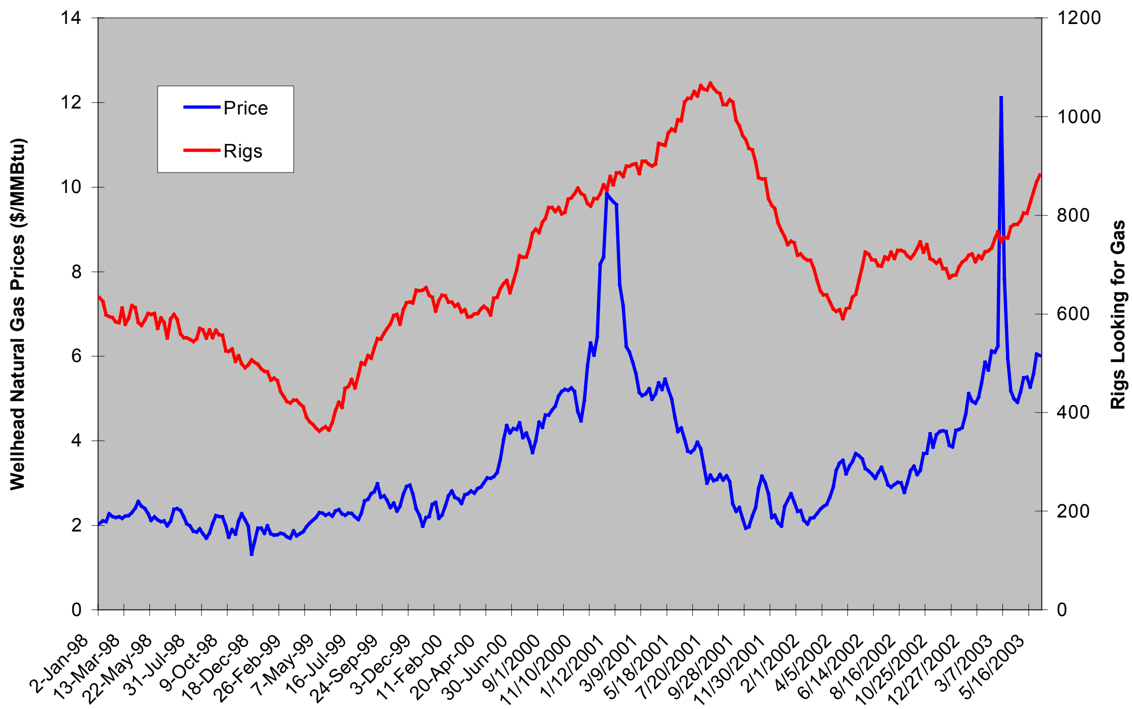
While market manipulation by natural gas marketers (such as the now infamous Enron) have been blamed for the price spikes in 2000 and 2001, similar attribution is much more difficult for the current run-up in prices. It appears that an imbalance between supply and demand contributed to both price spikes. Many experts feel that as the existing low-cost natural gas fields were depleted by the increases in consumption, and that low wellhead prices during most of the 1990s discouraged expanded exploration for new gas supplies that have a higher development costs (Chicago Fed 2003). As can be seen from Figure 4, natural gas exploration (as measured by rigs looking for gas) have increased in response to rising wellhead prices, only to fall back when prices drop below the point of financial attractiveness. While existing drill rigs are now fully deployed, with 93% looking for gas (EIA/NGM 2003), anecdotal reports say that little interest has been shown by the industry to market capital investments in new exploration capacity until evidence emerges that gas prices are likely to remain high for the longer term. Some experts speculate that if prices remain above $4 per million Btu, significant new gas production would emerge (Henning 2003).

In the short term, it appears that natural gas supplies will remain tight, and prices are likely to remain high for the next 2 to 3 years. This amount of time is needed for the supply markets to respond to the price signal. Longer term, many experts project that prices are likely to fall from the current level to something in the $4–5 dollar range per million Btu, but few are forecasting a return to the $2 per million Btu wellhead prices of the 1990s (EIA/SEO 2003; EEA 2003; Weismann 2003).

Growing Importance of Natural Gas in Electricity

One of the contributing factors to recent increases in natural gas consumption has been an expansion of natural gas-fueled electricity generation. Over the past 15 years, natural gas has assumed an increasing significant role in domestic electricity markets, now accounting for almost 20% of annual generation (EIA/MER 2003). The major motivations for this expansion of capacity was the relatively low cost of new gas generation plants, combined with bountiful, low-cost supplies of gas and the emergence of deregulated wholesale markets.

Figure 4. Comparison of Wellhead Price of Gas to Drill Rigs Looking for Gas (Sources: Baker Hughes 2003; EIA/NGM 2003)



Natural gas or dual fuel[1]-capable generation has increased from 30 to 41% of installed fossil generation, and from 22 to 30% of total generation in the past decade. The most dramatic increases in capacity occurred in 2000 and 2001, for the most part with exclusively gas-fired units (EIA/EA 2002). Other sources indicate that this trend of expanded gas capacity extended into 2002, despite slower growth in new gas fired capacity.
Combined heat and power (CHP) represents an important element of the generation base. Much of the CHP capacity installed in the past decade is gas-fired (EEA 2003). EIA groups this natural generation into categories (see Figure 5): commercial CHP, industrial CHP, and power-only generation. Since 1993, the CHP share of total natural gas generation has grown by 17%, while the electric-only gas generation has expanded by 75% (EIA/MER 2003).

In most regions, natural gas represents a disproportionate share of peak electricity generation (see Figure 6) (Barbose 2003). Electric efficiency and renewable generation investments have the largest impact on gas prices in regions with high gas-fired electric peak generation.

[1] EIA characterizes a duel fuel as capable of operating on natural gas or petroleum, although in reality most capacity has recently been operating on gas.

Figure 5. Natural Gas-Fired Electricity Generation by Facility Class (Source: EIA/MER 2003)

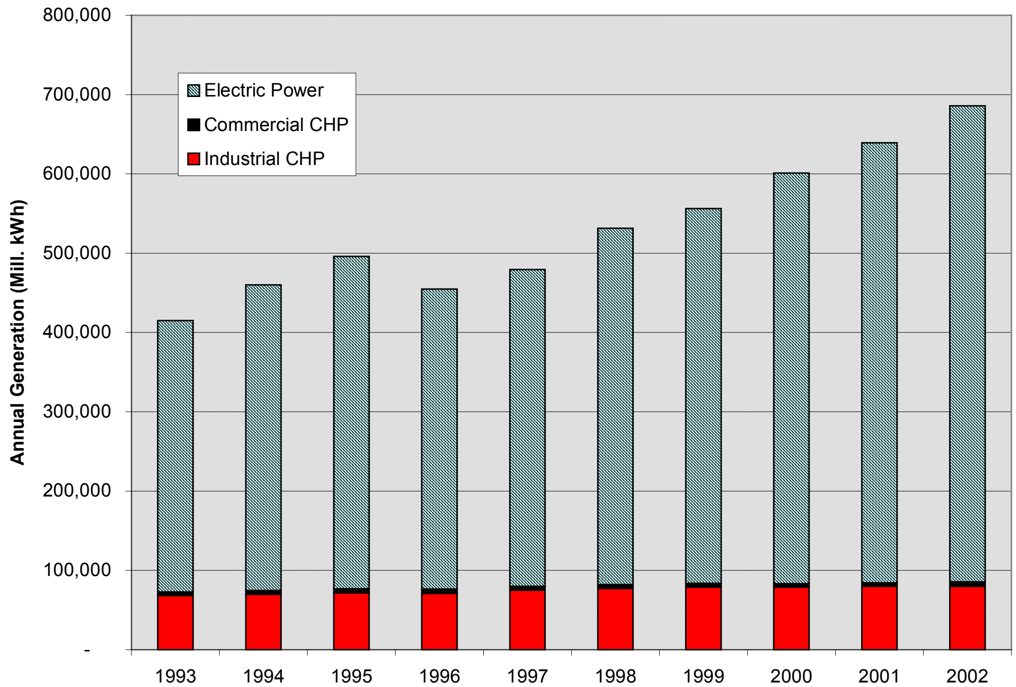
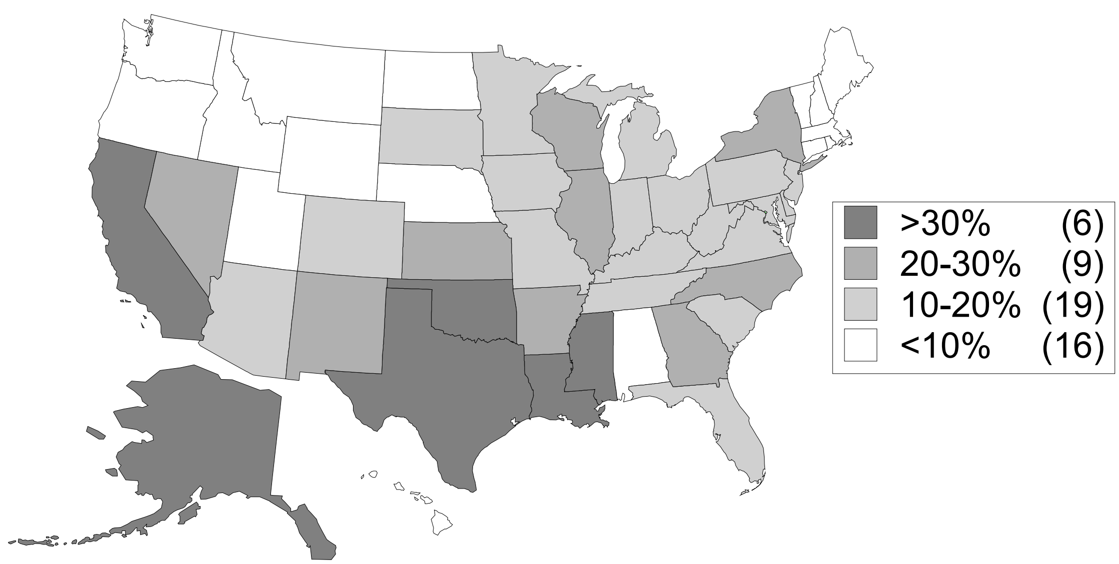


Figure 6. Percentage of Utility- and IPP-Installed Capacity Composed of Non-Combined Cycle, Natural Gas-Fired Plants (Source: Barbose 2003)

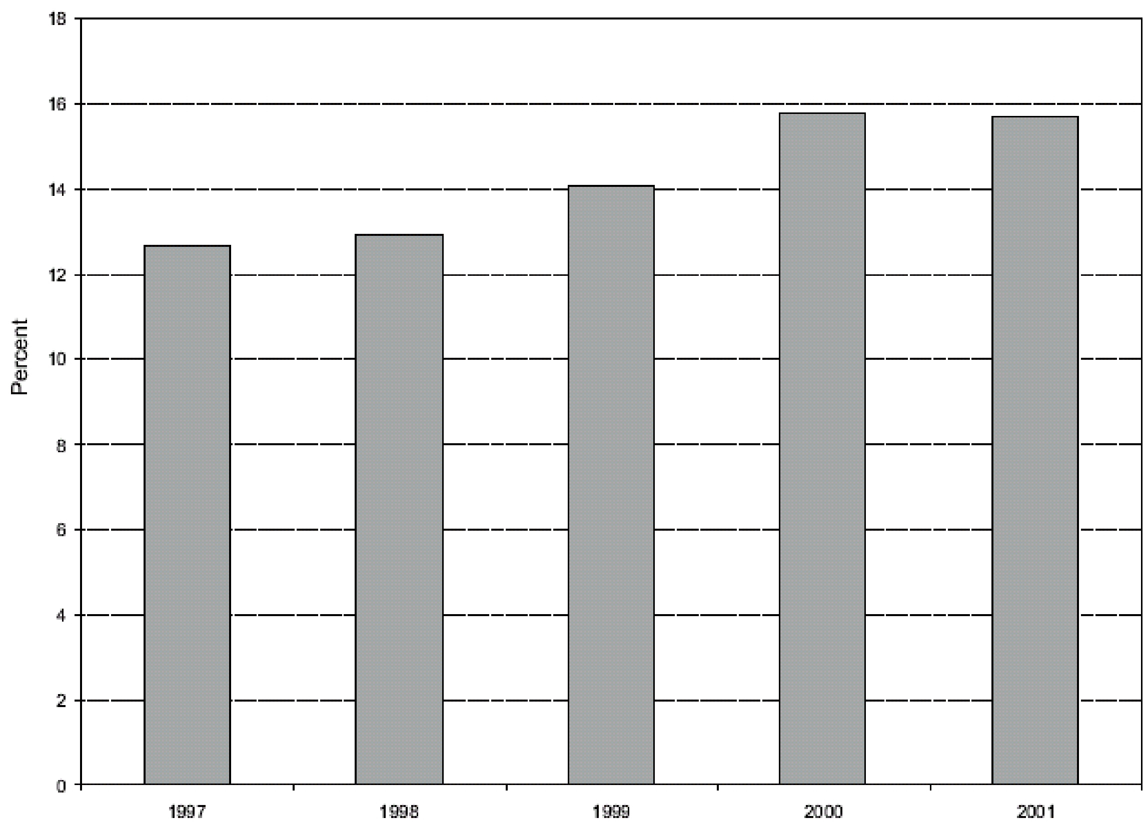


Natural Gas Reserves

While much of the current debate about gas prices implies that we are running out of gas, EIA estimates U.S. technically recoverable reserves to be over 1,430 trillion cubic feet (EIA/OGR 2003). These reserves should be sufficient to meet domestic consumption at the current level for 60 years. In addition, imports have been increasing, both from Canada and from liquid natural gas imports from overseas (see Figure 7).

While natural gas reserves are large and the potential for increased imports are significant, it is clear that the costs of bringing natural gas to the markets are increasing (Henning 2003). In summary, while we are in no imminent risk of running out of natural gas, the question is at what cost will the gas be available? Many analysts believe the U.S. economy will need to bear an increasing cost as the market prices of gas increase.

Figure 7. Net Imports as a Percentage of Total Consumption of Natural Gas, 1997–2001 (Source: EIA/NGM 2003)



Market Impacts of Rising Natural Gas Prices

Industrial and electric power consumers have been reeling under recent price increases. The industrial sector has been hard hit. This sector's consumption fall 16 percent from the highs of the late 90s due to the combined impacts of the economic downturn and rising natural gas prices. Some gas dependent industries such as organic chemicals and nitrogenous fertilizer are reducing production or closing domestic production and moving overseas.

The fertilizer industry has been particularly hard hit with an overall 45% reduction in production and the permanent closure of eleven ammonia plants representing 21% of U.S, capacity in the past three years (House 2003 and GAO 2003). Further closures are anticipated unless prices moderate. These impacts are felt not just at the industrial facilities, but also impact users of these factories' products. Farmers have experienced a 100% increase in fertilizer prices in the past year amounting to a 4% increase in their cost of production. The Speaker's Task Force for Affordable Natural Gas (House 2003) indicates that this situation is "shrinking profit margins for agricultural products, increasing the cost of food on the table and putting additional pressure on the already endangered family farm, farm states, and the agricultural sector of the economy."

As noted earlier, over 90% of new power generation in this country is fueled with natural gas. The increases in natural gas prices to electric power generators are raising the cost of electric power while imperiling the financial solvency of some new power plant owners. Already some new plants have been delayed or canceled, raising question of where the power will come from to satisfy growing demand for electricity (House 2003 and Weismann 2003).

Because of the pricing structure of many residential gas supply contracts and their low summer demand, many have yet to experience the full brunt of the dramatic price increases that other sectors of the economy have already experienced. Residential consumers will begin to experience the price increases this fall as consumer demand increases and their local distribution companies (LDC) begin to pass along the commodity increases as price increases in order to recover the costs they incurred in the winter from the higher gas prices. Thus, residential natural gas bills are likely to rise dramatically as we move into the fall heating season (EIA/SEO 2003).

Methodology

Because of the design of the EEA natural gas model, ACEEE needed to estimate the energy consumption reductions that could be implemented through energy efficiency and conservation on a state-by-state basis for the three primary end-use consuming sections: residential, commercial, and industrial. In addition, we needed to estimate implementable additions to renewable generation stocks above the base case at the regional level.

Different approaches were used for estimating the implementable potential for energy efficiency and renewables energy. Energy efficiency and conservation were assumed to impact consumption of natural gas and electricity, while new renewable energy resources were added to the regional electric power generation base. For energy efficiency and conservation, savings potentials were estimated for each of the lower 48 states for both direct use of natural gas and for use of electricity in the primary end-use sectors. Savings from energy efficiency and conservation were assumed to be front loaded, while the estimates for net new renewables were assumed to be added equally in the second through fifth year of the analysis.

General Approach for Energy Efficiency and Conservation

Similar, bottoms-up approaches were used for all end-use sectors for the energy efficiency and conservation analyses for both electricity and natural gas. Estimates of the major natural gas and electricity end uses for each of the states were developed. Based on a review of available literature, estimates were developed of the implementable savings that could be achieved in five years through the implementation of aggressive programs similar to those that have been deployed in recent years in response to recent regional energy shortages. These estimates were then applied to the end-use estimates in each state to develop sectoral estimates of energy savings for each state.

General Assumptions

To facilitate the performance of this analysis, we made several assumptions. The following parameters are assumed to be embodied in the base-case analysis, and were not being considered in the scenarios (except as noted):

- Demand destruction—the permanent elimination of energy demand due to facilities closing or shifting operations to other regions.
- Price-based fuel switching outside of renewables;
- Utility plant shutdowns or ramp-ups.
- Changes to natural gas infrastructure (except in the NYS/RPS scenario where we will explicitly assume no new gas transmission lines are constructed during the study period).
- A change in industrial feedstock utilization or sourcing—natural gas is used by some industries as a feed stock in addition to its use as a fuel.

To make the analysis doable, we made the following simplifying assumptions:

- Potential for industrial end-use energy efficiency and conservation does not vary by region.
- The load curve for industrial power and natural gas consumption does not vary seasonally.
- No significant new renewable resources are likely to become available in the first year above the base case.
- Wind, biomass, and solar are the principal renewable resources contributing to displaced utility generation above the base case.
- Additional displacement of consumer end-use gas by renewables is considered small, and is assumed to be zero for purposes of this analysis.

State-by-State Adjustments

The potential to achieve energy-efficiency savings varies among the states. Some states like New York and California have well established energy-efficiency programs supported by many market allies, and could expand efficiency programs off of existing policy platforms. Some other states, such as South Dakota and Mississippi, have no record of running energy efficiency programs, so are less likely to be able to rapidly deploy new programs. In order to estimate the energy saving potential for individual state, a state a weighting factor was developed. This state-weighting factor is intended to measure the current status of a state's energy-efficiency and renewable energy delivery infrastructure. The quality of the infrastructure is based on a matrix of policy handles and mechanisms, intended as a quantifiable measure of the various qualitative policy mechanisms (Table 1). Based on these factors, a "grade" was assigned to each state. Grades of "a", "b", "c", and "d" were assigned to each state. An "a" represented 100%, a "b" was equal to 85%, a "c" was equal to 70%, and a "d" was equal to 55%. This means that an "a" state would be able to achieve 100% of the regional savings potential. California, for example, located in the west census region was given a grade of "a" for its energy-efficiency and renewables infrastructure. The west regional maximum achievable five-year electricity and natural gas savings are 5.41% and 5.19%, respectively. California is expected to be able to achieve 100% of these savings under an aggressive policy scenario.

Table 1. State Energy Efficiency and Renewable Energy Programs and Policies

State	Public Benefit Fund[2]	IAC	RPS	Residential Buildings Codes	Commercial Buildings Codes	Utility Restructuring[3]	Regional Initiatives	Environmental Trust/ Environmental Trading Group	Tax Credits for Energy Efficiency	Tax Credits for Renewables	Score
Alabama	0	y		c	c	N					d
Arizona	0	y		c	c	A			Y	Y	b
Arkansas	0			c	b	D					d
California	2	y	y	a	a	S		Y			a
Colorado	1	y		c	c	N					b
Connecticut	2	y	y	b	b	A	y				a
Delaware	1	y		c	b	A	y				b
Florida	1	y		a	a	N					c
Georgia	0	y		a	a	N					d
Idaho	1			a	a	N			Y	Y	b
Illinois	0	y		c	c	A	y				b
Indiana	0	y		c	c	N	y				c
Iowa	1	y		c	b	N	y				b
Kansas	0			c	b	N					d
Kentucky	0			a	a	N					d
Louisiana	0	y		c	b	N					d
Maine	2		y	c	a	A	y				a
Maryland	0	y		a	b	A	y		Y	Y	b
Massachusetts	2		y	b	a	A	y	Y	Y	Y	a
Michigan	0	y		c	c	A	y				b
Minnesota	1			b	b	N	y				b
Missouri	0			c	c	N	y				d
Mississippi	0			c	c	N					d
Montana	1			c	b	D	y				c
Nebraska	0			c	c	N					d
Nevada	0		y	c	c	D					c

2 Spending greater than 1% of revenues = 2, greater than 0.1% =1, and less than 0.1% = 0
3 N=no, A=active, D=delayed, S=suspended (CA only)

State	Public Benefit Fund[2]	IAC	RPS	Residential Buildings Codes	Commercial Buildings Codes	Utility Restructuring[3]	Regional Initiatives	Environmental Trust/ Environmental Trading Group	Tax Credits for Energy Efficiency	Tax Credits for Renewables	Score
New Hampshire	1	y		a	b	A	y				b
New Jersey	2	y	y	b	a	A	y		Y	Y	a
New Mexico	0			a	a	D					d
New York	2	y		a	a	A	y		Y	Y	a
North Carolina	0	y		a	a	N					d
North Dakota	1			a	c	N					d
Ohio	0	y		a	a	A	y				c
Oklahoma	0	y		b	b	D					d
Oregon	1	y		a	a	A	y	Y	Y	Y	a
Pennsylvania	1	y	Y	a	a	A					a
Rhode Island	2	y		a	a	A	y				a
South Carolina	1			a	b	N					d
South Dakota	0			c	c	N					d
Tennessee	1			c	c	N					c
Texas	1	y	y	a	a	A					a
Utah	1	y		a	a	N					b
Vermont	2	y		b	c	N	y				a
Virginia	0	y		b	b	A					c
Washington	1	y		a	a	N	y				b
West Virginia	0	y		c	c	N					d
Wisconsin	2	y	y	a	b	N	y				a
Wyoming	1			c	c	N	y				c

Residential/Commercial Methodology and Characterization

General Approach

The estimation of the implementable savings from the residential and commercial sectors used a "bottoms-up" approach. The analysis began with data on energy use in each of the 48 states by end-use (e.g. lighting, cooling, heating, etc). A variety of published studies were then used to estimate average annual electric and gas savings over five years from efficiency programs, including adjustments for reasonable savings by end-use. We then estimated the savings achievable in one year, relative to savings achievable over five years. Finally, we looked at current policy initiatives to promote efficiency in each of the 48 states, and adjusted savings downward in states without strong efficiency policies, reasoning that a sudden change in policy was unlikely, thus, lower savings were likely in these states. Each step is discussed in the following sections.

Base Case by End-Use

Base case energy use for each state was estimated for each of the 48 states using data from the *1997 Residential Energy Consumption Survey* (RECS) (EIA 1999) and the *1999 Commercial Building Energy Consumption Survey* (CBECS) (EIA 2001a).

RECS provides energy use consumption and saturation figures for the four largest states (California, Texas, New York, and Florida) and for each Census region. We used data for space heating, space cooling, water heating and appliances/other. For the 44 states not individually profiled, we assumed that the regional figures would apply. For Census regions with the four large states, we subtracted out data on the large state in order to calculate average energy use for the remaining states. In the case of the Mountain region, given the large differences in latitude involved, we differentiated between north Mountain and south Mountain using data from a study on the region by the Southwest Energy Efficiency Project (SWEEP 2002).

CBECS also provides data on each region, but not for individual states. End-uses covered were space heating, space cooling, water heating, lighting, refrigeration, ventilation, cooking, office equipment, and other. We used regional data to characterize each of the individual states.

Overall Energy Savings Achievable Over Five Years

A variety of studies have been conducted in recent years to estimate the economic and achievable efficiency potentials for reducing gas and electricity use in different states. Economic potential is an estimate of the savings that can be achieved if all measures which are cost-effective to end-users are implemented. Achievable potential is a subset of economic potential and includes allowances for reasonable measure penetration rates given likely policy and program interventions.

To estimate achievable potential over one and five years, we considered two types of data. First, substantial savings can be achieved in the short-term through behavioral changes in response to high prices and appeals for conservation. For example, in 2001, in response to the California electricity crisis, California end-users reduced their energy use about 6%, of which about two-thirds was a behavioral response (Global Energy Partners 2003). Thus Californians used behavioral actions to reduce energy use by about 4%. The California situation was particularly dire; therefore, we estimated that a new campaign in response to the natural gas crisis could only achieve two-thirds of these savings—an average of 2.7%.

Second, energy use can be reduced through hardware improvements. To estimate these savings, we compiled information from ten different studies, including six studies on potential gas savings and eight studies on potential electricity savings (four studies included both fuels). Energy savings estimates were divided by the period of analysis (e.g. five years, 20 years, etc.) in order to estimate annual incremental savings. We examined overall savings estimates by sector (residential and commercial), as well as by end-use. In estimating the overall savings achievable, we only looked at achievable potential studies, and in order to be conservative, emphasized the lower end of the savings estimates. Based on these studies, we estimated an overall achievable savings potential, from hardware improvements (Table 2).

Table 2. Achievable Savings Potential in the Residential and Commercial Sectors from Hardware Improvements

Sector	Fuel	Savings Achievable (%/year)
Residential	Natural gas	0.5
	Electricity	0.7
Commercial	Natural gas	0.4
	Electricity	0.8

As a check on these figures, we compared the annual achievable savings figures to actual savings achieved by leading utility programs. For example, one of the leading gas efficiency programs in the country is run by XCEL Minnesota. They have achieved approximately 0.5% savings per year in recent years, right in line with our estimate (XCEL Energy 2003). Likewise, among electric utilities, a 1995 analysis by ACEEE found that the leading utilities were achieving energy savings of 0.5 to 1.0% per year, in line with the estimates above (Nadel and Geller 1995). And in 2001, as noted above, California achieved 6% electricity savings, of which one-third (i.e. 2%/year) was in hardware improvements.

We then added the behavioral savings (2.7%) to the hardware savings over five years (annual savings times five) to arrive at overall savings over five years for each fuel and sector.

End-Use Adjustments

Achievable savings varies somewhat by end-use. However, data on achievable savings by end-use is rarely compiled. As a proxy, we looked at estimates on economic savings potential by end-use in comparison to overall sector economic savings potential. Based on these data, we developed multipliers for each end-use, in which a multiplier greater than one means higher than average savings potential and visa versa. Multipliers used are displayed in Table 3.

Table 3. End-Use Adjustments for the Residential and Commercial Sectors

Sector	Fuel	End-Use	Multiplier
Residential	Gas	Space heating	1.0
		Water heating	1.1
		Other	0.6
Residential	Electric	Space heating	0.8
		Space cooling	1.2
		Water heating	1.0
		Appliances & other	0.9
Commercial	Gas	Space heating	0.9
		Water heating	1.4
		Cooking	0.6
		Other	0.6
Commercial	Electricity	Space heating	0.2
		Space cooling	1
		Ventilation	0.9
		Water heating	0.6
		Lighting	1.2
		Cooking	0.5
		Refrigeration	0.8
		Office equipment	1.1
		Other	0.5

Savings in Year 1

In the first year, the vast bulk of the behavioral savings can be achieved, plus one year of hardware savings. Across the different fuels and sectors, we estimate that approximately half of the five-year savings can be achieved in the first year, assuming a high prices and an active efficiency promotion campaign, with the remaining savings evenly distributed across the remain years of the study period.

Estimates of Implementable Residential and Commercial Energy Savings

Based on the above data, for each state, the base case end-use share for each state was multiplied by the appropriate end-use factor and overall achievable savings estimate to come up with maximum five-year savings. These savings were then multiplied by the numeric percentage for each state's current programs and policies, in order to reduce savings in those states with low or moderate current programs and policies. The result is total percent savings, by state, over five years. As noted above, the first year savings are half of the five-year savings figures. State-by-state savings estimates are provided in Table 4 and Table 5. A more detailed breakdown of the savings measures are presented in Appendix B.

Table 4. Estimated Residential and Commercial Natural Gas Energy Efficiency and Conservation Savings

State	State Score	Commercial			Residential		
		Savings Possible in 5 Yrs	Adjusted 5 Yr Savings	Year-One Savings	Savings Possible in 5 Yrs	Adjusted 5 Yr Savings	Year-One Savings
Alabama	d	4.7%	2.6%	1.3%	5.2%	2.9%	1.4%
Arizona	b	4.7%	4.0%	2.0%	5.3%	4.5%	2.2%
Arkansas	d	4.7%	2.6%	1.3%	5.2%	2.9%	1.4%
California	a	4.8%	4.8%	2.4%	5.1%	5.1%	2.6%
Colorado	b	4.7%	4.0%	2.0%	5.2%	4.4%	2.2%
Connecticut	a	4.7%	4.7%	2.3%	5.2%	5.2%	2.6%
Delaware	b	4.5%	3.8%	1.9%	5.2%	4.4%	2.2%
Florida	c	4.5%	3.1%	1.6%	4.8%	3.4%	1.7%
Georgia	d	4.5%	2.5%	1.2%	5.2%	2.9%	1.4%
Idaho	b	4.7%	4.0%	2.0%	5.2%	4.4%	2.2%
Illinois	b	4.6%	3.9%	1.9%	5.2%	4.4%	2.2%
Indiana	c	4.6%	3.2%	1.6%	5.2%	3.6%	1.8%
Iowa	b	4.6%	3.9%	2.0%	5.2%	4.4%	2.2%
Kansas	d	4.6%	2.6%	1.3%	5.2%	2.9%	1.4%
Kentucky	d	4.7%	2.6%	1.3%	5.2%	2.9%	1.4%
Louisiana	d	4.7%	2.6%	1.3%	5.2%	2.9%	1.4%
Maine	a	4.7%	4.7%	2.3%	5.2%	5.2%	2.6%
Maryland	b	4.5%	3.8%	1.9%	5.1%	4.4%	2.2%
Massachusetts	a	4.7%	4.7%	2.3%	5.2%	5.2%	2.6%
Michigan	b	4.6%	3.9%	1.9%	5.2%	4.4%	2.2%
Minnesota	b	4.6%	3.9%	2.0%	5.2%	4.4%	2.2%
Missouri	d	4.6%	2.6%	1.3%	5.2%	2.9%	1.4%
Mississippi	d	4.7%	2.6%	1.3%	5.2%	2.9%	1.4%
Montana	c	4.7%	3.3%	1.6%	5.2%	3.7%	1.8%
Nebraska	d	4.6%	2.6%	1.3%	5.2%	2.9%	1.4%
Nevada	c	4.7%	3.3%	1.6%	5.3%	3.7%	1.8%
New Hampshire	b	4.7%	4.0%	2.0%	5.2%	4.4%	2.2%
New Jersey	a	4.5%	4.5%	2.2%	5.1%	5.1%	2.6%
New Mexico	d	4.7%	2.6%	1.3%	5.3%	2.9%	1.5%
New York	a	4.5%	4.5%	2.2%	5.1%	5.1%	2.6%
North Carolina	d	4.5%	2.5%	1.2%	5.2%	2.9%	1.4%
North Dakota	d	4.6%	2.6%	1.3%	5.2%	2.9%	1.4%
Ohio	c	4.6%	3.2%	1.6%	5.2%	3.6%	1.8%
Oklahoma	d	4.7%	2.6%	1.3%	5.2%	2.9%	1.4%
Oregon	a	4.8%	4.8%	2.4%	5.1%	5.1%	2.5%
Pennsylvania	a	4.5%	4.5%	2.2%	5.1%	5.1%	2.6%
Rhode Island	a	4.7%	4.7%	2.3%	5.2%	5.2%	2.6%
South Carolina	d	4.5%	2.5%	1.2%	5.2%	2.9%	1.4%
South Dakota	d	4.6%	2.6%	1.3%	5.2%	2.9%	1.4%
Tennessee	c	4.7%	3.3%	1.7%	5.2%	3.6%	1.8%
Texas	a	4.7%	4.7%	2.4%	5.1%	5.1%	2.6%
Utah	b	4.7%	4.0%	2.0%	5.2%	4.4%	2.2%
Vermont	a	4.7%	4.7%	2.3%	5.2%	5.2%	2.6%

State	State Score	Commercial: Savings Possible in 5 Yrs	Commercial: Adjusted 5 Yr Savings	Commercial: Year-One Savings	Residential: Savings Possible in 5 Yrs	Residential: Adjusted 5 Yr Savings	Residential: Year-One Savings
Virginia	c	4.5%	3.1%	1.6%	5.2%	3.6%	1.8%
Washington	b	4.8%	4.1%	2.1%	5.1%	4.3%	2.2%
West Virginia	d	4.5%	2.5%	1.2%	5.2%	2.9%	1.4%
Wisconsin	a	4.6%	4.6%	2.3%	5.2%	5.2%	2.6%
Wyoming	c	4.7%	3.3%	1.6%	5.2%	3.7%	1.8%

Table 5. Estimated Residential and Commercial Electric Energy Efficiency and Conservation Savings

State	State Score	Commercial: Savings Possible in 5 Yrs	Commercial: Adjusted 5 Yr Savings	Commercial: Year-One Savings	Residential: Savings Possible in 5 Yrs	Residential: Adjusted 5 Yr Savings	Residential: Year-One Savings
Alabama	d	6.5%	3.6%	1.8%	5.7%	3.2%	1.6%
Arizona	b	6.8%	4.7%	2.4%	5.9%	4.1%	2.1%
Arkansas	d	6.7%	3.7%	1.9%	5.8%	3.2%	1.6%
California	a	6.7%	6.7%	3.4%	5.7%	5.7%	2.8%
Colorado	b	6.8%	4.7%	2.4%	5.6%	3.9%	2.0%
Connecticut	a	6.8%	6.8%	3.4%	5.6%	5.6%	2.8%
Delaware	b	6.7%	4.7%	2.3%	5.6%	3.9%	2.0%
Florida	c	6.7%	4.7%	2.3%	6.1%	4.3%	2.1%
Georgia	d	6.7%	4.7%	2.3%	5.8%	4.1%	2.0%
Idaho	b	6.8%	5.8%	2.9%	5.6%	4.8%	2.4%
Illinois	b	6.7%	5.7%	2.8%	5.7%	4.8%	2.4%
Indiana	c	6.7%	5.7%	2.8%	5.7%	4.8%	2.4%
Iowa	b	6.8%	5.8%	2.9%	5.7%	4.8%	2.4%
Kansas	d	6.8%	3.8%	1.9%	5.7%	3.1%	1.6%
Kentucky	d	6.5%	3.6%	1.8%	5.7%	3.2%	1.6%
Louisiana	d	6.7%	3.7%	1.9%	5.8%	3.2%	1.6%
Maine	a	6.8%	6.8%	3.4%	5.6%	5.6%	2.8%
Maryland	b	6.7%	5.7%	2.8%	5.8%	4.9%	2.5%
Massachusetts	a	6.8%	6.8%	3.4%	5.6%	5.6%	2.8%
Michigan	b	6.7%	4.7%	2.3%	5.7%	4.0%	2.0%
Minnesota	b	6.8%	5.8%	2.9%	5.7%	4.8%	2.4%
Missouri	d	6.8%	3.8%	1.9%	5.7%	3.1%	1.6%
Mississippi	d	6.5%	3.6%	1.8%	5.7%	3.2%	1.6%
Montana	c	6.8%	4.7%	2.4%	5.6%	3.9%	2.0%
Nebraska	d	6.8%	3.8%	1.9%	5.7%	3.1%	1.6%
Nevada	c	6.8%	4.7%	2.4%	5.9%	4.1%	2.1%
New Hampshire	b	6.8%	5.8%	2.9%	5.6%	4.8%	2.4%
New Jersey	a	6.6%	6.6%	3.3%	5.6%	5.6%	2.8%
New Mexico	d	6.8%	3.7%	1.9%	5.9%	3.3%	1.6%
New York	a	6.6%	6.6%	3.3%	5.6%	5.6%	2.8%
North Carolina	d	6.7%	3.7%	1.8%	5.8%	3.2%	1.6%

State	State Score	Commercial			Residential		
		Savings Possible in 5 Yrs	Adjusted 5 Yr Savings	Year-One Savings	Savings Possible in 5 Yrs	Adjusted 5 Yr Savings	Year-One Savings
North Dakota	d	6.8%	3.8%	1.9%	5.7%	3.1%	1.6%
Ohio	c	6.7%	4.7%	2.3%	5.7%	4.0%	2.0%
Oklahoma	d	6.7%	3.7%	1.9%	5.8%	3.2%	1.6%
Oregon	a	6.7%	6.7%	3.4%	5.5%	5.5%	2.8%
Pennsylvania	a	6.6%	4.6%	2.3%	5.6%	3.9%	2.0%
Rhode Island	a	6.8%	6.8%	3.4%	5.6%	5.6%	2.8%
South Carolina	d	6.7%	3.7%	1.8%	5.8%	3.2%	1.6%
South Dakota	d	6.8%	3.8%	1.9%	5.7%	3.1%	1.6%
Tennessee	c	6.5%	4.6%	2.3%	5.7%	4.0%	2.0%
Texas	a	6.7%	6.7%	3.4%	5.9%	5.9%	3.0%
Utah	b	6.8%	5.8%	2.9%	5.6%	4.8%	2.4%
Vermont	a	6.8%	6.8%	3.4%	5.6%	5.6%	2.8%
Virginia	c	6.7%	4.7%	2.3%	5.8%	4.1%	2.0%
Washington	b	6.7%	5.7%	2.9%	5.5%	4.7%	2.3%
West Virginia	d	6.7%	3.7%	1.8%	5.8%	3.2%	1.6%
Wisconsin	a	6.7%	6.7%	3.3%	5.7%	5.7%	2.8%
Wyoming	c	6.8%	4.7%	2.4%	5.6%	3.9%	2.0%

Industrial Methodology and Characterization

General Approach

A "bottom-up" approach was used for determining the electricity and natural gas savings potential for the industrial sector. The estimated savings were calculated based on electric and natural gas end-use savings estimates. Because there is no specific state-level end-use data for the industrial sector, the state estimates were based on the four Census regions for which specific sub-sector and end-use data is available through the Energy Information Administration. Once maximum achievable savings estimates were determined, a weighting factor based on each state's existing programmatic infrastructure was applied.

Energy Savings by End-Use

Disaggregated state-level energy use is not available. In order to develop estimates for each of the 48 states, regional data from the Manufacturing Energy Consumption Survey (MECS) 1998 was used (EIA 2001b). Regional savings estimates were determined using the methodology described below.

MECS provides energy consumption and end-use data on a sub-sector level for four major Census regions—Northeast, Midwest, South, and West. Because the industrial sector is highly heterogeneous, it is necessary to obtain data on a 3-digit North American Industrial Classification System (NAICS) code level in order to determine accurate estimates of potential savings in a region. It was assumed that the breakdown of energy use in each state was identical to its Census region breakdown. The six industrial sub-sectors that were included in estimating the Census region electricity and natural gas savings are summarized in Table 6.

Table 6. North American Industrial Classification System (NAICS) Key

NAICS Code	Industrial Sub-Sector
311	Food
322	Paper
324	Petroleum and Coal Products
325	Chemicals
327	Nonmetallic Mineral Products
331	Primary Metals
	All Others

These sub-sectors align with the sub-sectors represented in the EEA natural gas forecasting model. Specific end-use data for each of these sub-sectors within each of the four census regions was obtained. For determining electricity conservation potential, the following end-uses were considered: motors, process heating, HVAC, and lighting. For determining the natural gas conservation potential, the following end-uses were considered: boilers, process heating, and space heating.

The conservation potential by end-use was based on figures reported in "California Industrial Energy Efficiency Market Characterization Study" (XENERGY 2001). This study was done for the Pacific Gas and Electric Company (PG&E), and the end-use savings figures line up closely with recent studies done by ACEEE and Optimal Energy Inc. (NYSERDA 2003). The XENERGY study details achievable savings by end-use for both electric and natural gas-fired processes. Because the scope of our study focused on a relatively short 1-year and 5-year timeframe, we estimated that 50% of the total achievable savings cited in the study would be achievable by year 5. The Energy study concentrated on a 10-yr timeframe, making the 50% assumption for the 5-year outlook reasonable. These estimates align closely with data obtained from the Industrial Assessment Centers (IAC) database (IAC 2003). Table 7 includes maximum achievable 5-year savings estimates by end-use.

Table 7. Industrial Sector End-Use Breakdown

End-Uses		5-Year Savings Potential
Electricity End-Uses	Motors	7%
	Process Heating	5%
	HVAC	12%
	Lighting	10%
Natural Gas End-Uses	Boilers	6%
	Process Heating	5%
	Space Heating	5%

These end-use savings estimates were then applied to the unique end-use breakdowns for the seven major industrial sub-sectors that were considered in the analysis. Since each Census region has a distinct mix of industrial activity, the total regional savings potential will vary from the national average. Table 8 includes the end-use breakdowns for the various industrial sub-groups in the analysis.

Table 8. Industrial Sub-Sector End-Use

NAICS Code	Industrial Sub-Sector	Electricity End-Uses (Percent of Sub-Sector Electricity Consumption)				Natural Gas End-Uses (Percent of Sub-Sector Natural Gas Consumption)		
		Motors	Process Heating	HVAC	Lighting	Boilers	Process Heating	Space Heating
311	Food	78%	3%	6%	9%	60%	32%	6%
322	Paper	89%	2%	3%	4%	70%	21%	3%
324	Petroleum and Coal Products	92%	0%	0%	8%	26%	66%	2%
325	Chemicals	70%	3%	6%	4%	50%	44%	2%
327	Nonmetallic Mineral Products	61%	16%	5%	4%	4%	88%	5%
331	Primary Metals	26%	22%	3%	3%	15%	77%	7%
	All Others	64%	12%	9%	7%	38%	51%	7%

Overall Energy Savings Achievable Over Five Years

A variety of studies have been conducted in recent years to estimate the economic and achievable efficiency potentials for reducing gas and electricity use in different states. Economic potential is an estimate of the savings that can be achieved if all measures, which are cost-effective to end-users, are implemented. Achievable potential is a subset of economic potential and includes allowances for reasonable measure penetration rates given likely policy and program interventions. Following the previous methodology, the following maximum achievable five-year savings potentials for the various census regions of the industrial sector are displayed in Table 9.

Table 9. Achievable Potential for the Industrial Sector in 2008

Census Region	Electricity Savings Potential	Natural Gas Savings Potential
Northeast	5.96%	4.53%
Midwest	6.04%	4.94%
South	6.16%	5.19%
West	5.41%	5.19%

Savings in Year 1

In the first year under an aggressive policy scenario, a large portion (40%) of the five-year savings can be achieved. This result depends on an assumption of relatively high prices and an active efficiency promotion campaign.

Estimates of Implementable State Industrial Energy Savings

Based on the above data, the following one- and five-year cumulative state-by-state results were obtained (see Table 10):

Table 10. State Industrial Savings in 2004 and 2008

State	Infra-structure Score	Electricity Savings		Natural Gas Savings	
		1 year	5 years	1 year	5 years
Alabama	d	1.35%	3.39%	1.14%	2.85%
Arizona	c	1.51%	3.79%	1.45%	3.63%
Arkansas	d	1.35%	3.39%	1.14%	2.85%
California	a	2.16%	5.41%	2.08%	5.19%
Colorado	c	1.51%	3.79%	1.45%	3.63%
Connecticut	a	2.38%	5.96%	1.81%	4.53%
Delaware	c	1.72%	4.31%	1.45%	3.63%
Florida	c	1.72%	4.31%	1.45%	3.63%
Georgia	c	1.72%	4.31%	1.45%	3.63%
Idaho	b	1.84%	4.60%	1.76%	4.41%
Illinois	b	2.05%	5.14%	1.68%	4.20%
Indiana	b	2.05%	5.14%	1.68%	4.20%
Iowa	b	2.05%	5.14%	1.68%	4.20%
Kansas	d	1.35%	3.39%	1.14%	2.85%
Kentucky	d	1.35%	3.39%	1.14%	2.85%
Louisiana	d	1.35%	3.39%	1.14%	2.85%
Maine	a	2.38%	5.96%	1.81%	4.53%
Maryland	b	2.09%	5.23%	1.76%	4.41%
Massachusetts	a	2.38%	5.96%	1.81%	4.53%
Michigan	c	1.69%	4.23%	1.38%	3.46%
Minnesota	b	2.05%	5.14%	1.68%	4.20%
Missouri	d	1.33%	3.32%	1.09%	2.72%
Mississippi	d	1.35%	3.39%	1.14%	2.85%
Montana	c	1.51%	3.79%	1.45%	3.63%
Nebraska	d	1.33%	3.32%	1.09%	2.72%
Nevada	c	1.51%	3.79%	1.45%	3.63%
New Hampshire	b	2.03%	5.06%	1.54%	3.85%
New Jersey	a	2.38%	5.96%	1.81%	4.53%
New Mexico	d	1.19%	2.98%	1.14%	2.85%
New York	a	2.38%	5.96%	1.81%	4.53%
North Carolina	d	1.35%	3.39%	1.14%	2.85%
North Dakota	d	1.33%	3.32%	1.09%	2.72%
Ohio	c	1.69%	4.23%	1.38%	3.46%
Oklahoma	d	1.35%	3.39%	1.14%	2.85%
Oregon	a	2.16%	5.41%	2.08%	5.19%
Pennsylvania	c	1.67%	4.17%	1.27%	3.17%
Rhode Island	a	2.38%	5.96%	1.81%	4.53%
South Carolina	d	1.35%	3.39%	1.14%	2.85%
South Dakota	d	1.33%	3.32%	1.09%	2.72%
Tennessee	c	1.72%	4.31%	1.45%	3.63%
Texas	a	2.46%	6.16%	2.08%	5.19%
Utah	b	1.84%	4.60%	1.76%	4.41%
Vermont	a	2.38%	5.96%	1.81%	4.53%
Virginia	c	1.72%	4.31%	1.45%	3.63%
Washington	b	1.84%	4.60%	1.76%	4.41%
West Virginia	d	1.35%	3.39%	1.14%	2.85%
Wisconsin	a	2.42%	6.04%	1.98%	4.94%
Wyoming	c	1.51%	3.79%	1.45%	3.63%

Renewable Methodology and Characterization

General Approach

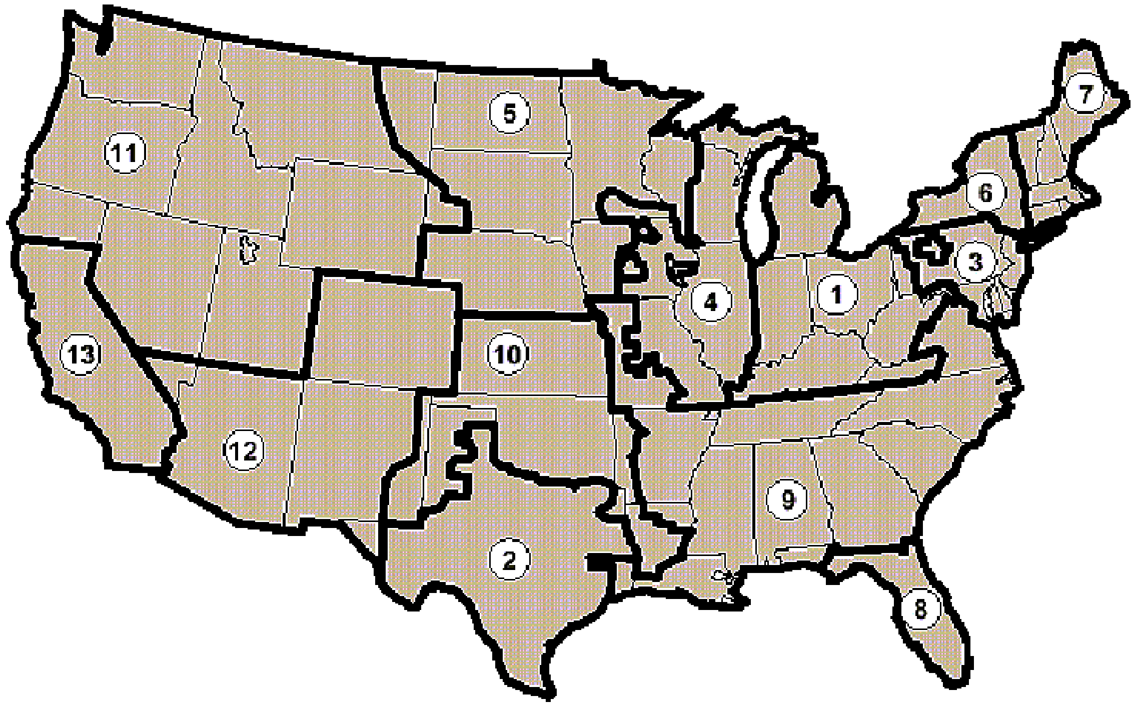
While estimates of the implementable potential for energy efficiency and conservation are somewhat available in the literature at a state level, data of nearer-term, implementable potential of renewable generation is less available. In addition, there is less need to make state-level estimates of renewables because generation markets are inherently multi-state. We elected to use the electric supply regions, used by EIA, which for the most part correspond to the National Electric Reliability Councils (NERC) sub-regions (Figure 8). The EEA model uses similar regions with the exception of Nevada which is placed in the same region as California, rather than with the upper West as does EIA and NERC.

We reviewed the available literature on renewables and interviewed experts. Based on the collected information, we developed estimates of the net additions of non-conventional hydro renewables for each of the thirteen EIA Electricity Supply Regions. These estimates were mapped to the EEA regions, and used as the model input. No independent assessment was attempted because of time and budget constraints. Nor was any attempt to estimate specific shares of renewable technologies, though it is likely that the renewables will be dominated by wind, along with biomass and solar in some regions.

Sources for Estimates

We reviewed the available literature on renewables and interviewed a number of leading experts. Many studies have looked at resource and economic potential at the state level and regional level, and most project the level that could be achieved over a fairly long policy horizon. Most of the studies use different assumptions, and study periods, so that it is difficult to place the findings on a common basis. One difficulty was that studies do not use a common definition of renewables. Most national data includes municipal solid waste (MSW) and conventional hydro power in the renewables definitions. Many renewable portfolio standards (RPS) exclude these two resources.

Figure 8. National Energy Modeling System Electricity Supply Regions (EIA 2002)



1 East Central Area Reliability Coordination Agreement
2 Electric Reliability Council of Texas
3 Mid-Atlantic Area Council
4 Mid-America Interconnected Network
5 Mid-Continent Area Power Pool
6 New York
7 New England
8 Florida Reliability Coordinating Council
9 Southeastern Electric Reliability Council
10 Southwest Power Pool
11 Northwest Power Pool
12 Rocky Mountain, Arizona, New Mexico, Southern Nevada
13 California

At the national level, EIA recently conducted two studies (EIA 2002, 2003) of the impacts of various RPSs using the National Energy Modeling System (NEMS). Both studies were prompted by requests from Congress to review legislation under consideration and look at 10 and 20% national RPS targets in 10 years. The base case developed for the more recent study was chosen as the base case for this study. However, data obtained for New York State indicated that the base case understated the anticipated renewables share (NYSERDA 2002b), so the base was modified from the EIA case.

A review of EIA's most recent regional projections from a national RPS indicated that they were not particularly aggressive. This result stems in large part from the fact that the modeled RPS only began in 2007, so little impact was realized. As a result, we decided we would turn to other sources for estimating near-term, implementable results.

The Environmental Law & Policy Center (ELCP 2001) had commissioned a study, *Repowering the Midwest* that presents energy futures in the Midwest, including a 2010 projection for renewables in the region. The prorated projection was for a renewables share of 1.4% in 2008. This was slightly higher than the EIA projection of 1.3%.

Another study, *Powering the South,* was prepared by the Renewable Energy Policy Project (REPP 2001) for the South projecting a 4% market share in 2010. The prorated 2008 estimate is 3.2%, which contrasts with the EIA projection of 1.6%.

A similar study of the West is underway for Western Resource Advocates (WRA) (Nielsen 2003). Preliminary results for the three electricity supply regions are presented in Table 11. In addition, a UCS study for California projected a renewables share of 20% in 2010 that prorates to 17.1% in 2008 (UCS 2001). For Washington State, a recent study (Shimshak 2003) projected a 14% market share for 2020, which prorates to 4.1% in 2008. We chose to use the preliminary WRA estimates.

Table 11. Projected Non-Hydro Renewables Share of Generation in the West (Nielsen 2003)

Region	2008 Renewables Generation (Mill. MWh)	2008 Renewables Share
ID, MT, OR, UT, WA, WY	11.4	5.2%
AZ, CO, NM, NV	8.5	7.3%
CA	42.2	17.4%

For New York State, three sources were used. NYSERDA has just released a study of energy efficiency and renewable energy potential (NYSERDA 2003). This study projects an economically achievable renewables share of 5.5% in 2008. A recent internal NYSERDA (Pakenas 2003) assessment projects renewables share of 5.9% in 2008 while environmental groups have been setting an RPS target of 27 million MWh (Greene 2003) that would prorate to an 8.7% market share in 2008. We chose to use the environmental groups' target.

Texas represents perhaps the most successful renewables market, with current installation of renewables (largely wind) outstripping the targets in the state's current RPS (about 2% of electric sales. While no systematic analysis has been done recently, renewables experts in the state believe Texas could achieve more than twice its existing 2008 target (Marston 2003).

Estimates of Implementable Renewable Energy Resources

Based on this review of existing studies, we developed a set of estimates for additional non-hydro generation that could be plausibly installed in each region by 2008 for each of the thirteen EIA Electricity Supply Regions. These estimates were mapped to the EEA regions. In most cases this represented an approximate doubling of installed generation relative to the EIA renewables base case discussed above. These results and the adjusted EIA base case are presented in Table 12.

We assume that the new renewable generation will displace existing and new conventional generation in the region. The electric module of the EEA model handles the dispatch of the additional renewables. We assume that since natural gas is the fuel on the margin in most of these regions, renewable generation is likely to disproportionately displace natural gas generation.

Table 12. Base Case and Policy Case Renewables Generation (Mill. MWh) by EIA Electricity Supply Regions

		EIA Renewables Base Case (2003)					2008 Policy Case		
EIA Region	States In Region	2008 Total Electricity Generation	2008 Base Renew. Generation	Conventional Hydro Generation	Non-Hydro Renew. Generation	Renew. Share	Total Non-Hydro Renewables Generation	Net New Renewables Generation	Renew. Share
1	MI, IN, OH, WV	680.79	7.86	3.18	4.69	0.7%	9.37	4.69	1.4%
2	TX	318.58	9.65	0.73	8.92	2.8%	15.32	6.40	4.8%
3	DE, DC, MD, NJ, PA	291.47	12.26	4.52	7.74	2.7%	15.48	7.74	5.3%
4	WI, IL	310.40	6.00	2.45	3.55	1.1%	20.23	16.67	6.5%
5	IA, MN, MO, NE, ND, SD	198.48	19.80	15.04	4.76	2.4%	24.33	19.58	12.3%
6	NY	172.40	23.46	26.40	10.20	5.9%	15.00	4.80	8.7%
7	CT, MA, ME, NH, RI, VT	131.16	12.99	5.10	7.88	6.0%	15.76	7.88	12.0%
8	FL	182.76	4.49	0.05	4.45	2.4%	11.72	7.27	6.4%
9	AL, GA, KY, NC, SC, TN, VA	910.18	39.15	33.28	5.87	0.6%	23.26	17.38	2.6%
10	AR, KS, LA, MS, OK	203.69	5.82	5.10	0.72	0.4%	1.45	0.72	0.7%
11	OR, WA, ID, MT, NV, UT, WY	311.19	165.36	154.31	11.06	3.6%	21.16	10.10	6.8%
12	AZ, CO, NM	209.80	20.81	15.12	5.69	2.7%	10.91	5.22	5.2%
13	CA	256.76	63.63	41.20	22.43	8.7%	44.01	21.57	17.1%

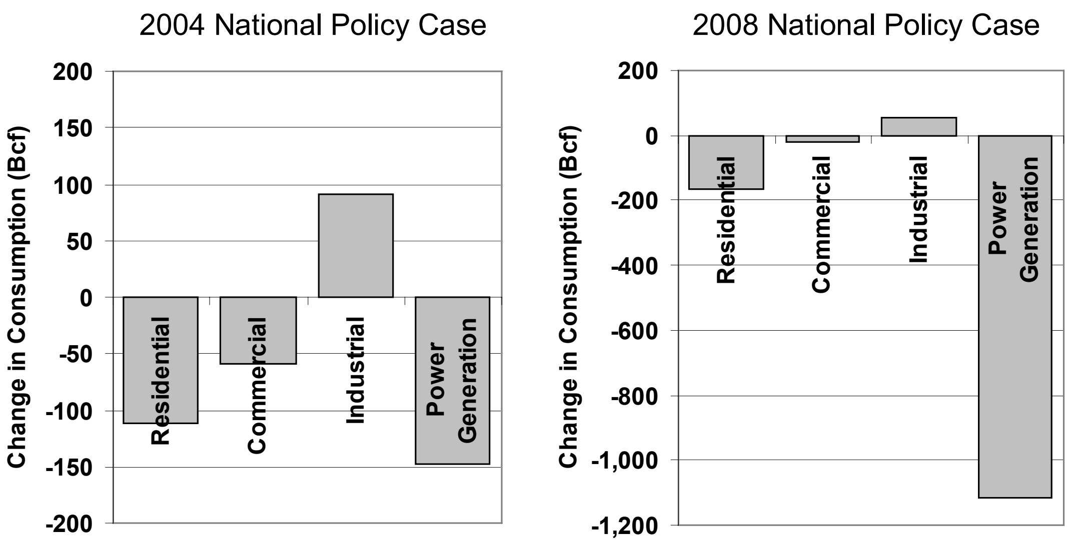
Changes in Natural Gas Consumption, Price, and Expenditures

Efficiency and Renewables Reduce Gas Consumption

Four different scenarios were examined in detail as part of this analysis. First, a "national" scenario was examined in which all 48 states in the continental United States implemented energy efficiency and renewable energy. In the other three scenarios, we looked at the effects of implementing efficiency or renewable energy in just one region or state. Table 13 displays the change in natural gas consumption on a national level for each of the scenarios. Our initial discussion will focus on the national scenario, followed by discussion of the other scenarios as part of a discussion of selected regional effects.

Our analysis of the national scenario shows that energy efficiency could reduce natural gas consumption by 1.1% in the next 12 months, significantly reducing wholesale and retail prices. By 2008, the combined energy efficiency and renewable energy measures would reduce total gas consumption by 5.5% (see Table 13). The power generation sector would represent the largest national natural gas savings in both 2004 and 2008 (see Figure 9). The 2004 results reflect the impact of electric efficiency savings by all consumers while the 2008 results reflect the combined effects of efficiency and expanded use of renewables that would both displace gas-fired electricity generation. Detailed sectorial and state specific information about natural gas consumption is presented in Appendix C.

Figure 9. Natural Gas Savings from Energy Efficiency and Renewable Energy



Residential consumers could make important contributions to natural gas efficiency (especially in the near-term) through many low- and no-cost measures such as furnace tune-ups and shifts to more efficient. These savings are projected to grow over the five years studied.

In addition, electricity savings, particularly from residential air conditioners are important in reducing demand for natural gas-produced electricity. Commercial air conditioning and lighting improvements are also important to electric savings.
Commercial gas savings are more modest than from the other sectors.

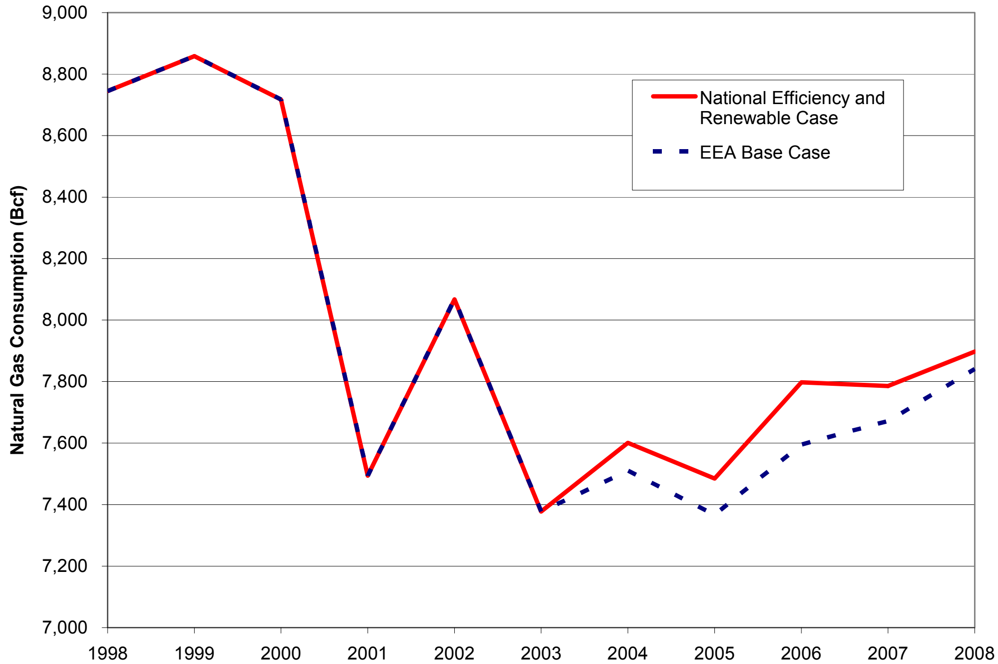
Table 13. Changes in Natural Gas Consumption under Different Policy Scenarios

	Change from EEA Base Case in 2004		Change From EEA Base Case in 2008	
	Bcf	Percent	Bcf	Percent
Total Demand				
EEA July 2003 Base Case				
ACEEE: National	-238	-1.1%	-1,349	-5.5%
ACEEE: Pacific West	-31	-0.1%	-290	-1.2%
ACEEE: Northeast/PJM	-31	-0.1%	-230	-0.9%
ACEEE: NY Renewables	0	0.0%	-9	0.0%
Residential				
EEA July 2003 Base Case				
ACEEE: National	-112	-2.1%	-167	-3.1%
ACEEE: Pacific West	-14	-0.3%	-12	-0.2%
ACEEE: Northeast/PJM	-30	-0.6%	-48	-0.9%
ACEEE: NY Renewables	0	0.0%	1	0.0%
Commercial				
EEA July 2003 Base Case				
ACEEE: National	-59	-1.8%	-22	-0.6%
ACEEE: Pacific West	-5	-0.2%	16	0.5%
ACEEE: Northeast/PJM	-19	-0.6%	-18	-0.5%
ACEEE: NY Renewables	0	0.0%	1	0.0%
Industrial				
EEA July 2003 Base Case				
ACEEE: National	91	1.2%	57	0.7%
ACEEE: Pacific West	41	0.5%	60	0.8%
ACEEE: Northeast/PJM	53	0.7%	72	0.9%
ACEEE: NY Renewables	0	0.0%	9	0.1%
Power Generation				
EEA July 2003 Base Case				
ACEEE: National	-147	-3.3%	-1,115	-18.5%
ACEEE: Pacific West	-51	-1.1%	-332	-5.5%
ACEEE: Northeast/PJM	-26	-0.6%	-199	-3.3%
ACEEE: NY Renewables	0	0.0%	-19	-0.3%

Note: The sum of end-use sector consumption will not equal the national total because pipeline fuel, and lease and plant fuel are not reported in the table.

Industrial gas consumption would decline less under all the efficiency and renewable energy scenarios than in the base case—in large part as a result of a decrease in "demand destruction" in the base case (see Figure 10). "Demand destruction" refers to plant closures and layoffs at natural gas-dependent industries such as chemicals and primary metals that would have occurred as a result of higher natural gas prices. Because gas prices would be lower as a result of energy efficiency and renewable energy investments, gas would be more affordable for feedstock uses and certain more such businesses would remain in operation relative to the base case. Hence industrial demand for natural gas would increase slightly under the scenarios run in this study. The industrial increases in gas use would be greatest in the first three years of the analysis when the projected natural gas consumption declines from the base case are most pronounced.

Figure 10. Efficiency and Renewable Energy Frees Gas for Industrial Use



The reductions in natural gas consumption the power sector are slightly lower that the combined reductions in the residential and commercial sector in 2004 when only electric efficiency measures are implemented. By 2008, with four years of increased renewables and five years of electric efficiency measures in place, the power generation sector dominates the gas savings. These results reflect the importance of the growing relationship between natural gas markets and the electric power sector.

Reductions in Natural Gas Consumption Reduce Natural Gas Prices

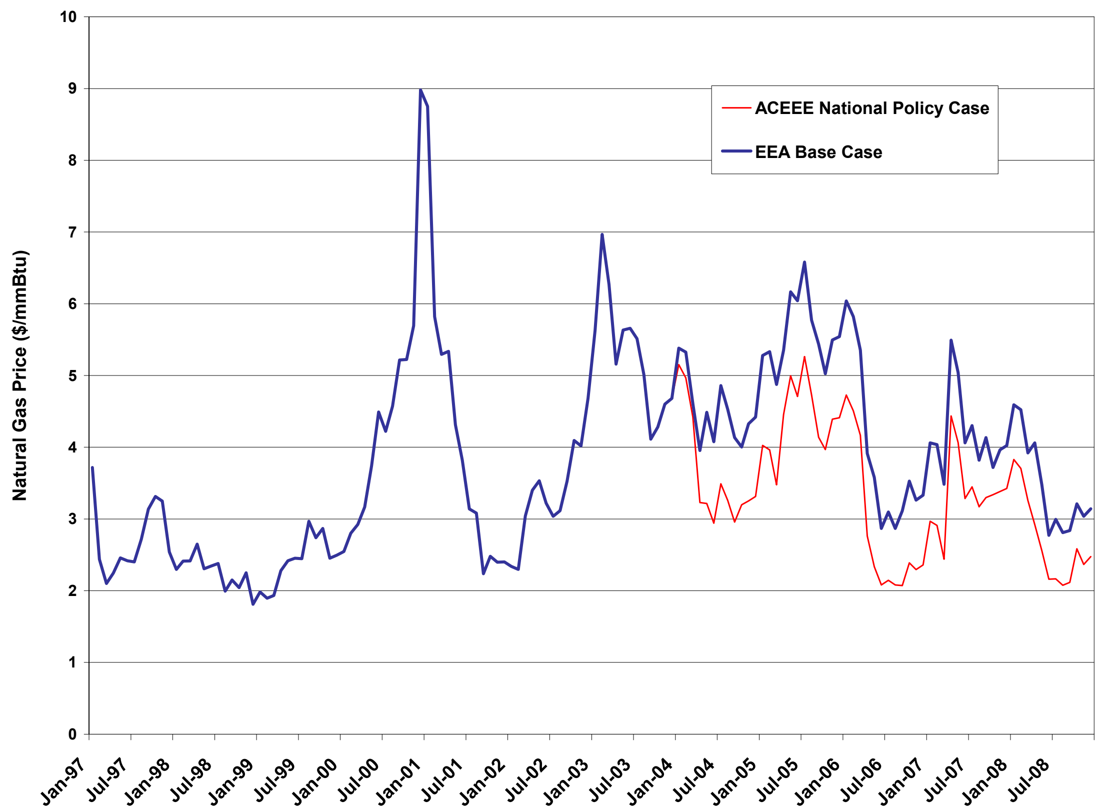
As we have seen in recent years, modest increases in natural gas consumption have produced dramatic increases in natural gas prices. This volatility results from a very tight supply situation. As we would expect from this experience, the modeling shows that modest reductions in natural gas consumption from energy efficiency and renewable energy generation would result in large reduction in the price of natural gas. The national reference Henry Hub wholesale price (see map in Appendix A) would be reduced by almost $0.90/MMBtu or 20% in 2004, and by 22% in 2008 (see Figure 11 and Table 14).

Regional Gas Savings Would Have National Price Impacts

Energy efficiency and renewable energy efforts that would be restricted to a region would reduce wholesale and retail prices in the region in which they would be implemented. The Northeast/PJM scenario would have about the same impact on the New York City Hub as it would on New England hub prices of natural gas (see map in Appendix A and Table 14). Under this scenario, the average New York State residential gas customer could save about $60 annually on her gas bill. Likewise, the Pacific West scenario would have marked price impact on the Southern California Hub wholesale price. At the retail level, the average

California residential natural gas customer would save about $37/year, and the combined state residential, commercial, and industrial savings would average over $900 million annually for the five years studied.

Figure 11. Energy Efficiency and Renewable Energy Reduce Wholesale Gas Prices



In addition, the modeling indicates that these regional efforts would cause natural gas price reductions nationally—for example, the Northeast/PJM scenario would produce a 6.1% reduction in Southern California Hub pricing in 2004 and the Pacific West Scenario would produce a 5.2% reduction in the New York City hub wholesale price of gas (see map in Appendix A and Table 14). It is important to remember, as will be discussed in greater detail in the next section, that changes in natural gas prices account for only a fraction of the consumer bill savings that result from expanded deployment of energy efficiency and renewable energy resources. The bill savings that result from reductions in both gas and electricity consumption are important contributors to consumers' overall benefits. Thus, while consumers everywhere will benefit from nationally reduced natural gas prices, only consumers in those regions in which greater energy efficiency and renewables are implemented will realize this large fraction of the savings potential.

Table 14. Change in Wholesale Natural Gas Prices at Key Transmission Hubs*

Gas Prices (in 2002$/MMBtu)	Change from EEA Base Case in 2004		Change from EEA Base Case in 2008	
	Dollars	Percent	Dollars	Percent
Henry Hub				
EEA July 2003 Base Case				
ACEEE: National	-0.89	-19.8%	-0.76	-22.1%
ACEEE: Pacific West	-0.27	-5.9%	-0.15	-4.3%
ACEEE: Northeast/PJM	-0.28	-6.2%	-0.21	-6.0%
ACEEE: NY Renewables	0.00	0.0%	-0.02	-0.5%
New York City				
EEA July 2003 Base Case				
ACEEE: National	-0.95	-19.0%	-0.94	-23.6%
ACEEE: Pacific West	-0.26	-5.2%	-0.13	-3.2%
ACEEE: Northeast/PJM	-0.35	-7.1%	-0.43	-10.9%
ACEEE: NY Renewables	0.00	0.0%	-0.07	-1.8%
New England				
EEA July 2003 Base Case				
ACEEE: National	-0.95	-19.2%	-0.90	-23.6%
ACEEE: Pacific West	-0.26	-5.3%	-0.14	-3.6%
ACEEE: Northeast/PJM	-0.35	-7.0%	-0.36	-9.3%
ACEEE: NY Renewables	0.00	0.0%	-0.03	-0.7%
Southern California				
EEA July 2003 Base Case				
ACEEE: National	-0.91	-20.1%	-0.95	-29.1%
ACEEE: Pacific West	-0.34	-7.4%	-0.66	-20.3%
ACEEE: Northeast/PJM	-0.28	-6.1%	-0.15	-4.7%
ACEEE: NY Renewables	0.00	0.0%	-0.01	-0.4%

* See Appendix A for a map of North American natural gas transmission system

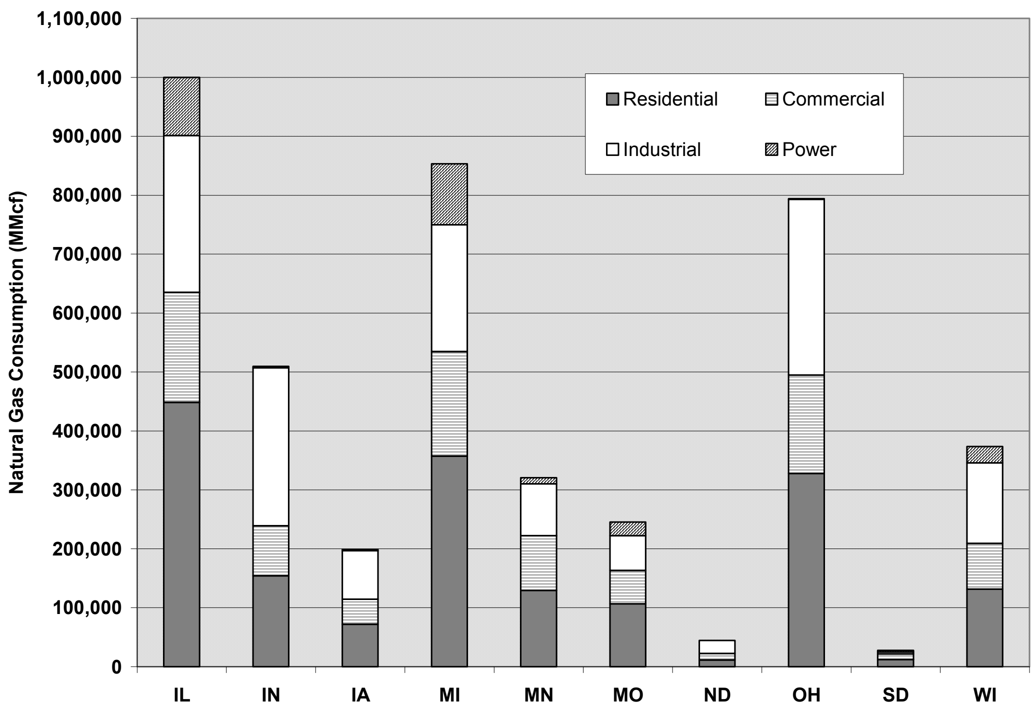
Regional Results

The potential impacts vary by state, with those most dependent on gas for peak electric power generation benefiting the most. In addition to the bill savings from reduced natural gas prices and consumption that retail customers would realize from energy efficiency measures, the customer would also experience additional savings from reductions in electricity prices and consumption. The model used for our analysis does not project electricity prices, so we cannot quantify these savings. However, if we assume that consumer electricity prices would remain constant at 2002 levels (they are actually forecast to rise), the dollar savings nationally would be similar to those from natural gas savings. We would, however, anticipate significant variation in the ratio of electric-to-gas savings among the states due to variation in the end-use energy mix. Several examples follow.

Midwest

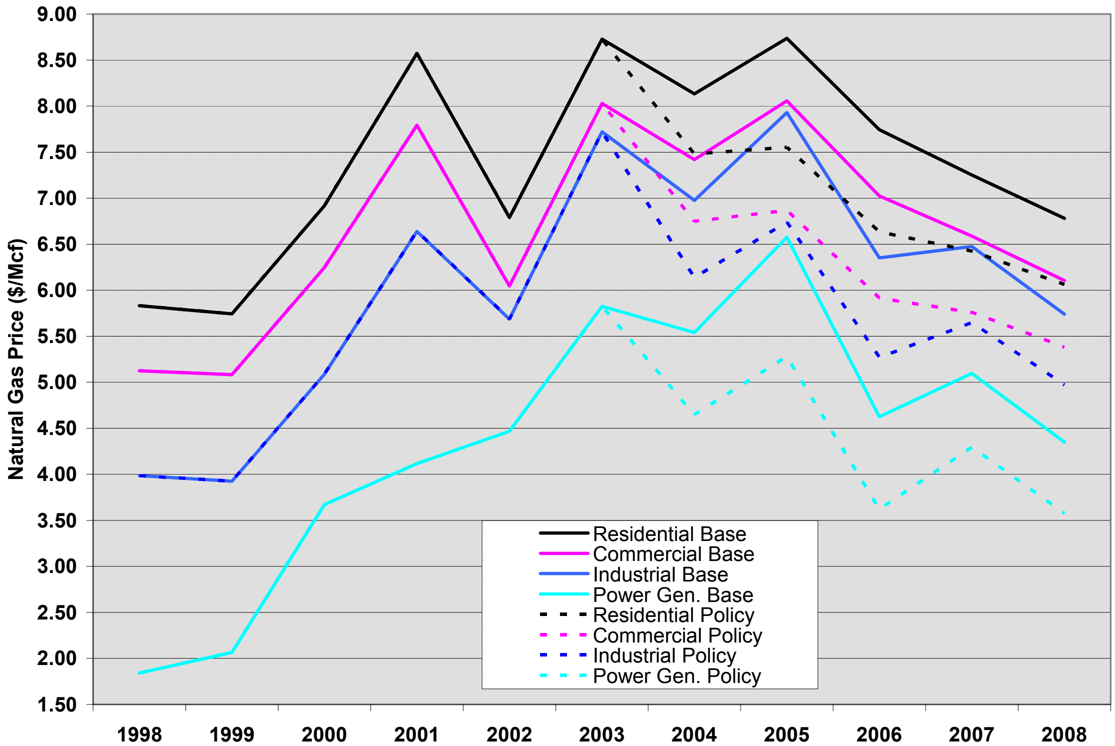
Natural gas represents an increasingly important energy source for the Midwest. Average residential gas customer natural gas bills are 3.6 times as much as the national average, with residential customers' bills in Illinois being 4.5 times the national average. Natural gas consumption in the residential, commercial and industrial sectors of the Midwest is projected to continue to grown at a rate slightly greater than the national average over the next five years. Electric power generation from gas in the region is relatively modest, with only Michigan having significant share of total generation from natural gas generation at 12% (EIA/EA 2003). However, projections suggest that natural gas generation in Indiana, North Dakota and Ohio will grow rapidly in coming years.

Figure 12. 2002 Natural Gas Consumption in the Midwest (Source: EEA 2003).



Wholesale natural gas prices in the Midwest average slightly less than the national average, except for the industrial sector where prices are slightly above national averages. There is significant variation in the industrial, commercial, residential, and power generation prices in the various states. Natural gas prices in the region are projected to remain high in the base case (Figure 13). With expanded energy efficiency and renewable energy at the national level, natural gas prices are projected to be reduced dramatically, with industrial and power sectors seeing the greatest price reductions.

Figure 13. Historical and Projected Retail Natural Gas Prices



EE and RE policies reduce natural gas consumption in the residential and commercial sectors in all the states in the region (see Figure 14). Industrial consumption of gas expands robustly in Illinois, Indiana, Michigan and Ohio reflecting an enhanced recovery of these depressed energy intensive industries due to reduced natural gas prices. Natural gas consumption by electric power generators in Indiana, Michigan and Ohio expands due to the reduced price of natural gas to the power sector. Part of this increase is likely due to expanded operation of industrial CHP facilities in these states reflecting the corresponding increase in industrial activity.

Total expenditures for natural gas decline in almost all sectors in all states in the region, except for the power and manufacturing sectors in Indiana and Ohio where increased industrial activity outweighs the price and efficiency savings (Figure 15).

Figure 14. Cumulative Change in Consumption by Sector in the Midwest

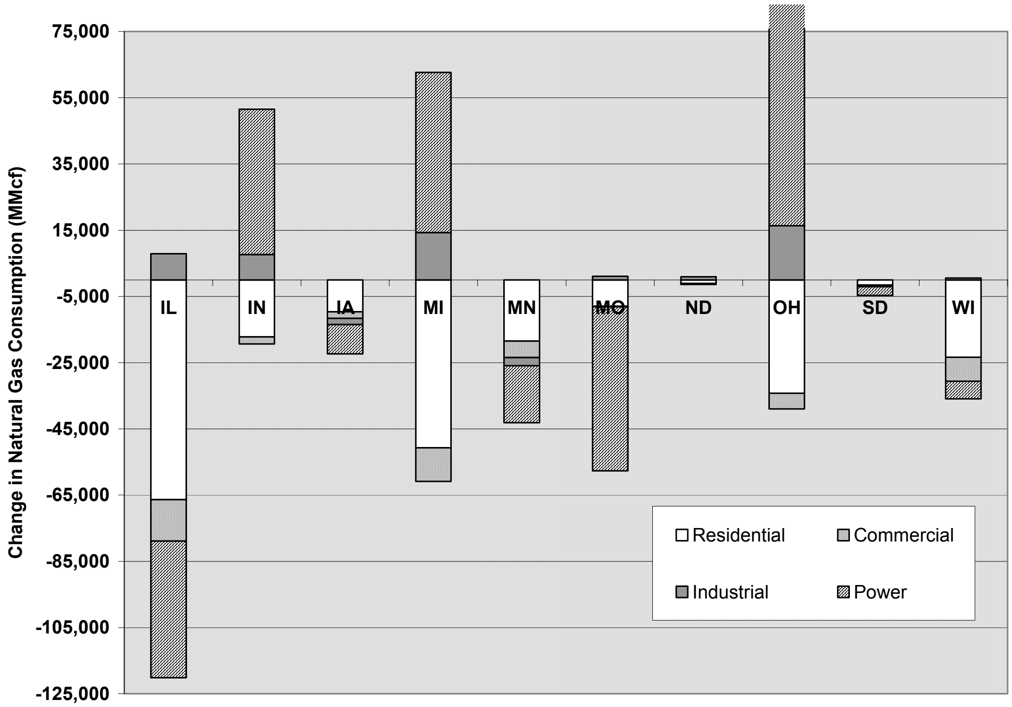
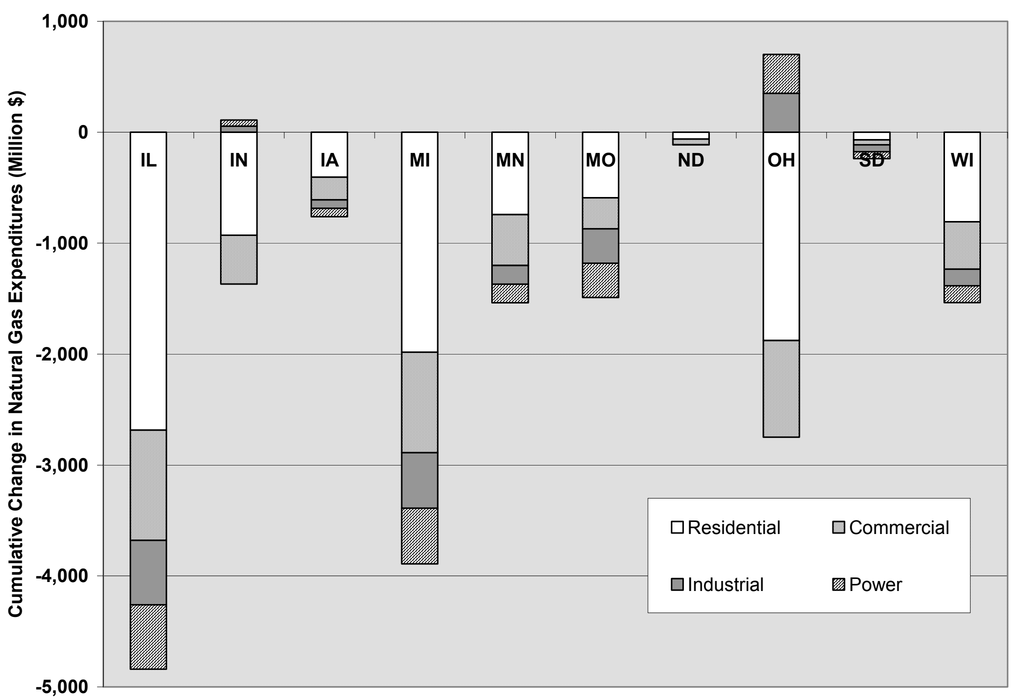


Figure 15. Cumulative Change in Natural Gas Expenditure by Sector for the Midwest



New England and Mid-Atlantic

How natural gas is consumed varies significantly among the New England and Mid-Atlantic states. In 2002, power generation accounted for more than 20% of total gas consumption in seven of the 12 states, the majority of total consumption in Maine and Rhode Island (Figure 16). Gas demand for power generation has increased rapidly in the region, jumping by more than 30% from 1998 to 2002. While growth is projected to decrease for the next few years, likely due to increased gas prices, rapid growth in gas fired generation is projected to resume in 2006 increasing to 169% of the 1998 level by 2008. Residential gas usage provides the base in most states in the region, varying between 20 and 50% of state consumption. Industrial gas demand is modest in New Hampshire, Pennsylvania and Vermont which all exceed 25% of total state demand. Delaware leads the region, with industrial demand accounting for about 50% of the state's total gas demand.

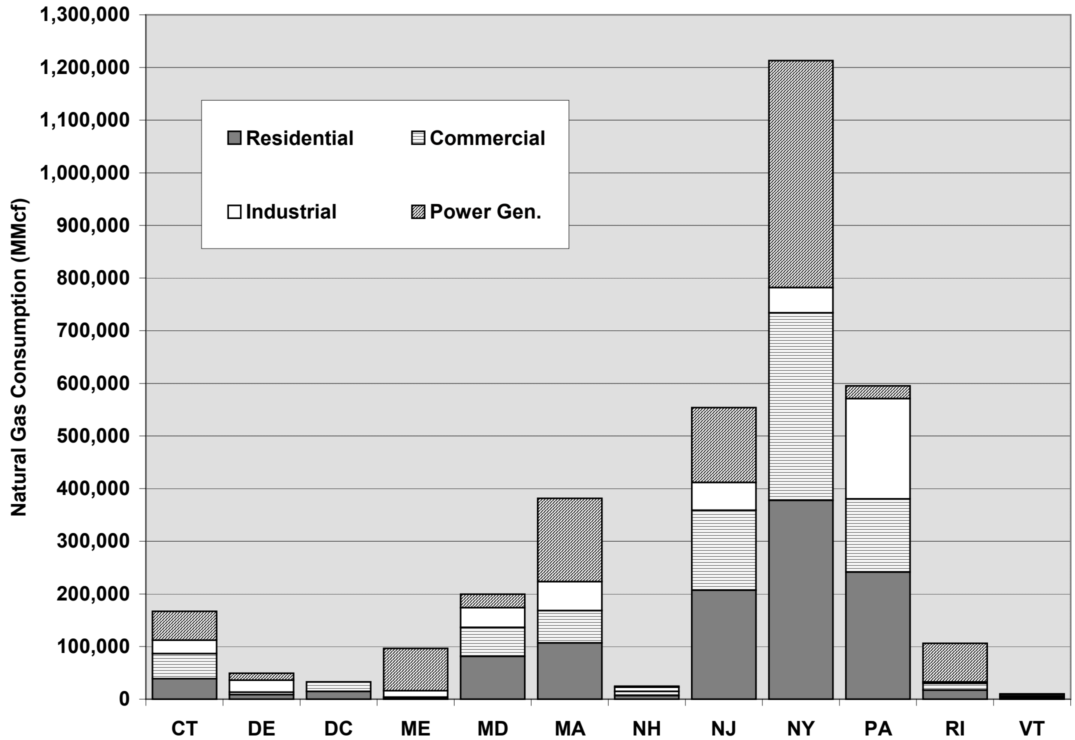
Natural gas prices vary significantly across the region (see Table 15). The average residential, commercial and industrial retail gas prices were above the national average in 2002, though the average power generation price was slightly below the national average. Residential prices for gas vary almost a factor of two, with Delaware and New Jersey having residential prices less than the national average. New Jersey at $5.93 per Mcf had some of the lowest cost residential gas in the country in 2002. D.C., while Massachusetts and New Hampshire all had natural gas prices approaching $11 per Mcf. Industrial and commercial prices showed similar variability. Commercial prices were more than a $1 per Mcf higher than the national average while industrial prices were almost $2 higher. Vermont was the only state in the region in which the average industrial natural gas cost is less than the national average while Maryland and Massachusetts have the highest industrial prices in the region. The range in natural gas prices was even more dramatic, with Maine and New Hampshire averaging less than $2 per Mcf and Pennsylvania leading the region at $8.74.

Table 15. Average Annual Retail Natural Gas Price by Sector (EEA 2003).

	$ per thousand cubic feet (Mcf)			
	Residential	**Commercial**	**Industrial**	**Power Gen.**
CT	10.63	6.34	6.06	5.42
DE	7.32	8.68	5.93	3.91
DC	10.84	10.58	NA+	NA+
ME	10.49	9.18	7.15	1.95
MD	9.90	8.75	8.38	7.12
MA	11.00	9.85	8.51	2.90
NH	10.96	9.59	7.10	1.90
NJ	5.93	6.22	5.76	3.26
NY	9.98	8.22	6.67	4.05
PA	9.78	9.08	6.31	8.74
RI	10.37	9.12	5.74	4.72
VT	8.31	6.41	4.32	4.25
NE/PJM Region	9.29	8.12	6.70	3.90
US Average	7.86	6.95	4.79	4.22

Notes: + D.C. has no significant reported Industrial or Power Generation natural gas sales so no price available.

Figure 16. Natural Gas in the Northeast and Mid-Atlantic State in 2002 by Sector (EEA 2003)



In the New England and Mid-Atlantic region we can compare the results for both the National and the New England and Mid-Atlantic scenario. As can be see in Figure 16, the application of energy efficiency and renewable energy measures in the region achieve 32% of the price reduction seen with lower-48 state application of the measures. Similarly, we see about a third of the price reduction at the retail level (Figure 19).

In contrast to the Midwest were we see significant increases in industrial gas consumption as a result of avoided demand destruction, we only see modest increases in industrial consumption in Maryland and Pennsylvania, both noted for their gas dependent industries (see Figure 18). In eight of the states, the power generation sector experiences the greatest cumulative gas savings as a result of the combined effects of electric energy efficiency and conservation and expanded renewables. In the remaining jurisdictions, (D.C., Massachusetts, Rhode Island and Vermont), it is the residential gas conservation that contributes the greatest share to the total state gas reductions. The commercial sector also factors prominently in the gas reduction in these states.

The residential sector accounts for more than half of the cumulative natural gas expenditure reductions in seven of the states I the region (see Figure 20), while power generation accounts for more than half in Delaware, Maine and New Hampshire. The share of savings in the commercial sector is modest in all the states, while the industrial sector experiences significant natural gas expenditure reductions in Delaware, Maine, Massachusetts, Pennsylvania, and Vermont.

Figure 17. Impact of Regional and National Application of Renewable Energy Efficiency and Renewable Energy Measures on Regional Wholesale Prices

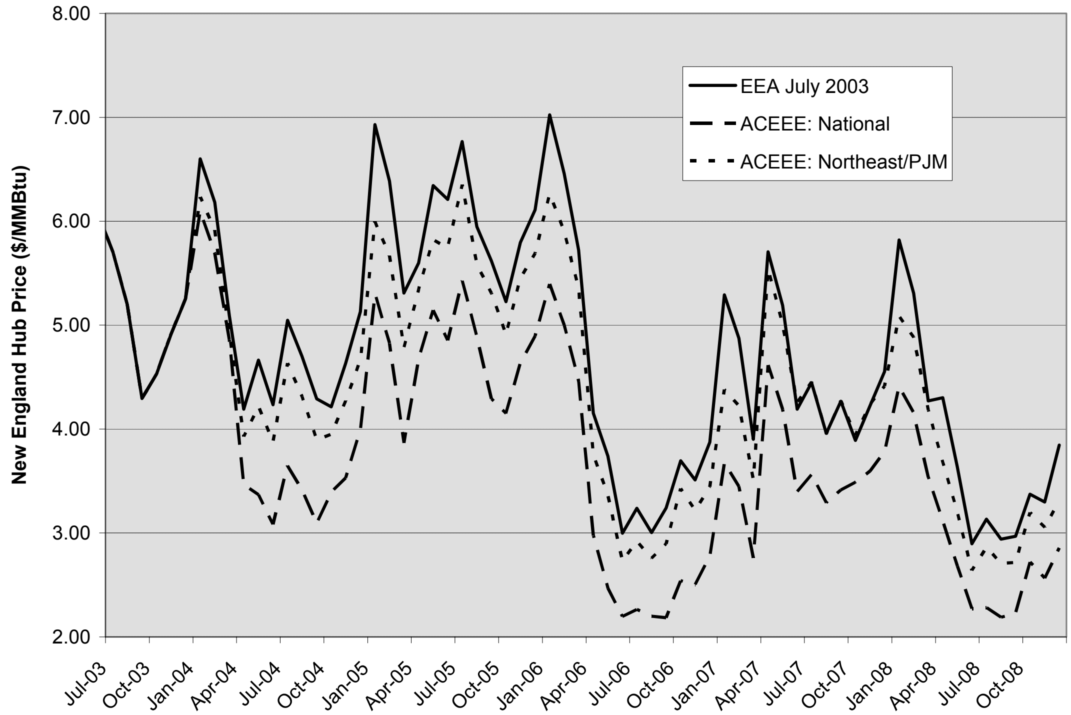


Figure 18. Change in Natural Gas Consumption in the Northeast and Mid-Atlantic

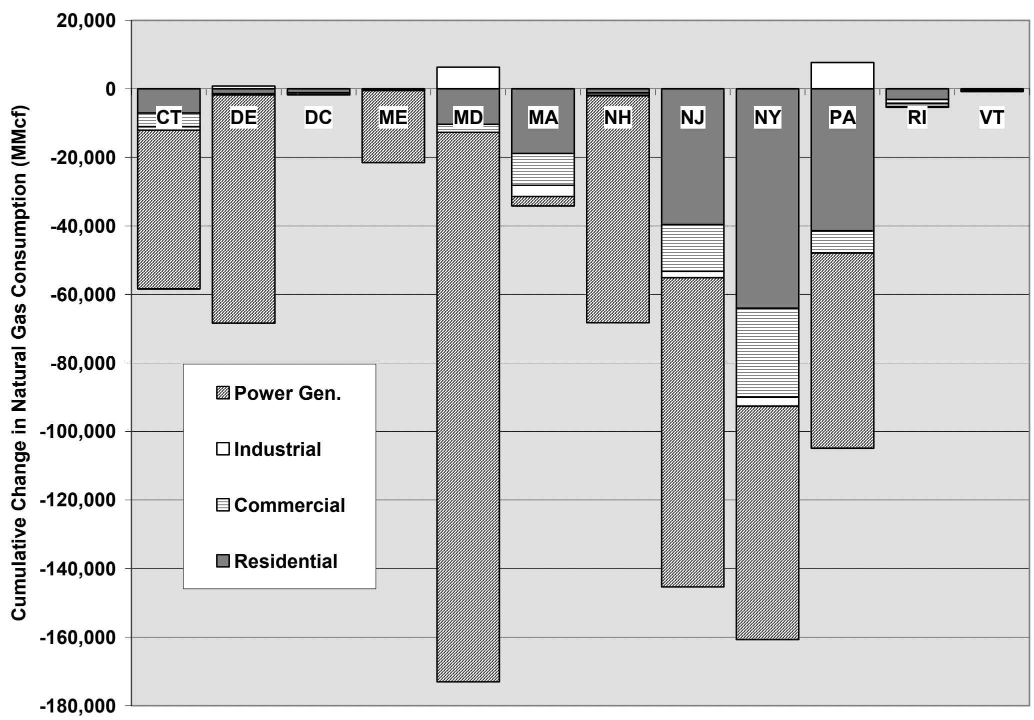


Figure 19. Historical and Projected Average Annual Retail Natural Gas Prices in the New England / Mid-Atlantic Region for both Base and Scenario Cases

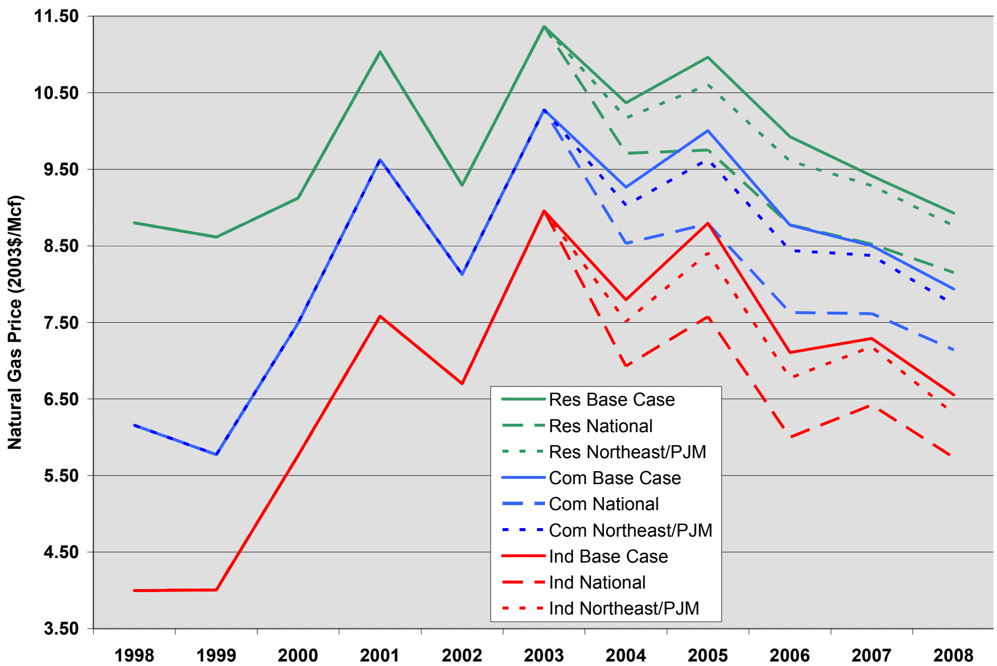
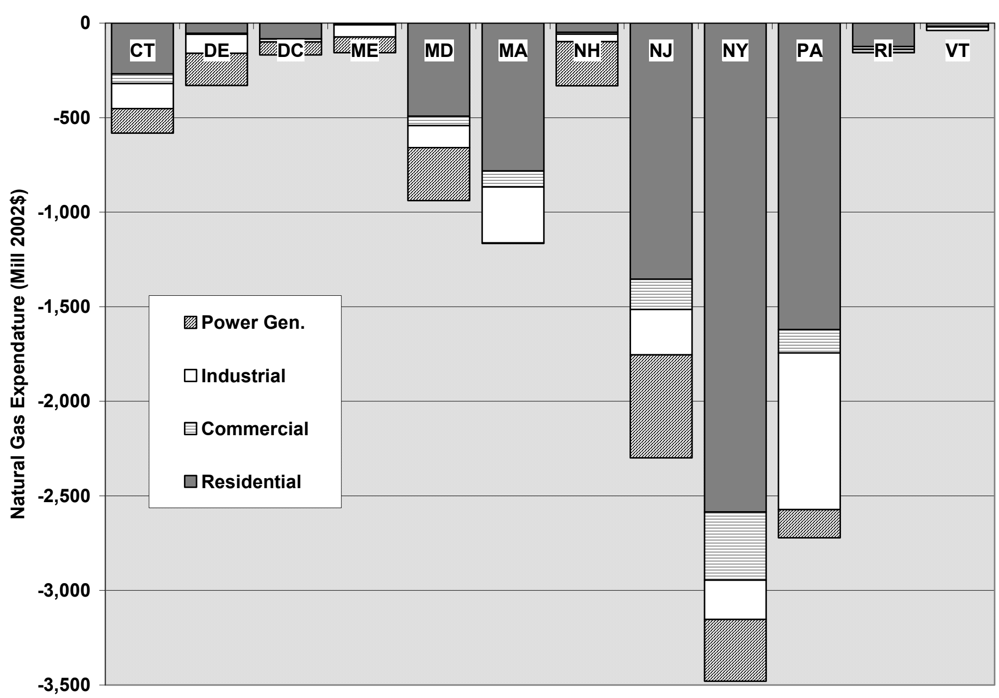


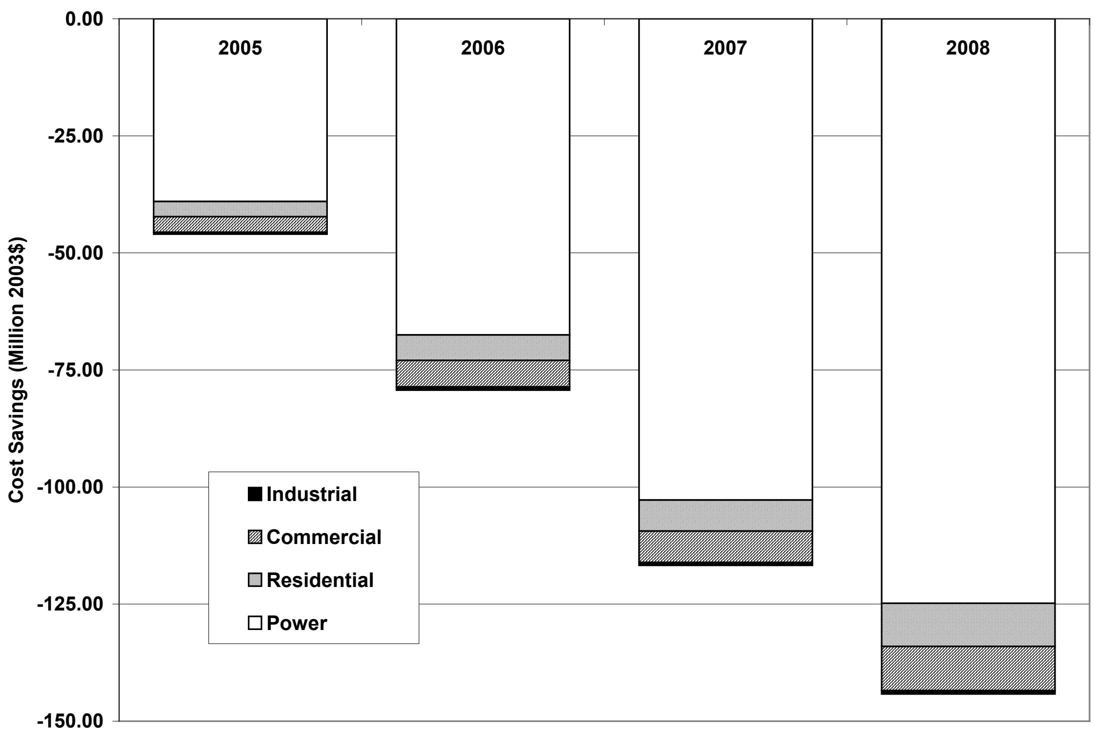
Figure 20. Cumulative Change in Natural Gas Expenditures by Sector in New England and the Mid-Atlantic Region



Expanded Renewables in New York State Would Reduce Gas Prices

In the most geographically narrow scenario, we expand only renewable energy generation in New York State from 5.9% of total generation to 8.7% in 2008. This increase in renewables share would displace 19 Bcf in electric generation fuel and reduce the New York City wholesale price by almost 2%. The combined savings in natural gas expenditures resulting from expanded use of renewables in New York State would increase from about $46 million in the first year of expanded renewables, 2005, to about $144 million in 2008 (see Figure 21). In the power sector, natural gas expenditures would be reduced by almost $125 million in 2008 from a combination of a 5% reduction in consumption of gas for power production and a 1.4% reduction in pricing to electricity generators. Overall expenditures by retail residential, commercial, and industrial customers would be reduced 0.25% for a savings of $19 million in 2008. As the share of renewable power generation expands, this saving would continue to increase as well.

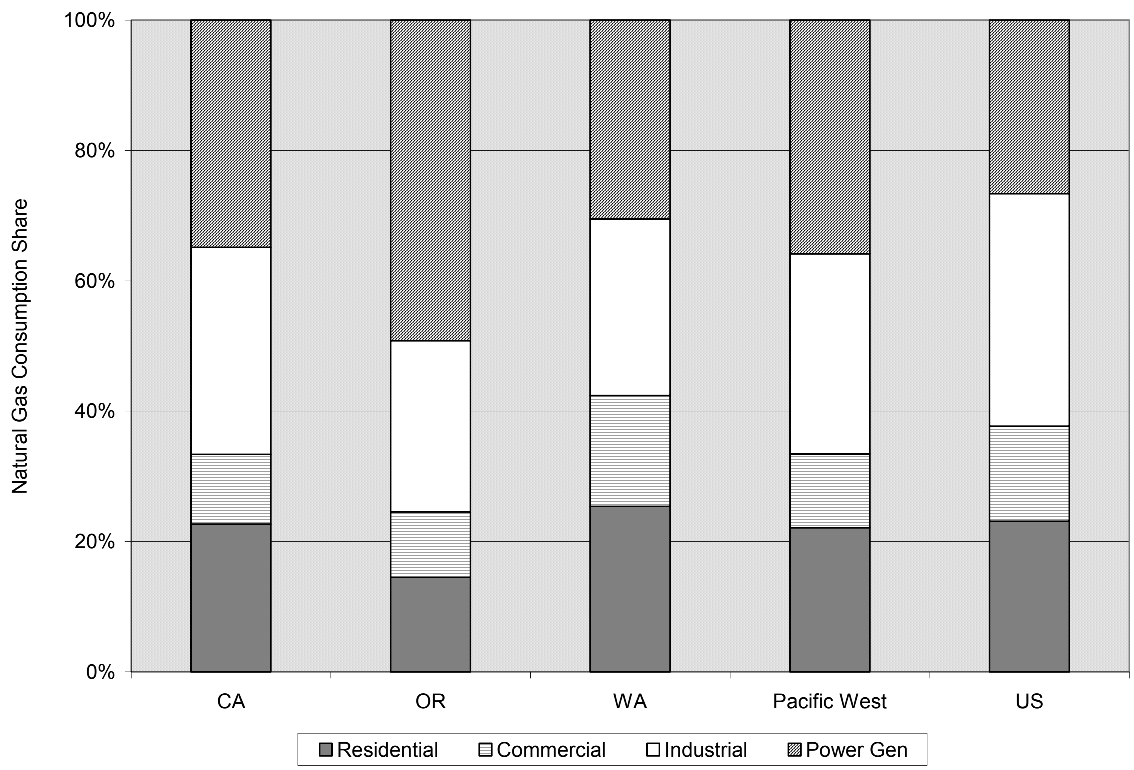
Figure 21. Impact of Expanded Renewables in New York



Pacific West

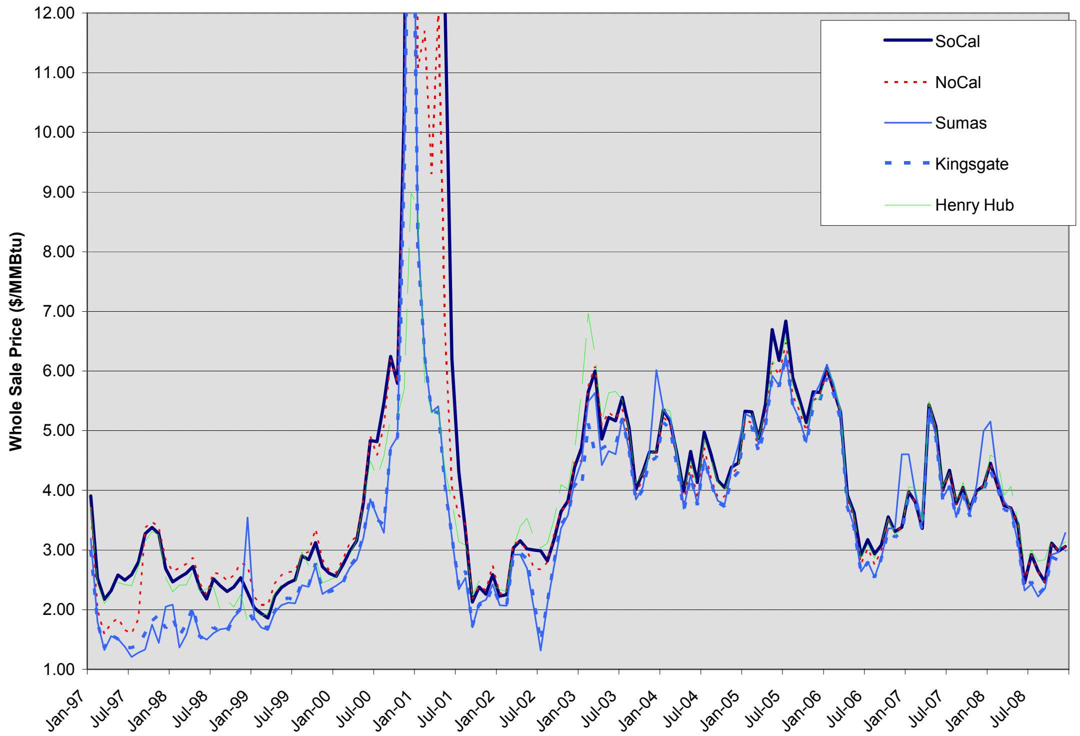
Natural gas consumption in the pacific west region (California, Oregon and Washington) in 2002 was dominated by California which accounts for 79% of the gas consumed in the region and almost 10% of the national consumption (Figure 22). Distribution of use in the region is fairly similar to the national average, with residential use representing slightly more than 20% and industrial about 25%, almost identical to the national average. Commercial usage is somewhat less than the national average while gas use for power generation was somewhat greater. Within the region, power generation (as a percentage of natural gas use) was most dominant in Oregon where it accounted for about half of the total. Commercial gas consumption (as a percentage of state total consumption) was greatest in Washington State, while the power generation was the lowest.

Figure 22. Share of Natural Gas by End-Use Sector for the Pacific West Region compared to the National Average



Historically the wholesale price of natural gas in the Northwest has been somewhat lower, particularly at the points of price excursions compared with the Henry Hub and prices in Southern California. The moderation in the northwest occurs because the northwest is tied to the Canadian producing regions by two import hubs (Kings Gate and Sumas – see map in appendix for locations). The wholesale prices are also somewhat moderated in Northern California compared with Southern California, where prices track Henry Hub except during excursions. The EEA projection is for prices in the west to moderate to the $3-4 per MMBtu range after a few more years on volatility (Figure 23).

Figure 23. Wholesale Natural Gas Prices in Pacific West



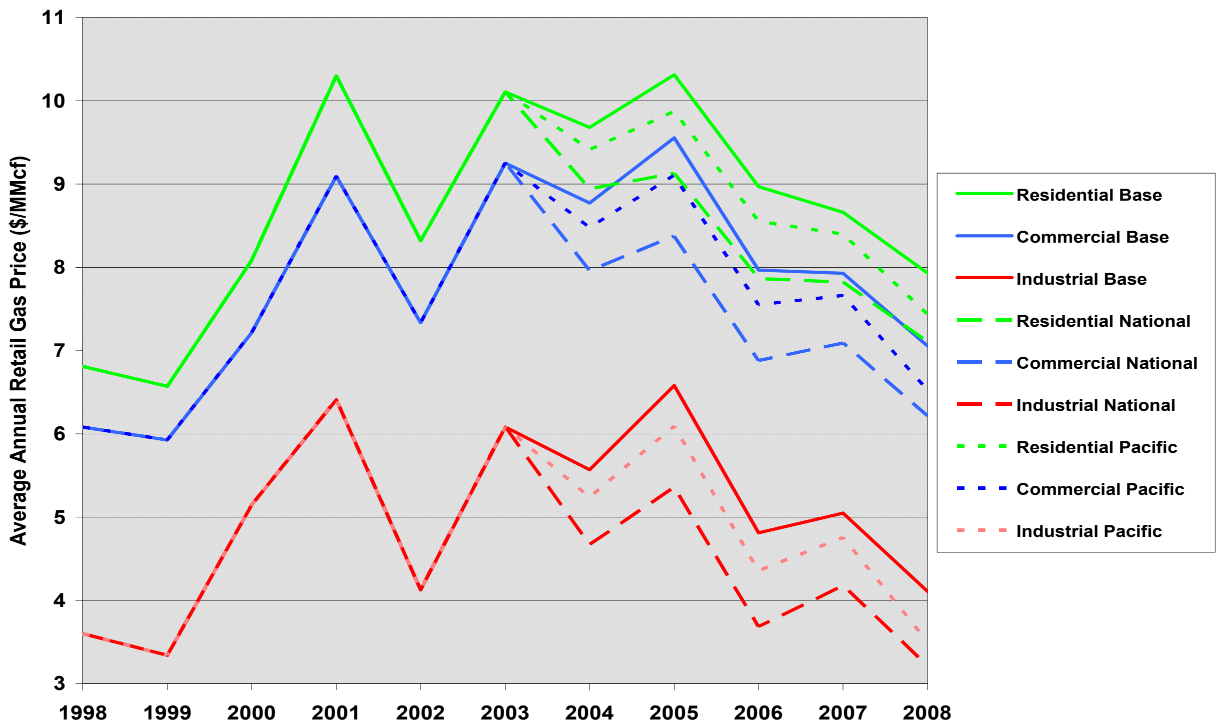
The lower wholesale prices in Washington and Oregon translate into lower residential, commercial and industrial retail price of natural gas compared to California (Table 16). Northwest prices have been at or below the national average, while California prices are slightly above the national average. Prices for natural gas used in power generation are below the national average for Oregon, but above the national average for California and Washington. These price trends are projected to continue in the base case.

As with the New England and Mid-Atlantic region, in the Pacific West we can compare the results for both the National and the region only scenarios. Significant retail price reductions are achieved in all sectors. As can be seen in Figure 24, the application of energy efficiency and renewable energy measures in the region achieve 36% of the price reduction seen with lower-48 state application of the measures for the first four years, but achieved over 60% of the retail price reductions in 2008. Thus regional application of the measures would achieve for the region a significant share of the benefits that would result from national level application of efficiency and renewable energy investments.

Table 16. Historical and Projected Average Annual Retail Natural Gas Prices ($/MMcf) in the Pacific West Compared to the National Average (EEA 2003)

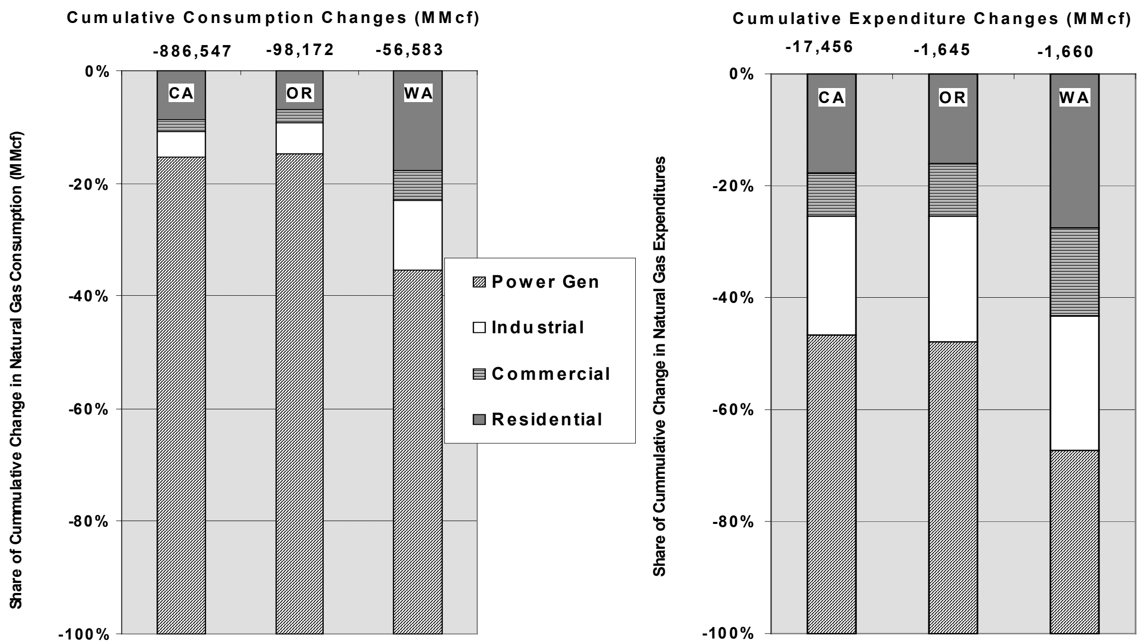
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
RESIDENTIAL											
CA	6.92	6.62	8.21	10.43	8.34	10.13	9.70	10.32	8.91	8.61	7.88
OR	6.81	7.13	8.12	9.70	8.23	10.07	9.65	10.38	9.30	8.97	8.22
WA	5.84	5.88	7.16	9.79	8.22	9.97	9.54	10.24	9.14	8.81	8.04
Pacific West	6.81	6.57	8.08	10.30	8.32	10.11	9.68	10.31	8.97	8.66	7.93
US Average	6.83	6.68	7.80	9.68	7.86	9.86	9.16	9.77	8.71	8.24	7.76
COMMERCIAL											
CA	6.37	6.17	7.54	9.33	7.48	9.42	8.93	9.70	7.99	8.00	7.10
OR	5.25	5.66	6.48	7.99	6.54	8.44	8.02	8.83	7.62	7.45	6.66
WA	4.76	4.89	6.02	8.62	7.11	8.93	8.49	9.28	8.06	7.88	7.06
Pacific West	6.08	5.93	7.22	9.09	7.33	9.25	8.77	9.56	7.97	7.93	7.05
US Average	5.56	5.38	6.71	8.56	6.95	9.00	8.25	8.98	7.76	7.49	6.94
INDUSTRIAL											
CA	3.75	3.33	5.29	6.60	4.07	6.00	5.49	6.50	4.69	4.92	4.00
OR	3.75	4.01	4.93	6.09	4.95	7.04	6.50	7.54	5.92	6.19	5.22
WA	2.64	2.82	4.01	5.02	3.88	5.94	5.43	6.46	4.83	5.10	4.09
Pacific West	3.60	3.34	5.15	6.41	4.13	6.08	5.57	6.58	4.81	5.05	4.11
US Average	3.24	3.26	4.69	5.76	4.79	6.77	6.00	7.02	5.35	5.58	4.83
POWER GEN											
CA	2.79	2.76	5.88	9.38	6.18	8.19	7.68	8.73	6.79	7.12	6.16
OR	1.56	1.96	2.94	3.82	3.21	5.19	4.90	5.86	4.53	4.55	3.73
WA	3.44	3.39	5.19	6.01	4.90	7.02	6.68	7.56	6.28	6.27	5.42
Pacific West	2.74	2.74	5.63	8.73	5.66	7.68	7.25	8.31	6.49	6.77	5.84
US Average	2.45	2.66	4.56	5.31	4.22	6.29	5.59	6.69	4.82	5.21	4.42

Figure 24. Historical and Projected Average Annual Retail Natural Gas Prices in the Pacific West Region for both Base and Scenario Cases



In the national scenario results in a 3.1% reduction in gas consumption in 2004, increasing to more than a 10% reduction in 2008. The cumulative consumption reduction is dominated by reductions in the power generation sector (Figure 25) resulting from electric efficiency and conservation, and expanded renewable power generation. Power generation accounts for more than 80% of the consumption reductions in California and Oregon, and more than two thirds of the reduction in Washington State. On the natural gas expenditures side, power generation still remains the dominant source of reduction though less so than with consumption. Power generation accounts for slightly more than half of the cumulative savings in California and Oregon, and about a third of the savings in Washington State. Industry accounts for about a fifth of the savings in all states, while residential savings over a quarter in Washington State, but less than a fifth in the other states.

Figure 25. Cumulative Change in Consumption and Expenditures in the Pacific West Region from National Application of Energy Efficiency and Renewable Energy



Energy Efficiency and Renewable Energy Reduce Consumer Energy Expenditures

Implementation of expanded energy efficiency and renewable energy result in a significant change in energy expenditures by end-use consumers (i.e., residential, commercial and industrial). These changes in expenditures come from five effects:

- Changes in natural gas prices resulting from the market effects discussed previously
- Changes in natural gas consumption resulting from natural gas energy efficiency measures
- Changes in electricity gas prices resulting from the reduced price of natural gas and increased use of renewables
- Changes in electricity consumption resulting from electric energy efficiency measures
- Changes in consumption of both gas and electricity due to changes in economic activity (This effect is most noticeable in the industrial sector of state with significant gas-intensive industries)

Unfortunately the analysis in this study does not allow the relative effects of each of these elements to be discretely determined because of the limited set of scenarios that were modeled and because of interaction between the various elements.

In addition, expenditures for natural gas by the power generation sector are also reduced as a result of reduced natural gas prices and because natural gas generation is displaced by electric efficiency and renewable generation. Because electric power markets are regional in most of the lower-48 states, this analysis cannot attribute these savings to the end-user consumers in individual states.

Changes in Natural Gas Expenditures – National Scenario

The analysis does produce a detailed estimation of aggregate changes in natural gas expenditures by sector and by state. The total net changes in end-use consumer expenditures for gas are presented in Table 17.

Table 17. Total Net Reductions (2004–2008) in End-Use Consumer Gas Expenditures (Million Dollars)

	Residential	Commercial	Industrial	Total		Residential	Commercial	Industrial	Total
AL	253	113	839	1,206	**NE**	210	111	148	470
AZ	226	159	65	450	**NV**	186	126	19	333
AR	259	169	395	825	**NH**	49	52	39	140
CA	3,098	1,336	3,714	8,149	**NJ**	1,354	916	239	2,510
CO	594	250	254	1,098	**NM**	224	157	39	421
CT	269	280	133	683	**NY**	2,585	2,080	208	4,874
DE	54	27	101	183	**NC**	364	204	294	862
DC	84	94	-	178	**ND**	60	50	94	206
FL	81	233	283	598	**OH**	1,877	870	1,264	4,012
GA	715	245	521	1,482	**OK**	343	185	478	1,006
ID	110	62	116	289	**OR**	263	153	370	787
IL	2,684	993	1,138	4,816	**PA**	1,621	740	828	3,190
IN	928	439	1,177	2,545	**RI**	125	82	15	223
IA	404	207	375	986	**SC**	160	98	301	560
KS	361	168	380	910	**SD**	67	45	14	128
KY	363	179	411	954	**TN**	385	250	520	1,157
LA	265	118	3,066	3,451	**TX**	1,141	949	8,109	10,201
ME	7	17	63	88	**UT**	297	168	127	593
MD	492	300	117	910	**VT**	18	16	18	53
MA	782	468	294	1,545	**VA**	495	373	251	1,120
MI	1,982	905	908	3,796	**WA**	456	262	397	1,116
MN	742	458	411	1,612	**WV**	148	122	169	440
MS	179	111	429	721	**WI**	808	425	621	1,855
MO	591	279	258	1,128	**WY**	76	66	101	244
MT	110	62	36	209	**US**	28,964	16,196	30,151	75,311

Table 18 displays what this national scenario would mean specifically for individual residential gas customers. The data in this table represents the average annual natural gas bill reduction per residence with gas service. While these are annual savings numbers, the great majority of these savings would be obtained during the peak winter heating season when residential consumer gas consumption and bills are the highest.

Table 18. Average Annual Natural Gas Expenditure Change per Residential Natural Gas Customer ($/customer)

	Number of Natural Gas Residential Consumers	2004	2008	5-Year Avg.		Number of Natural Gas Residential Consumers	2004	2008	5-Year Avg.
AL	807,245	-47	-54	-63	**NE**	476,275	-70	-78	-88
AZ	884,789	-40	-47	-51	**NV**	550,850	-53	-69	-68
AR	552,716	-70	-85	-94	**NH**	84,760	-85	-111	-116
CA	9,600,493	-52	-61	-65	**NJ**	2,436,771	-79	-100	-111
CO	1,365,594	-77	-76	-87	**NM**	485,969	-70	-88	-92
CT	458,105	-85	-112	-118	**NY**	4,243,130	-90	-112	-122
DE	122,829	-65	-78	-88	**NC**	891,227	-58	-72	-82
DC	138,412	-90	-107	-122	**ND**	106,758	-89	-99	-114
FL	590,221	-22	-24	-28	**OH**	3,195,407	-87	-101	-118
GA	1,737,850	-62	-68	-82	**OK**	868,314	-62	-67	-79
ID	251,004	-70	-84	-88	**OR**	542,799	-73	-87	-97
IL	3,670,693	-111	-128	-146	**PA**	2,542,724	-94	-116	-127
IN	1,613,373	-85	-101	-115	**RI**	216,781	-85	-110	-116
IA	818,313	-76	-85	-99	**SC**	501,161	-45	-56	-64
KS	836,486	-68	-73	-86	**SD**	144,310	-72	-81	-94
KY	749,106	-70	-84	-97	**TN**	993,363	-56	-68	-78
LA	952,753	-42	-49	-56	**TX**	3,738,260	-47	-53	-61
ME	17,302	-59	-76	-80	**UT**	657,728	-80	-81	-91
MD	959,772	-77	-92	-103	**VT**	29,463	-89	-114	-122
MA	1,283,008	-89	-116	-122	**VA**	941,582	-78	-97	-105
MI	3,011,205	-98	-111	-132	**WA**	841,617	-82	-95	-108
MN	1,249,748	-90	-100	-119	**WV**	363,126	-60	-69	-82
MS	437,899	-62	-77	-82	**WI**	1,484,536	-82	-95	-109
MO	1,326,160	-69	-77	-89	**WY**	129,897	-105	-110	-118
MT	226,171	-76	-85	-98	**US**	60,252,745	-73	-86	-96

Changes in Electricity Expenditures

The EEA model used in this study does not directly provide estimates of changes in end-use consumer expenditures for electricity. Thus, ACEEE undertook an indirect approach to obtain an approximation of the end-user electric savings.

The electric power sector experiences a significant reduction in expenditures for natural gas because of decreases in natural gas prices and reduced consumption of gas. These consumption reductions occur because overall demand for electricity is reduced as a result of increased energy efficiency and conservation by end-use consumers, and because a portion of the remaining natural gas generation is displaced by new renewable generation. Changes in natural gas expenditures by the power sector in each of the lower-48 states are presented in Table 19.

It is important to keep in mind that with the exception of Texas (for all practical purposes has an autonomous grid), all other states are part of broad regional markets so that the changes in gas consumption in the power sector in a state may actually result from reductions in electricity demand and increased renewables in other states. As a result, these "savings" from the power sector in a state may not solely benefit the electricity consumers in that state. A portion of these expenditure reductions are likely to be passed along to end-use electricity consumers in the form of lower rates. Another portion is likely to be used to offset the costs associated with procurement of new renewable power generation. The analysis and modeling do not allow for an apportioning of these expenditure changes to price reductions at either the state or national level. In addition, some states that have undergone restructuring have frozen retail rates (for at least some customer classes) so these savings would not be passed along to consumers. The reductions in power generation gas expenditures should be viewed as the upper limit on savings to end-use consumers from electricity price reductions. However, these expenditure reductions do, represent an important benefit at the regional and national level in the evaluation of the cost/benefit relationship of energy efficiency and renewable energy on natural gas markets.

Table 19. Reductions in Natural Gas Expenditures in the Power Sector (Million 2002$)

State	2004	2008	Cum.	State	2004	2008	Cum.
AL	133	385	1,377	**NC**	48	126	482
AR	27	38	213	**ND**	0	0	1
AZ	162	127	747	**NE**	3	21	79
CA	1,090	2,312	9,306	**NH**	2	3	16
CO	55	24	172	**NJ**	183	234	1,027
CT	67	129	528	**NM**	38	37	192
DC	0	0	0	**NV**	231	730	2,491
DE	40	170	493	**NY**	431	545	2,499
FL	648	1,026	4,655	**OH**	-70	-53	-350
GA	130	263	1,106	**OK**	84	90	508
IA	2	23	75	**OR**	144	179	857
ID	21	38	155	**PA**	67	326	828
IL	89	129	581	**RI**	85	149	643
IN	-11	-3	-55	**SC**	38	82	351
KS	18	18	104	**SD**	-1	15	62
KY	35	94	352	**TN**	37	103	371
LA	124	147	802	**TX**	1,550	1,805	8,413
MA	176	280	1,283	**UT**	27	29	127
MD	37	82	304	**VA**	25	54	213
ME	71	69	403	**VT**	1	1	7
MI	99	86	501	**WA**	100	110	543
MN	8	45	169	**WI**	28	31	151
MO	23	94	310	**WV**	-10	-10	-62
MS	48	102	510	**WY**	5	6	27
MT	28	75	269	**US-Total**	-1,896	727	24,361

End-use consumers do directly benefit from expenditure reductions that result from reduced consumption energy efficiency and conservation. Assuming no direct electricity price impacts beyond the base case, this analysis projects consumers would reduce their electricity bills cumulatively by $4.24 billion for the 2004-2008 modeling period. This reduction represents a 2.5% change in 2004, rising to 4.9% by 2008. Cumulative changes in end-use consumer electric expenditures by state and sector are presented in Table 20**.** Annual values can be found in Appendix C.

Table 20. Cumulative Electricity Expenditure Reductions (2004-2008) in Million 2002$[1]

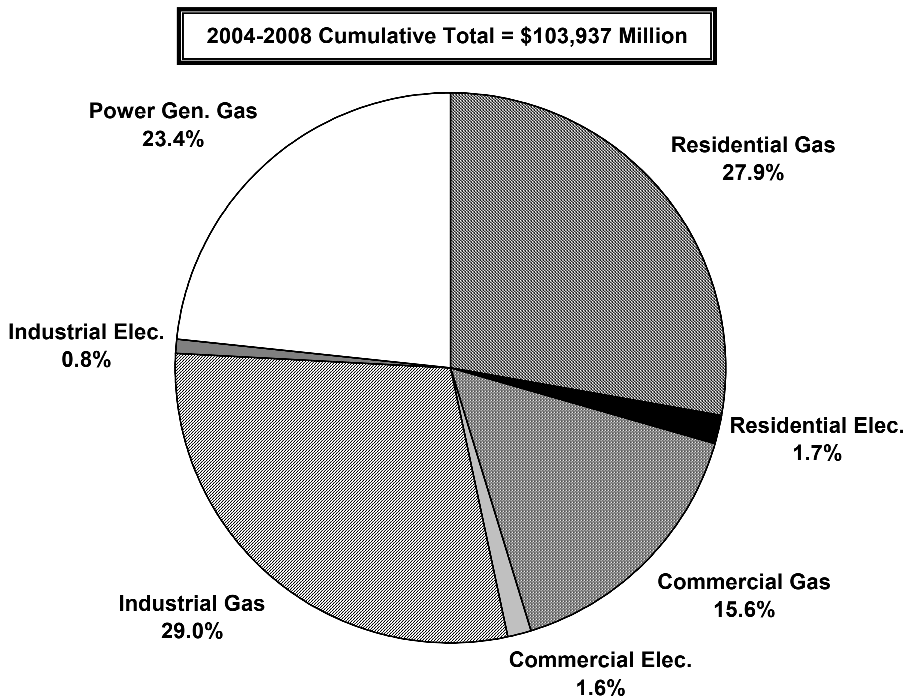
STATE	Residential	Commercial	Industrial	Total End-Users	STATE	Residential	Commercial	Industrial	Total End-Users
AL	23.0	15.8	14.4	53.2	NC	44.8	31.6	17.7	94.1
AR	14.0	7.5	8.8	30.3	ND	2.6	2.5	1.3	6.4
AZ	33.7	27.4	8.0	69.0	NE	6.6	5.3	3.2	15.1
CA	207.4	299.8	86.8	594.1	NH	8.4	8.5	4.0	20.9
CO	15.9	17.1	6.5	39.5	NJ	54.8	74.0	21.4	150.2
CT	27.3	27.9	8.9	64.1	NM	5.3	6.8	3.0	15.1
DC	1.9	9.7	0.2	11.8	NV	13.5	9.5	9.8	32.9
DE	4.7	4.2	2.5	11.4	NY	129.8	182.3	28.5	340.7
FL	139.4	87.0	15.2	241.6	OH	58.8	55.7	40.9	155.3
GA	52.4	41.6	22.1	116.1	OK	17.2	11.4	6.8	35.4
IA	14.4	11.8	12.3	38.5	OR	22.7	19.4	10.5	52.6
ID	7.4	6.9	4.4	18.7	PA	65.6	57.9	40.1	163.6
IL	65.6	64.7	33.7	164.1	RI	6.9	9.0	2.7	18.6
IN	36.8	27.4	31.2	95.4	SC	22.8	14.7	14.5	52.1
KS	10.9	10.6	5.7	27.2	SD	3.1	2.6	0.9	6.5
KY	15.8	9.6	14.0	39.4	TN	35.1	26.8	19.6	81.4
LA	36.8	17.7	19.0	73.6	TX	229.9	163.6	110.3	503.7
MA	37.7	67.9	19.2	124.8	UT	8.0	9.4	4.2	21.7
MD	37.2	32.9	7.8	78.0	VA	44.1	28.3	12.3	84.7
ME	10.6	11.6	4.7	27.0	VT	5.3	5.3	2.7	13.2
MI	39.6	43.9	25.6	109.1	WA	31.7	26.4	14.9	73.0
MN	26.8	24.7	16.6	68.1	WI	34.2	28.2	23.5	85.9
MO	24.8	20.6	8.1	53.5	WV	7.3	4.8	4.9	17.1
MS	14.7	10.1	8.0	32.8	WY	2.1	2.7	3.5	8.3
MT	3.9	3.8	2.9	10.6	US-Total	1,763.6	1,688.9	788.2	4,240.7

[1]Note: These changes in electricity expenditures are calculated from the projected base-case electricity price by state and sector, and reductions in electricity consumption provided as an input to the model. No attempt was made to account for changes in electricity prices resulting from the effects of the energy efficiency or renewable energy policies.

Cumulative Changes in Energy Expenditure

The proposed energy efficiency and renewable energy expansion proposed in this study produce cumulative energy expenditure reductions for natural gas and electricity of almost $104 billion for the five year study period. The $30,170 million in industrial gas expenditure reductions account for largest share of the savings (29% of the total), followed closely by residential sector (27.8% or $28,966 million) (see Figure 26). These expenditure reductions however come from different market effects. In the industrial sector, most of the expenditure reductions occur from the average 16.4% reduction in the natural gas price while actual industrial consumption increases modestly as was discussed above. More of the residential savings results from the 3.1% reduction in consumption in 2008 resulting from energy efficiency and conservation, rather than the 10% average reduction in residential natural gas prices. Electric power generation reduces natural gas by $24,361 million (23.4% of cumulative reductions) with these reductions resulting from a reduction in consumption that rises to over 15% by 2008 and an average 18.8% reduction in price. The $ 1,689 million reduction in commercial natural gas (15.6% of the total) results from a modest reduction in consumption and an average 11.6% reduction in natural gas pricing for the sector. The electric expenditure reductions from reduced consumption in all of the end-use sectors account for 4.1% of the total national expenditure reductions.

Figure 26. Total Net Energy Expenditure Reductions (2004-2008) from Expanded Energy Efficiency and Renewable Energy

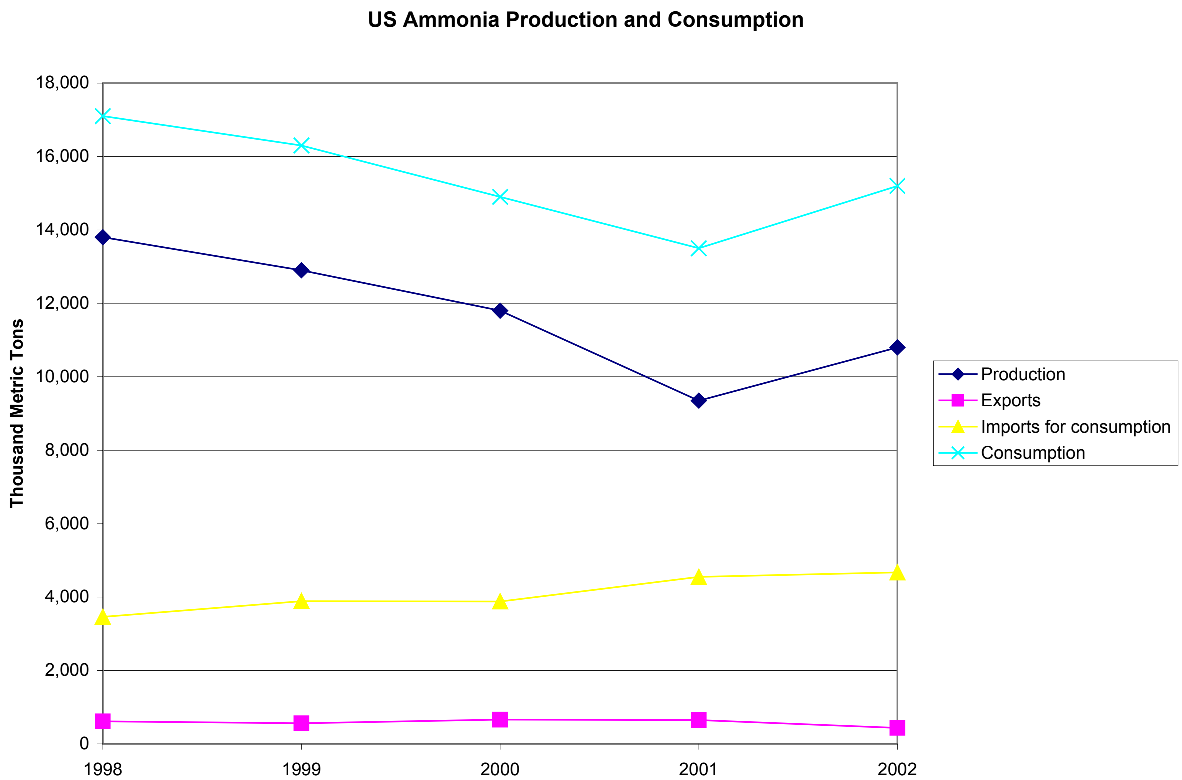


Renewable Energy and Energy Efficiency Can Lower the Cost of Natural Gas, Fertilizer, and Crops

Introduction

Volatile and high prices for natural gas are having serious repercussions in the U.S. fertilizer industry, and by extension, are raising production costs for farmers. Since natural gas accounts for the bulk of raw material costs for fertilizer, price spikes for natural gas result in price spikes for fertilizer. In 2001, when gas prices rose to $10 per million BTU, fertilizer prices more than doubled. The result is plant closures by American producers, increased fertilizer imports from abroad and higher production costs for farmers.

Figure 27. Ammonia Production and Consumption



Aggressive policies to promote renewable energy and energy efficiency can reduce the price of natural gas by lowering demand, especially gas used for electric power production. Modeling by ACEEE and EEA finds that efficiency improvements in furnaces, appliances, and industry, along with rapid increases in cost-effective renewable energy (such as wind power), can reduce wholesale gas prices by 20 percent, resulting in a significant reduction of fertilizer costs. This will modestly reduce corn production costs, increasing profits in a very low-margin business.

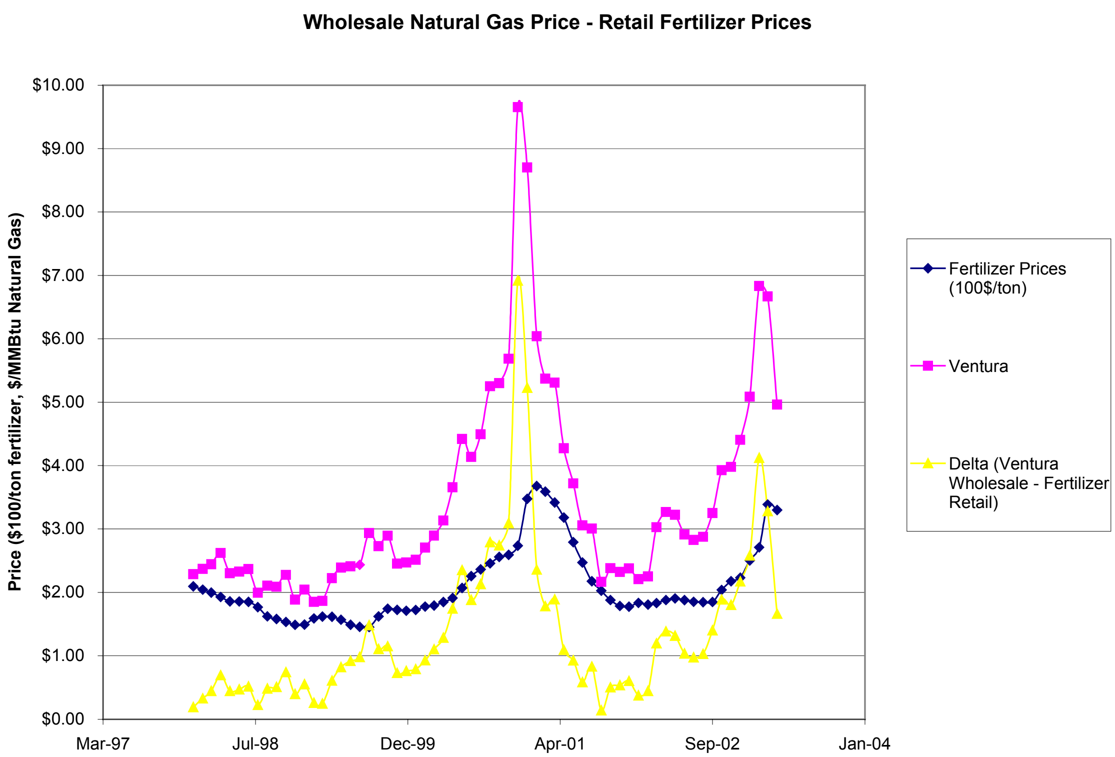
Nitrogenous Fertilizer Trends

Nitrogenous fertilizers utilize a large quantity of natural gas in their production. The cost of natural gas typically represents 70-90% percent of the raw material cost of producing anhydrous ammonia, one of the more commonly utilized nitrogenous fertilizers. Fertilizer production has been historically a low profit margin business, and higher gas prices have resulted in the shutdown of over 8 ammonia producing facilities in the US since 2001. Domestic production of nitrogenous fertilizers (Figure 27) was 25% lower in 2001 than 2000 (USGS 2003). Anhydrous ammonia production facilities are located close to central natural gas production and transmission hubs. The majority of ammonia is produced in the gulf coast region of the US.

The following table shows the amount of anhydrous ammonia produced and consumed in the US. Both domestic consumption and production decreased significantly between 1998 and 2001. A slow, but steady increase in fertilizer imports is continuing, while exports are slowly decreasing.

In January 2001, when Henry Hub spot price for natural gas rose to well over $10/mmbtu, the spot price for anhydrous ammonia increased by 144%, from $119 to $290 per ton (GAO 2003). The wholesale spot market price of ammonia closely follows that of natural gas. The following chart shows the wholesale price of natural gas at the Ventura hub (located in Iowa) and the retail price of ammonia paid by Iowa farmers. The retail price of ammonia tends to follow a similar curve as the price of natural gas, but with a 2-3 month delay (Figure 28).

Figure 28. Gas Price and Ammonia Price



The decline in ammonia production due to plant closures, coupled with the increased retail price in domestically produced ammonia, resulted in a significant increase in the retail price paid by farmers for ammonia-based fertilizer. Farmers, who are the primary consumers of anhydrous ammonia fertilizer, were somewhat sheltered from the spot market price spikes for ammonia. The volatility of retail ammonia price was somewhat dampened because of the 43% increase in imports (primarily from Canada and Trinidad and Tobago). Farmers also have some control over their need for nitrogenous fertilizer. There are several farming techniques that can be employed during periods of fertilizer price spikes that can lessen the need for fertilizer.

Impact on Farmers and Corn Production

Nitrogen is a necessary nutrient in soil for the production of corn and other crops. When the retail price of fertilizer increases, the cost of corn also increases to compensate for the increased costs of production. There are several fixed and variable costs incurred by farmers during the production of corn. Fixed costs included items such as land, machinery, and labor. The variable costs of corn production include the cost of seed, fertilizers, and pesticides. Pesticide costs have also increased along with the price of natural gas, though much less dramatically.

In the typical production of silage corn, fixed costs are between $230 and $290 per acre of harvested corn (or $12 to $15 per ton). Variable costs are between $190 and $230 per acre (or $10 to $12 per ton). Nitrogen costs range from $28 to $38 per acre, depending on the productivity level of the soil. Nitrogen represents between 6.6 and 7.3% ($1.65 to $1.80 per ton) of the cost of silage corn production. A doubling in the retail price of nitrogenous fertilizer, as occurred in the spring of 2001, can increase the price of corn production by about 7% (Iowa State University 2003).

Even seemingly small increases in production costs such as these can have a tremendous impact on farmers, since profit margins in corn production are miniscule. When the price of ammonia is anticipated to be higher than normal, farmers have employed crop rotation techniques as well as utilizing alternate nitrogen sources such as manure to maintain high crop yields.

The Impact of Efficiency and Renewable Energy on Gas, Fertilizer, and Corn Production Costs

Modeling by ACEEE and EEA ("Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets," http://aceee.org/energy/efnatgas-study.htm) found that a package of policies and programs aimed at increasing energy efficiency and renewable energy production could reduce natural gas demand by 4.1 percent over the next five years, reducing prices by 22 percent, and saving American consumers $75 billion. This reduction in natural gas prices would provide a significant boost to domestic natural gas production, protecting American jobs, and reducing fertilizer costs to farmers.

These policies would see other direct and indirect benefits for farmers as well. Wind power developers, for example, pay farmers and ranchers between $2000 and $5000 per turbine per year to site turbines on their land. This typically takes a quarter acre out of production for each turbine, but allows continued use of the rest of the land for crops and grazing. (See National Wind Coordinating Committee, "Assessing the Economic Development Impacts of Wind Power," March 2003, http://nationalwind.org/pubs/economic/econ_final_report.pdf). Likewise, programs that encourage the use of more efficient motors, pumps, and refrigeration systems can help farmers reduce electricity costs

Analysis of Investment and Program Costs

Analysis of the consumer and programmatic costs of delivering the energy efficiency and renewable energy improvements described earlier shows a very favorable cost-to-benefit ratio. Implementation of efficiency and renewables across the United States would cost consumers just over $23 billion over five years (see Figure 29 and Table 21). Significant programmatic support would be necessary however to achieve the savings. An additional $7.2 billion would be required from programmatic administration offices such as state energy offices, public benefit funds, and the federal government. A nation-wide effort would require a total societal investment of just over $30 billion. As presented in the previous section, these levels of investment would save consumers over $100 billion over the next five years. For every dollar invested, $3.44 would be gained in reduced consumption and energy bills. From the public expenditure perspective, the total program costs of just over $7 billion would produce $14.71 of benefit for each program dollar.

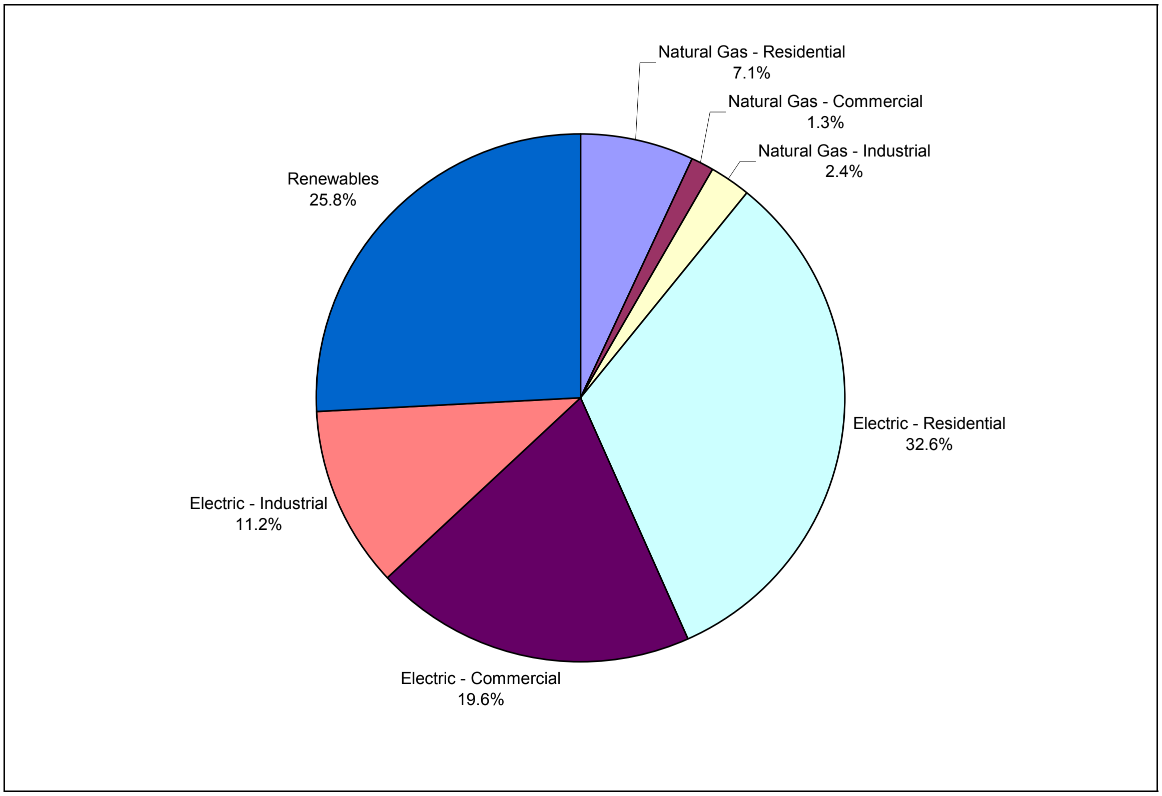
Summary of Costs for Efficiency and Renewable Energy

Table 21 and Figure 29 show how investment and program costs must be allocated in order to achieve the savings described earlier. Nearly two-thirds (64%) of the total investment will have to be made in the areas of electric efficiency, with half of those electric efficiency investments being made in the residential sector. The end-use natural gas savings will require only 11% of the total investment. Overall, the residential efficiency investments account for about 40% of the total required investment. Just over a quarter of the total investment is required to meet the renewable market share for all of the regions specified in the national scenario.

Table 21. Costs of Implementing Energy Efficiency and Renewable Energy

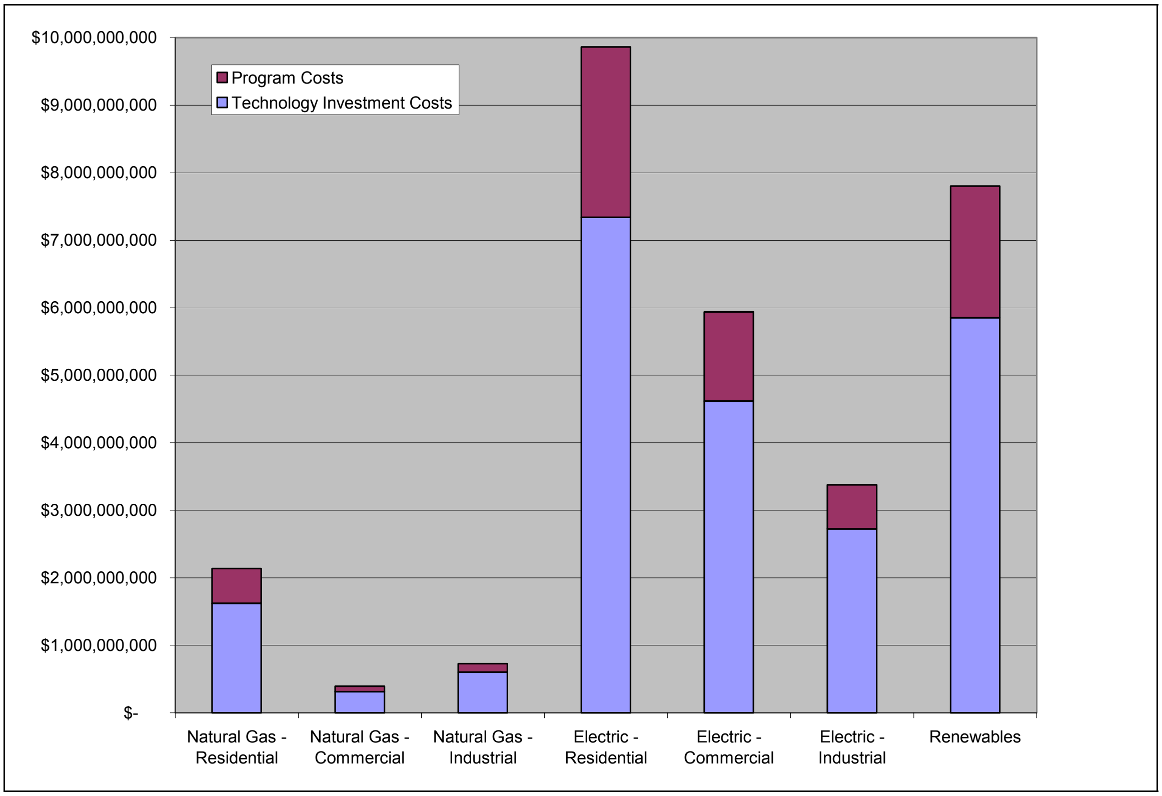
Sector	Technical Investment Costs	Program Costs	Total Cost
Natural Gas - Residential	$1,623,514,825	$514,062,322	$2,137,577,147
Natural Gas - Commercial	$314,589,436	$81,180,475	$395,769,910
Natural Gas - Industrial	$602,709,583	$124,440,731	$727,150,313
Total Natural Gas	**$2,540,813,843**	**$719,683,528**	**$3,260,497,371**
Electric - Residential	$7,341,513,564	$2,521,965,439	$9,863,479,003
Electric - Commercial	$4,617,018,241	$1,322,652,656	$5,939,670,897
Electric - Industrial	$2,726,631,713	$651,168,588	$3,377,800,301
Total Electric	**$14,685,163,518**	**$4,495,786,683**	**$19,180,950,201**
Renewables - $0.045/kWh Installed	**$5,851,457,683**	**$1,950,485,894**	**$7,801,943,577**
Total Cost of Efficiency and Renewables	**$23,077,435,044**	**$7,165,956,105**	**$30,243,391,149**

Figure 29. Distribution of Technical Investment and Program Costs to National Implement Energy Efficiency and Renewable Energy Scenario



Overall, the program costs represent about 24% of the total cost required to implement the national scenario. The program share of the total costs varies by the sector. Figure 30 displays both the magnitude of total investment in each sector as well as the ratio of consumer-borne technical investment costs and the programmatic costs. For energy efficiency, the programmatic costs as a percentage are highest in the residential sector (25% of total costs), followed by the commercial (22%) and industrial (19%) sectors. The high program cost for residential results from the need to work with many small consumers to obtain significant energy reductions, in contrast to the commercial and industrial sectors where contacts can be more efficiently made with the largest energy users. For renewables, the program costs average about 25%, in large part because of the incentives specified under the policy section.

Figure 30. Investment and Program Costs of Energy Efficiency and Renewable Energy



It is important to note that while the economics of efficiency and renewables are attractive for consumers; these savings will require an up-front investment on the part of both consumers and program administrators. Without the programmatic support to educate the consumer and create an attractive market for efficiency and renewable products, very little of this potential will be achieved. Furthermore, the cost of administering the efficiency and renewable programs will be higher in states with little or no experience in delivering such services to their consumers. To account for the differences in administrative experience among the various states, it was assumed that an "a" state would incur no additional charges beyond its standard sector-based administrative adder. A "b" state would incur 5% in additional costs, a "c" state would incur 10%, and a "d" state would incur 15%.

Sector Cost Methodologies

Because the estimates for achievable savings potential were different for each sector, the approaches to estimating the costs were different. As with the savings potential natural gas and electric efficiency costs estimates were made on a state basis, while renewable energy costs were made at the regional level. The next sections discuss how the costs estimates were made.

Residential and Commercial Sector Methodologies

Estimated costs for energy efficiency were based on the average cost per saved Therm of end-use gas and average cost per saved kWh from leading utility and state energy efficiency programs. This analysis separately looked at the residential and commercial programs, and separately looked at programs to save natural gas and electricity. Most of this program cost data combined the residential and commercial sectors, so we first calculated average cost per unit gas and electricity savings across programs, and then adjusted these costs to reflect the cost of commercial versus residential programs.

In the case of electricity savings, available data covered programs operated in California, Vermont, and Massachusetts, as well as projected program costs from a study of six mountain states. Overall, we found that on average, programs cost $0.03 per kWh saved. For gas savings, available data covered programs in Vermont, Minnesota, and projected program costs in Washington and New York. Overall, we found that programs cost an average of $0.15 per Therm saved. To adjust these averages to reflect differences between the residential and commercial sectors, we looked at several studies that examined either program costs or program benefit-cost by sector. This analysis included studies of electric programs from Massachusetts, Connecticut and the mountain states, and studies on gas programs from Vermont and New York. Based on these studies, we calculated average ratios of residential sector program costs to total program costs, and commercial sector program costs to total program costs. In general, residential sector programs are more expensive per kWh or Therm saved than commercial programs. For example, for electric programs, as noted above, the average residential program had costs per kWh saved 36% higher than the average program (e.g., $0.041/kWh saved for residential versus $0.03/kWh saved for the average program) while the average commercial program had costs per kWh saved 21% lower than the average program (e.g. $0.024/kWh saved for commercial versus $0.03/kWh saved for the average program). Calculations by sector for both electric and gas programs are shown in Table 22.

Table 22. Residential and Commercial Costs of Saved Energy

Resource	Technology Costs (Customer-Borne)	Administrative Adder	Total Cost of Energy Savings
Residential Energy Efficiency			
Electricity	$0.041/kWh	25%	$0.051/kWh
Natural Gas	$2.400/MCF	25%	$3.000/MCF
Commercial Energy Efficiency			
Electricity	$0.024/kWh	20%	$0.029/kWh
Natural Gas	$0.800/MCF	20%	$0.960/MCF

Industrial Sector Methodology

There remains a great wealth of cost-effective measures for both electric and natural gas efficiency in the industrial sector. Several good sources of "real-world" data regarding energy efficiency improvements exist for this sector. One of the best sources of this data is the Industrial Assessment Center (IAC) database[4]. The IAC Program, direct, one-to-one contact with industrial end-users and plant site managers significantly increases the adoption of commercially available and emerging energy-efficient technologies. In addition to

[4] Since the program's inception in the 1970s, data has been collected on recommendations, implementation, and costs. The database is available at http://iac.rutgers.edu/database/.

traditional energy streams, IAC targets waste streams and productivity improvements. The program is focused on preparing energy and waste audits of small-to medium-sized manufacturing facilities. IAC is implemented through 26 universities.

In order to determine the customer cost of efficiency improvements in the industrial sector, data from implemented recommendations was obtained from the IAC database. Data was obtained for efficiency measures that were implemented between 1995 and the present. There were 3319 electricity efficiency measures and 1637 natural gas efficiency measures in the database. Table 23 shows the total installation costs and first year energy savings of these measures.

Table 23. Installation Costs and First-Year Savings of IAC Projects

Electricity Efficiency Measures		Natural Gas Efficiency Measures	
Total First-Year Electricity Savings (kWh)	246,783,051	Total First-Year Natural Gas Savings (MCF)	3,375,022
Total Implementation Cost	$19,230,983	Total Implementation Cost	$8,592,863
Total First-Year $/kWh Saved	$0.078	Total First-Year $/MCF Saved	$2.546
Cost of Saved Energy ($/kWh)	$0.016	Cost of Saved Energy ($/MCF)	$0.509

Note: Cost of saved energy figures estimates a typical 5-year capital improvement cycle for industrial facilities.

These figures align with program data provided from the US DOE and other industrial efficiency programs (see Table 24). A comprehensive study of the industrial electric efficiency potential in New York found that a portfolio of 35 different measures would cost an average of $0.018/kWh saved (NYSERDA 2003). The Steam Saver Programs of the U.S. Department of Energy provides data for 203 boiler and steam projects (DOE 2001). These measures included more extensive and capital intensive project improvements such as boiler unit replacements and heat recovery and economizer projects. These improvements typically have a long equipment life.

Table 24. DOE Steam Saver Program Data

Natural Gas Efficiency Measures	
Total First-Year Natural Gas Savings (MCF)	1,659,295
Total Implementation Cost	$15,493,967
Total First-Year $/MCF Saved	$9.33
Cost of Saved Energy ($/MCF) (5-year capital cycle)	$1.866
Cost of Saved Energy ($/MCF) (15-year capital cycle)	$0.622

Savings Estimates Used for Industrial Analysis

The data indicates that the technology and programmatic costs of energy efficiency in the industrial sector vary. The tables in the previous section represent some of the best data available for this sector. In summary, the values used to estimate the technological and programmatic costs of delivering efficiency are listed in Table 25.

Table 25. Industrial Cost of Saved Energy

Resource	Technology Costs (Customer-Borne)	Administrative Adder	Total Cost of Energy Savings
Electricity	$0.016/kWh	15%	$0.0184/kWh
Natural Gas	$0.6/MCF	15%	$0.69/MCF

Renewables Sector Methodology

Because of the limited nature of the renewables analysis, for purposes of cost estimation it was assumed that the vast majority of the new capacity would be wind power. Over the course of our study horizon, certain types of wind power in the United States are the most cost effective of the renewable energy options. The economics of wind power were described by the American Wind Energy Association (AWEA) in a 2002 white paper (AWEA 2002), and depend on many variables, including:

1. Proximity of electricity use to source. The price of onsite wind power is lower because transmission and distribution costs do not need to be included in the price.
2. Size and conditions of wind farms. Large spaces with good wind conditions are the best candidates for higher margin wind power.
3. Size and appropriate configuration of the wind turbine. It is economically important that the wind turbine be the most appropriate and have the best configuration for the wind farm location chosen. Inefficiencies in the wind turbine decrease the economics of the project.
4. The cost of financing. Wind power, like many renewable energy technologies is capital intensive, so the effect of competitive interest rates and expeditious loan processing is large.
5. Tax and environmental regulations. Financially encouraging tax policies as well as tighter environmental regulations create a better environment for wind power.

There a number of programs that encourage the use of wind power in various sectors. Most of the financial incentives for wind power are state-based tax credits or deductions, including the federal production tax credit that applies to wind energy. In Minnesota, for example, there is a statute that offers an incentive for wind (and other renewable technology) electricity generators (under 2 MW) that are owned by the same person who owns the land they are on of 1.5 cents per kWh (Minn 2002). Several other states (a full list can be found at dsire.org) have similar incentives. Other wind incentive programs, such as NYSERDA's Wind Incentive Program (NYSERDA 2003), support partial funding of wind projects using public benefit fund monies or, in regulated states, the utility money earmarked for efficiency and conservation.

Due to the variables in the economics of wind energy and the financial incentive programs available, there is a large range of averages prices for wind power. The AWEA white paper indicates that the range is two to four cents per kWh, when including the federal tax incentive (AWEA 2002). In Texas specifically, AWEA claims wind prices of three to six cents per kWh (with federal incentive) (AWEA 2002). Researchers for the New York State Renewable Portfolio Standard (RPS) team found contract prices for installed wind power as low as 2.6 cents per kWh (NYDPS 2003). There is however still a discrepancy between utility and individually owned prices for wind power, due to economies of scale and general access to the grid. LBNL's report, *Alternative Windpower Ownership Structures: Financing Terms and Project Costs*, approached the issue of how ownership affects the price of wind power. If a facility that is financed by a wind developer could sell power at about 5 ¢/kWh, the same facility could sell power for about $0.035/kWh if it were owned by an IOU (Wiser and Kahn 1996).

For this analysis, an average price of $0.045/kWh for the installation of new renewable energy resources was used. A programmatic adder of $0.015/kWh was assumed.

Table 26. Renewables Cost of Generation

Resource	Technology Costs (Customer-Borne)	Administrative Adder	Total Cost of Energy Savings
Renewable Energy	$0.045/kWh	33%	$0.06/kWh

Discussion of Benefits and Costs

As noted earlier, the ratio of benefits to costs is very attractive. With all of the technology and administrative costs included, the overall benefit to cost ratio is 3.44 (see Table 27). The total benefit to consumer investment ratio is 4.5, while the total benefit to program expenditure ratio is 14.5.

Table 27. Benefit to Cost Ratio of Energy-Efficiency and Renewable Energy

Sector	Total Cost of Efficiency and Renewables	Total Change in Consumer Expenditures	Total Benefit to Total Cost Ratio	Total Benefit to Consumer Cost Ratio
Natural Gas - Residential	$2,137,577,147	$-28,965,921,332	13.55	-17.84
Natural Gas - Commercial	$395,769,910	$-16,199,503,576	40.93	-51.49
Natural Gas – Industrial	$727,150,313	$-30,170,074,072	41.49	-50.06
Electric - Residential	$9,863,479,003	$-1,763,644,596	0.18	-0.24
Electric - Commercial	$5,939,670,897	$-1,688,852,069	0.28	-0.37
Electric – Industrial	$3,377,800,301	$-788,171,289	0.23	-0.29
Power Generation	NA	$-24,360,986,280	-	-
Renewables	$7,801,943,577	NA	-	-
Total	**$30,243,391,149**	**$-103,937,153,213**	**3.44**	**4.50**

It is important to note that while most of the costs are incurred from measures that affect electric power (i.e., electric efficiency and renewable energy), most of the benefits to end-use consumers accrue in the form of reductions in natural gas expenditures. The analysis does not allow for the determination of the relative impacts of electric efficiency and renewable energy on the total benefits.

Policy Mechanisms for Obtaining Results

Policymakers 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 our recent study (Elliott et al. 2003). Rather, a portfolio of strategies would be most likely to achieve quick and sustained savings from energy efficiency and renewable energy resources.

Energy Efficiency Performance Targets

One of the leading sources of energy efficiency savings are incentive and technical assistance programs operated by utilities and states. 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% each year. Establishing binding savings targets for states built around the achievements of the most effective programs could expand these benefits to additional customers. Financing for these programs could come from state system benefit funds or through electric and gas rates. The benefits of these programs are typically on the order of two-times program costs, making them very cost-effective to consumers and businesses. Such targets could be established at the state level, as Texas has done (Kushler and Witte 2001), or at the federal level. Possible models are contained in electricity legislation drafted in 2002 by House Energy and Air Quality Subcommittee Chairman Joe Barton or the oil savings amendment adopted on the Senate floor in the spring of 2003 (Barton 2002).

Alternatively, states or the federal government could adopt system benefit funds, providing a stable source of funding for energy efficiency and renewable energy initiatives. State system benefit programs are proving themselves to be an attractive strategy for funding in many states where a small fee is collected on each unit of energy sold in the state (York and Kushler 2002). These funds are then used to support energy efficiency and renewable energy programs. These programs could also be funded by including them in electric and gas rates.

Regardless of whether programs are induced through the setting of targets or through providing a source of funding, these programs can be tailored to meet the unique needs of their states. Increasing the funding for existing programs represents a sound strategy for expanding the impact of energy efficiency and renewable energy resources. States that do not currently have significant programs should be encouraged to establish them through state or federal action.

Expanded Federal Funding for EERE Implementation Programs at DOE and EPA

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 energy and 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 should lead us to expand support for existing programs (Kushler and Vine 2003). These initiatives represented the installed infrastructure of energy efficiency and renewable energy resources. Federal initiatives such as ENERGY STAR® and Industrial Best Practices are already having impacts in the marketplace. Similarly, many state and regional initiatives are well positioned to channel funding into the market.

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, we have important standards waiting in the wings for a number of products that could result in important energy savings in the mid term, even as soon as 2005. At the federal level, the energy bill currently under consideration in Congress includes standards on six products that would go into effect in either 2005 or 2006. In addition, three federal rulemakings are underway that should move forward as quickly as possible, and additional rulemakings are behind legislatively mandated schedules and should begin soon. Standards for a number of products are also ready to be implemented at the state level. Model state legislation includes 10 products (some the same as in federal legislation), but California is considering as many as 25 products for state standards. Significant independent opportunities exist for both state and federal action. In addition, standards on additional products represent a critical long-term strategy that could deliver significant energy savings (Prindle et al. 2003).

Insuring More Efficient Buildings through Codes

As with appliance standards, buildings codes represent an energy efficiency success story. These specifications, administered at the local level, define how new residential commercial builds are constructed, and in some cases what upgrades need to be made when major renovations take place. Energy efficiency experts 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 these codes.

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 remove tariffs and "exit fees" that act as disincentives to the development of new distributed resources (Brown and Elliott 2003).

State and federal governments should establish or 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 production incentives (Elliott 2001).

Renewable Portfolio Standards

A renewable portfolio standard (RPS) is a market-based policy that increases the diversity of our electricity supply by establishing a minimum commitment to generate electricity from renewable resources. The experiences of the 13 states that have implemented renewable portfolio standards have proven them an effective means of reducing market barriers and encouraging the installation of renewable energy technologies. Several states have successful programs that could be expanded (i.e., Texas, California, Connecticut, Iowa, and Wisconsin) and proposals are under consideration to establish renewable portfolio standards in several other states (ELPC 2001, UCS 2001, Marston 2003), such as New York (Greene 2003). The other states without renewable portfolio standards should be encouraged to implement them as has been proposed by several regional initiatives (ELPC 2001, REPP 2001, Nielsen 2003 and Shimshak 2003).

Because renewable energy can help meet critical national fuel diversity, energy security, economic, and environmental goals, a renewable portfolio standard should be a cornerstone of America's national energy policy. In July, the Senate passed a renewable portfolio standard requiring major electricity companies to obtain 10% of their electricity from renewable energy sources by 2020 (Senate 2003). A national renewable portfolio standard should also establish a minimum commitment that allows states to adopt higher standards.

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 credit for renewable energy sources (now slated to expire at the end of 2003) be extended through at least 2006. Grants and loans for renewable energy were part of the *Farm Bill of 2002* passed by the 107^{th} 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 (Oregon, Massachusetts, New York, and California) have designated that system benefit charges should be used to support renewable energy projects.

Public Awareness Campaign by State and National Leaders

Finally, our state and national 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. Witness the public response to Federal Reserve Chairman Alan Greenspan’s Congressional testimonies. Our public leaders should use their position to issue a call to action by the people and businesses of America to take steps to improve their energy efficiency and encourage investment in renewable energy resources. The window of opportunity to effect significant savings is however limited as was learned in the Northwest in 2002. Once a market has adapted to higher electricity prices it is difficult to motivate public action. The lesson learned is that policy makers must also 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.

Conclusions, Discussions, and Recommendations

Energy efficiency and renewable energy resources can have a relatively quick moderating effect on natural gas markets, resulting in significant savings to the economy at an attractive cost.

As a result of these findings, it is clear that natural gas and electric efficiency and renewable energy resources should be important components in our response to our current natural gas price problems. A consensus appears to exist that in the near term, efficiency and renewable energy resources can be brought to the market faster than new wells can be drilled or new pipelines and liquefied natural gas (LNG) terminals could be built.

The findings of this study do not indicate that energy efficiency renewable energy are the only policy solution required to address the future natural gas needs of the United States. Additional sources of natural gas will be required whether from domestic sources such as the proposed pipeline to bring Alaskan gas to the lower-48 state, as has been explored in a recent report by the National Commission on Energy Policy (NCEP 2003), or through importation of gas in the form of LNG. However, due to energy efficiency and renewable energy resources' low cost and environmental impacts, these resources also can be an important part of the long-term solution reducing the rate of increase in demand. In addition, expanded energy efficiency and renewable energy resources provide national decision- makers with some breathing room to develop rational energy policies that can result in the lowest cost to consumers and to the environment. Research is underway by a number of groups ranging from the National Petroleum Council to the National Commission on Energy Policy, which has several analyses underway, to the Federal Reserve and Congress. Time is needed to complete and analyze the results of this research to develop a comprehensive natural gas policy. The questions are complex because of the interrelationships between natural gas, industrial production and electric power generation; thus, simple long-term solutions are not likely.

If we don't address the natural gas price problem, we will further damage our economy: industry will move overseas where prices are lower, and businesses and individual consumers will divert money from other purchases to pay higher natural gas and electricity bills. Efficiency and renewable energy may not completely solve our natural gas problems, but they represent an important part of the portfolio of policies needed to insure a healthy economy. Public and private leaders need to step up to the podium and issue a call to action to implement the policies and programs needed to realize the benefits that will result from increased use of energy efficiency and renewable energy. A window of opportunity may be closing in the near future, so leaders must act now if the full, cost-effective benefits of energy efficiency and renewable energy are to be realized. We have provided some concrete policy recommendations. These policies are relatively low-cost and the measures recommended are cost-effective from the customer's perspective. However, local, state, and federal governments all must be prepared to commit resources if this opportunity is to be realized.

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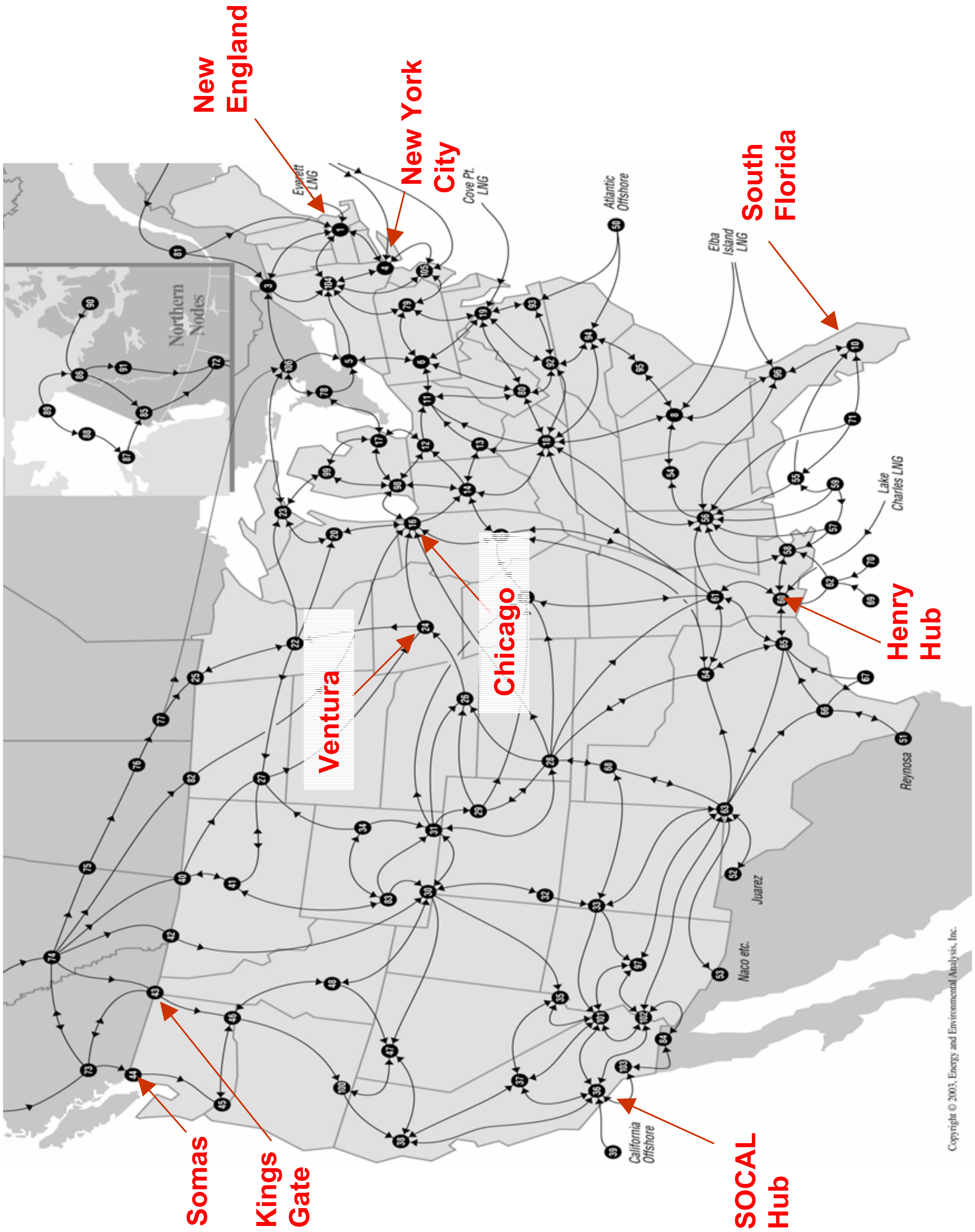
Appendix A-The North American Natural Gas Transmission Network



Appendix B-Residential and Commercial Savings by State by Measure

Residential Natural Gas Savings by end use by state

	Avg NG use/hh		Weighted for total fuel use in hhs with SH, WH, OT Avg NG Use as sum of parts			% By Enduse			% Enduse Sum of Parts				Adjusted Savings	
State	Mbtu	Summed, Weighted NG/per hh	SH (MBTU/hh)	WH (MBTU/hh)	OT (MBTU/hh)	SH	WH	OT	SH	WH	OT	Score	5 yr (%)	1 yr (%)
Alabama	30	30	21	7	2	69	24	7	69	24	7	d	2.9%	1.4%
Arizona	56	37	20	15	2	35	27	4	53	41	6	b	4.5%	2.2%
Arkansas	50	49	30	15	4	59	31	8	61	31	8	d	2.9%	1.4%
California	41	41	17	19	6	41	46	15	40	45	15	a	5.1%	2.6%
Colorado	56	110	92	15	2	164	27	4	84	14	2	b	4.4%	2.2%
Connecticut	31	33	24	7	2	75	22	7	72	21	6	a	5.2%	2.6%
Delaware	181	26	18	6	2	10	4	1	69	24	6	b	4.4%	2.2%
Florida	27	4	1	2	1	3	9	5	17	52	31	c	3.4%	1.7%
Georgia	181	26	18	6	2	10	4	1	69	24	6	d	2.9%	1.4%
Idaho	56	110	92	15	2	164	27	4	84	14	2	b	4.4%	2.2%
Illinois	99	97	73	19	5	73	19	5	75	20	6	b	4.4%	2.2%
Indiana	99	97	73	19	5	73	19	5	75	20	6	c	3.6%	1.8%
Iowa	73	73	56	15	3	77	20	4	76	20	4	b	4.4%	2.2%
Kansas	73	73	56	15	3	77	20	4	76	20	4	d	2.9%	1.4%
Kentucky	30	30	21	7	2	69	24	7	69	24	7	d	2.9%	1.4%
Louisiana	50	49	30	15	4	59	31	8	61	31	8	d	2.9%	1.4%
Maine	31	33	24	7	2	75	22	7	72	21	6	a	5.2%	2.6%
Maryland	68	62	46	11	5	67	17	7	74	18	8	b	4.4%	2.2%
Massachusetts	31	33	24	7	2	75	22	7	72	21	6	a	5.2%	2.6%
Michigan	99	97	73	19	5	73	19	5	75	20	6	b	4.4%	2.2%
Minnesota	73	73	56	15	3	77	20	4	76	20	4	b	4.4%	2.2%
Missouri	73	73	56	15	3	77	20	4	76	20	4	d	2.9%	1.4%
Mississippi	30	30	21	7	2	69	24	7	69	24	7	d	2.9%	1.4%
Montana	56	110	92	15	2	164	27	4	84	14	2	c	3.7%	1.8%
Nebraska	73	73	56	15	3	77	20	4	76	20	4	d	2.9%	1.4%
Nevada	56	37	20	15	2	35	27	4	53	41	6	c	3.7%	1.8%
New Hampshire	31	33	24	7	2	75	22	7	72	21	6	b	4.4%	2.2%
New Jersey	68	62	46	11	5	67	17	7	74	18	8	a	5.1%	2.6%
New Mexico	56	37	20	15	2	35	27	4	53	41	6	d	2.9%	1.5%
New York	57	53	36	12	5	63	22	8	68	23	9	a	5.1%	2.6%
North Carolina	181	26	18	6	2	10	4	1	69	24	6	d	2.9%	1.4%
North Dakota	73	73	56	15	3	77	20	4	76	20	4	d	2.9%	1.4%
Ohio	99	97	73	19	5	73	19	5	75	20	6	c	3.6%	1.8%
Oklahoma	50	49	30	15	4	59	31	8	61	31	8	d	2.9%	1.4%
Oregon	159	81	48	23	10	30	14	6	59	28	12	a	5.1%	2.5%
Pennsylvania	68	62	46	11	5	67	17	7	74	18	8	a	5.1%	2.6%
Rhode Island	31	33	24	7	2	75	22	7	72	21	6	a	5.2%	2.6%
South Carolina	181	26	18	6	2	10	4	1	69	24	6	d	2.9%	1.4%
South Dakota	73	73	56	15	3	77	20	4	76	20	4	d	2.9%	1.4%
Tennessee	30	30	21	7	2	69	24	7	69	24	7	c	3.6%	1.8%
Texas	46	46	24	16	5	53	36	11	53	35	11	a	5.1%	2.6%
Utah	56	110	92	15	2	164	27	4	84	14	2	b	4.4%	2.2%
Vermont	31	33	24	7	2	75	22	7	72	21	6	a	5.2%	2.6%
Virginia	181	26	18	6	2	10	4	1	69	24	6	c	3.6%	1.8%
Washington	159	81	48	23	10	30	14	6	59	28	12	b	4.3%	2.2%
West Virginia	181	26	18	6	2	10	4	1	69	24	6	d	2.9%	1.4%
Wisconsin	99	97	73	19	5	73	19	5	75	20	6	a	5.2%	2.6%
Wyoming	56	110	92	15	2	164	27	4	84	14	2	c	3.7%	1.8%

5 yr savings potential	5.20%
End-use multipliers	
Space heating	1.00
Water heating	1.10
Other	0.60

Legend:
SH=Space Heating
WH= Water Heating
OT=Other
EP=Economic Potential
hh=Household

Commercial Natural Gas Savings by State by Measure

	Percent By Enduse				State Score	Adjusted Savings (%)	
State	SH	WH	CK	OT		5 yr	1 yr
Alabama	58	30	5	7	d	2.6%	1.3%
Arizona	62	26	7	5	b	4.0%	2.0%
Arkansas	44	34	16	6	d	2.6%	1.3%
California	31	42	17	11	a	4.8%	2.4%
Colorado	62	26	7	5	b	4.0%	2.0%
Connecticut	56	29	7	8	a	4.7%	2.3%
Delaware	41	29	21	9	b	3.8%	1.9%
Florida	41	29	21	9	c	3.1%	1.6%
Georgia	41	29	21	9	d	2.5%	1.2%
Idaho	62	26	7	5	b	4.0%	2.0%
Illinois	67	22	8	4	b	3.9%	1.9%
Indiana	67	22	8	4	c	3.2%	1.6%
Iowa	77	19	3	0	b	3.9%	2.0%
Kansas	77	19	3	0	d	2.6%	1.3%
Kentucky	58	30	5	7	d	2.6%	1.3%
Louisiana	44	34	16	6	d	2.6%	1.3%
Maine	56	29	7	8	a	4.7%	2.3%
Maryland	41	29	21	9	b	3.8%	1.9%
Massachusetts	56	29	7	8	a	4.7%	2.3%
Michigan	67	22	8	4	b	3.9%	1.9%
Minnesota	77	19	3	0	b	3.9%	2.0%
Missouri	77	19	3	0	d	2.6%	1.3%
Mississippi	58	30	5	7	d	2.6%	1.3%
Montana	62	26	7	5	c	3.3%	1.6%
Nebraska	77	19	3	0	d	2.6%	1.3%
Nevada	62	26	7	5	c	3.3%	1.6%
New Hampshire	56	29	7	8	b	4.0%	2.0%
New Jersey	55	23	11	12	a	4.5%	2.2%
New Mexico	62	26	7	5	d	2.6%	1.3%
New York	55	23	11	12	a	4.5%	2.2%
North Carolina	41	29	21	9	d	2.5%	1.2%
North Dakota	77	19	3	0	d	2.6%	1.3%
Ohio	67	22	8	4	c	3.2%	1.6%
Oklahoma	44	34	16	6	d	2.6%	1.3%
Oregon	31	42	17	11	a	4.8%	2.4%
Pennsylvania	55	23	11	12	a	4.5%	2.2%
Rhode Island	56	29	7	8	a	4.7%	2.3%
South Carolina	41	29	21	9	d	2.5%	1.2%
South Dakota	77	19	3	0	d	2.6%	1.3%
Tennessee	58	30	5	7	c	3.3%	1.7%
Texas	44	34	16	6	a	4.7%	2.4%
Utah	62	26	7	5	b	4.0%	2.0%
Vermont	56	29	7	8	a	4.7%	2.3%
Virginia	41	29	21	9	c	3.1%	1.6%
Washington	31	42	17	11	b	4.1%	2.1%
West Virginia	41	29	21	9	d	2.5%	1.2%
Wisconsin	67	22	8	4	a	4.6%	2.3%
Wyoming	62	26	7	5	c	3.3%	1.6%

5 yr savings potential	4.70%
End-use multipliers	
Space heating	0.9
Water heating	1.4
Cooking	0.6
Other	0.6

Legend:
CL=Cooling
VE=Ventiliation
LI=Lighting
CK=Cooking
RE=Refrigeration
OE=Office Equipment
SH=Space Heating
WH= Water Heating
OT=Other
EP=Economic Potential

Commercial Electricity Savings by State by Measure

	Percent By Enduse									Score	Adjusted 5 Yr Savings	1 Yr Savings
State	SH	CL	VE	WH	LI	CK	RE	OE	OT		%	%
Alabama	6	16	5	2	44	1	8	11	8	d	3.6%	1.8%
Arizona	4	13	7	2	46	1	7	14	7	c	4.7%	2.4%
Arkansas	2	19	7	1	43	1	8	11	8	d	3.7%	1.9%
California	5	10	6	1	48	1	7	15	8	a	6.7%	3.4%
Colorado	4	13	7	2	46	1	7	14	7	c	4.7%	2.4%
Connecticut	2	10	5	3	51	1	6	13	8	a	6.8%	3.4%
Delaware	4	16	6	2	43	1	6	13	8	c	4.7%	2.3%
Florida	4	16	6	2	43	1	6	13	8	c	4.7%	2.3%
Georgia	4	16	6	2	43	1	6	13	8	c	4.7%	2.3%
Idaho	4	13	7	2	46	1	7	14	7	b	5.8%	2.9%
Illinois	4	11	6	2	47	1	7	13	9	b	5.7%	2.8%
Indiana	4	11	6	2	47	1	7	13	9	b	5.7%	2.8%
Iowa	4	10	7	1	50	0	5	14	8	b	5.8%	2.9%
Kansas	4	10	7	1	50	0	5	14	8	d	3.8%	1.9%
Kentucky	6	16	5	2	44	1	8	11	8	d	3.6%	1.8%
Louisiana	2	19	7	1	43	1	8	11	8	d	3.7%	1.9%
Maine	2	10	5	3	51	1	6	13	8	a	6.8%	3.4%
Maryland	4	16	6	2	43	1	6	13	8	b	5.7%	2.8%
Massachusetts	2	10	5	3	51	1	6	13	8	a	6.8%	3.4%
Michigan	4	11	6	2	47	1	7	13	9	c	4.7%	2.3%
Minnesota	4	10	7	1	50	0	5	14	8	b	5.8%	2.9%
Missouri	4	10	7	1	50	0	5	14	8	d	3.8%	1.9%
Mississippi	6	16	5	2	44	1	8	11	8	d	3.6%	1.8%
Montana	4	13	7	2	46	1	7	14	7	c	4.7%	2.4%
Nebraska	4	10	7	1	50	0	5	14	8	d	3.8%	1.9%
Nevada	4	13	7	2	46	1	7	14	7	c	4.7%	2.4%
New Hampshire	2	10	5	3	51	1	6	13	8	b	5.8%	2.9%
New Jersey	5	10	6	2	48	0	9	12	9	a	6.6%	3.3%
New Mexico	4	13	7	2	46	1	7	14	7	d	3.7%	1.9%
New York	5	10	6	2	48	0	9	12	9	a	6.6%	3.3%
North Carolina	4	16	6	2	43	1	6	13	8	d	3.7%	1.8%
North Dakota	4	10	7	1	50	0	5	14	8	d	3.8%	1.9%
Ohio	4	11	6	2	47	1	7	13	9	c	4.7%	2.3%
Oklahoma	2	19	7	1	43	1	8	11	8	d	3.7%	1.9%
Oregon	5	10	6	1	48	1	7	15	8	a	6.7%	3.4%
Pennsylvania	5	10	6	2	48	0	9	12	9	c	4.6%	2.3%
Rhode Island	2	10	5	3	51	1	6	13	8	a	6.8%	3.4%
South Carolina	4	16	6	2	43	1	6	13	8	d	3.7%	1.8%
South Dakota	4	10	7	1	50	0	5	14	8	d	3.8%	1.9%
Tennessee	6	16	5	2	44	1	8	11	8	c	4.6%	2.3%
Texas	2	19	7	1	43	1	8	11	8	a	6.7%	3.4%
Utah	4	13	7	2	46	1	7	14	7	b	5.8%	2.9%
Vermont	2	10	5	3	51	1	6	13	8	a	6.8%	3.4%
Virginia	4	16	6	2	43	1	6	13	8	c	4.7%	2.3%
Washington	5	10	6	1	48	1	7	15	8	b	5.7%	2.9%
West Virginia	4	16	6	2	43	1	6	13	8	d	3.7%	1.8%
Wisconsin	4	11	6	2	47	1	7	13	9	a	6.7%	3.3%
Wyoming	4	13	7	2	46	1	7	14	7	c	4.7%	2.4%

5 yr savings potenti	6.70%
End-use multipliers	
Space heating	0.2
Cooling	1
Ventilation	0.9
Water heating	0.6
Lighting	1.2
Cooking	0.5
Refrigeration	0.8
Office equipment	1.1
Other	0.5

Legend:
CL=Cooling
VE=Ventiliation
LI=Lighting
CK=Cooking
RE=Refrigeration
OE=Office Equipment
SH=Space Heating
WH= Water Heating
OT=Other
EP=Economic Potential

Residential Electricity Use Savings by State by Measure

	MBTU/hh					% Enduse				Score	Adjusted Savings	
State	Elec Use	SH	WH	OT	AC	SH	WH	OT	AC		5 yr	1 yr
Alabama	49	11	3	28	7	22	6	58	14	d	3.2%	1.6%
Arizona	35	3	3	23	6	9	9	65	18	c	4.1%	2.1%
Arkansas	50	10	2	28	9	21	5	56	18	d	3.2%	1.6%
California	20	2	0	17	1	9	2	82	7	a	5.7%	2.8%
Colorado	31	4	3	23	1	12	10	75	3	c	3.9%	2.0%
Connecticut	26	4	3	18	1	16	11	71	3	a	5.6%	2.8%
Delaware	39	5	3	29	2	14	8	74	4	c	3.9%	2.0%
Florida	45	2	4	27	12	5	8	59	27	c	4.3%	2.1%
Georgia	51	9	12	24	5	18	24	48	10	c	4.1%	2.0%
Idaho	31	4	3	23	1	12	10	75	3	b	4.8%	2.4%
Illinois	32	5	2	23	2	14	7	71	7	b	4.8%	2.4%
Indiana	34	5	2	25	2	14	7	73	6	b	4.8%	2.4%
Iowa	38	7	3	25	4	18	9	64	9	b	4.8%	2.4%
Kansas	38	7	3	25	4	18	9	64	9	d	3.1%	1.6%
Kentucky	49	11	3	28	7	22	6	58	14	d	3.2%	1.6%
Louisiana	50	10	2	28	9	21	5	56	18	d	3.2%	1.6%
Maine	26	4	3	18	1	16	11	71	3	a	5.6%	2.8%
Maryland	51	9	12	24	5	18	24	48	10	b	4.9%	2.5%
Massachusetts	26	4	3	18	1	16	11	71	3	a	5.6%	2.8%
Michigan	32	5	2	23	2	14	7	71	7	c	4.0%	2.0%
Minnesota	38	7	3	25	4	18	9	64	9	b	4.8%	2.4%
Missouri	38	7	3	25	4	18	9	64	9	d	3.1%	1.6%
Mississippi	49	11	3	28	7	22	6	58	14	d	3.2%	1.6%
Montana	31	4	3	23	1	12	10	75	3	c	3.9%	2.0%
Nebraska	38	7	3	25	4	18	9	64	9	d	3.1%	1.6%
Nevada	35	3	3	23	6	9	9	65	18	c	4.1%	2.1%
New Hampshire	26	4	3	18	1	16	11	71	3	b	4.8%	2.4%
New Jersey	39	5	3	29	2	14	8	74	4	a	5.6%	2.8%
New Mexico	35	3	3	23	6	9	9	65	18	d	3.3%	1.6%
New York	21	3	0	17	1	13	1	81	5	a	5.6%	2.8%
North Carolina	51	9	12	24	5	18	24	48	10	d	3.2%	1.6%
North Dakota	38	7	3	25	4	18	9	64	9	d	3.1%	1.6%
Ohio	32	5	2	23	2	14	7	71	7	c	4.0%	2.0%
Oklahoma	50	10	2	28	9	21	5	56	18	d	3.2%	1.6%
Oregon	42	11	5	26	1	25	11	61	2	a	5.5%	2.8%
Pennsylvania	39	5	3	29	2	14	8	74	4	c	3.9%	2.0%
Rhode Island	26	4	3	18	1	16	11	71	3	a	5.6%	2.8%
South Carolina	51	9	12	24	5	18	24	48	10	d	3.2%	1.6%
South Dakota	38	7	3	25	4	18	9	64	9	d	3.1%	1.6%
Tennessee	49	11	3	28	7	22	6	58	14	c	4.0%	2.0%
Texas	48	7	1	29	10	15	2	62	22	a	5.9%	3.0%
Utah	31	4	3	23	1	12	10	75	3	b	4.8%	2.4%
Vermont	26	4	3	18	1	16	11	71	3	a	5.6%	2.8%
Virginia	51	9	12	24	5	18	24	48	10	c	4.1%	2.0%
Washington	42	11	5	26	1	25	11	61	2	b	4.7%	2.3%
West Virginia	51	9	12	24	5	18	24	48	10	d	3.2%	1.6%
Wisconsin	32	5	2	23	2	14	7	71	7	a	5.7%	2.8%
Wyoming	31	4	3	23	1	12	10	75	3	c	3.9%	2.0%

5 yr savings potenti	6.20%
End-use multipliers	
Space heating	0.8
Cooling	1.2
Water heating	1
Other	0.9

Legend:
SH=Space Heating
WH= Water Heating
AC= Air Conditioning
OT=Other
EP=Economic Potential
hh=Household

CHANGE IN RESIDENTIAL GAS DEMAND

MMcf	2004	2005	2006	2007	2008
AL	-606	-614	-637	-615	-693
AZ	-870	-959	-1,051	-1,136	-1,297
AR	-1,177	-1,336	-1,495	-1,661	-1,911
CA	-12,595	-14,066	-15,343	-16,603	-18,781
CO	-2,451	-2,707	-3,168	-3,460	-4,110
CT	-1,127	-1,266	-1,405	-1,539	-1,756
DE	-221	-247	-272	-298	-339
DC	-189	-206	-223	-239	-272
FL	-213	-224	-231	-237	-266
GA	-1,709	-1,740	-1,775	-1,762	-1,991
ID	-384	-428	-477	-525	-614
IL	-10,954	-12,029	-13,082	-14,162	-16,165
IN	-3,004	-3,201	-3,386	-3,573	-4,056
IA	-1,635	-1,769	-1,907	-2,045	-2,327
KS	-1,014	-1,019	-1,019	-1,015	-1,139
KY	-1,135	-1,190	-1,246	-1,288	-1,463
LA	-803	-848	-893	-938	-1,072
ME	-26	-29	-32	-36	-41
MD	-1,731	-1,886	-2,036	-2,181	-2,490
MA	-2,995	-3,364	-3,733	-4,089	-4,664
MI	-8,340	-9,170	-9,995	-10,821	-12,362
MN	-3,002	-3,320	-3,637	-3,965	-4,559
MS	-1,065	-1,210	-1,354	-1,503	-1,723
MO	-1,564	-1,567	-1,559	-1,547	-1,719
MT	-357	-374	-396	-414	-474
NE	-602	-604	-604	-602	-673
NV	-624	-675	-720	-766	-878
NH	-184	-207	-230	-252	-287
NJ	-6,165	-6,987	-7,809	-8,653	-9,969
NM	-1,251	-1,454	-1,667	-1,868	-2,183
NY	-10,112	-11,432	-12,733	-13,907	-15,821
NC	-839	-864	-883	-890	-1,008
ND	-200	-209	-222	-232	-266
OH	-6,041	-6,400	-6,734	-7,067	-7,983
OK	-955	-959	-959	-956	-1,072
OR	-1,071	-1,199	-1,341	-1,465	-1,707
PA	-6,646	-7,424	-8,188	-8,961	-10,210
RI	-489	-550	-610	-668	-762
SC	-404	-415	-422	-424	-478
SD	-259	-280	-302	-324	-368
TN	-1,091	-1,144	-1,197	-1,237	-1,407
TX	-5,392	-6,014	-6,617	-7,247	-8,332
UT	-2,060	-2,414	-2,796	-3,212	-3,731
VT	-67	-75	-84	-92	-105
VA	-2,003	-2,269	-2,537	-2,807	-3,229
WA	-1,591	-1,778	-1,989	-2,174	-2,515
WV	-423	-425	-424	-422	-472
WI	-3,669	-4,136	-4,604	-5,090	-5,855
WY	-680	-781	-891	-1,017	-1,181
US	-111,986	-123,464	-134,915	-145,986	-166,782

CHANGE IN COMMERCIAL GAS DEMAND

MMcf	2004	2005	2006	2007	2008
AL	-259	-136	-40	142	193
AZ	-511	-384	-272	-110	-67
AR	-719	-661	-598	-519	-564
CA	-5,120	-4,533	-3,740	-2,709	-2,654
CO	-1,070	-828	-851	-600	-783
CT	-996	-900	-793	-618	-630
DE	-113	-98	-81	-61	-61
DC	-246	-185	-120	-33	-13
FL	-560	-383	-188	54	115
GA	-551	-263	4	383	517
ID	-207	-163	-122	-65	-62
IL	-4,177	-3,328	-2,428	-1,376	-1,215
IN	-1,138	-785	-409	24	169
IA	-769	-571	-375	-146	-89
KS	-513	-252	7	308	419
KY	-507	-327	-147	83	159
LA	-400	-244	-89	97	155
ME	-64	-58	-51	-40	-40
MD	-968	-727	-471	-130	-51
MA	-2,354	-2,127	-1,874	-1,461	-1,488
MI	-3,351	-2,685	-1,983	-1,134	-1,007
MN	-1,617	-1,301	-969	-577	-539
MS	-576	-533	-485	-424	-454
MO	-694	-365	-24	367	534
MT	-174	-102	-39	41	64
NE	-335	-157	11	211	280
NV	-330	-217	-92	58	119
NH	-175	-158	-139	-108	-110
NJ	-3,633	-3,210	-2,721	-2,054	-2,088
NM	-882	-874	-896	-832	-1,014
NY	-6,873	-6,183	-5,395	-3,807	-3,701
NC	-440	-212	21	328	459
ND	-143	-84	-32	34	53
OH	-2,526	-1,747	-914	47	371
OK	-443	-217	6	266	362
OR	-697	-580	-480	-309	-315
PA	-1,767	-1,533	-1,275	-949	-950
RI	-304	-274	-242	-188	-192
SC	-189	-89	8	139	189
SD	-162	-120	-79	-31	-19
TN	-707	-456	-206	116	222
TX	-4,027	-3,467	-2,869	-2,121	-2,248
UT	-1,203	-1,270	-1,377	-1,524	-1,829
VT	-71	-64	-56	-44	-45
VA	-1,460	-1,342	-1,210	-1,008	-1,089
WA	-872	-725	-597	-385	-366
WV	-282	-134	22	206	288
WI	-1,877	-1,659	-1,414	-1,118	-1,164
WY	-579	-564	-571	-603	-725
US	-57,635	-47,276	-36,632	-22,180	-20,906

CHANGE IN INDUSTRIAL GAS DEMAND

MMcf	2004	2005	2006	2007	2008
AL	1,117	-228	338	1,659	-629
AZ	50	91	559	505	189
AR	4,178	6,373	6,973	4,043	3,821
CA	-6,369	-17,369	-607	-2,538	-13,232
CO	-141	485	-790	1,012	-1,807
CT	32	-173	-72	-328	-490
DE	85	72	268	153	211
DC	0	0	0	0	0
FL	2,607	3,054	6,095	5,354	4,173
GA	3,668	4,296	7,412	7,533	5,233
ID	-148	64	635	368	29
IL	-282	-1,317	4,618	3,731	1,135
IN	-276	-1,291	4,527	3,657	1,054
IA	-627	-1,157	460	123	-671
KS	2,063	3,011	3,995	2,434	2,011
KY	656	-338	762	885	-275
LA	28,196	42,630	46,569	27,000	25,079
ME	2	-12	-5	-22	-33
MD	795	918	1,879	1,624	1,139
MA	100	-546	-228	-1,037	-1,546
MI	472	-264	5,762	5,284	3,051
MN	-671	-1,203	314	-37	-825
MS	1,202	-248	1,981	1,774	593
MO	-132	-362	729	624	244
MT	-6	154	322	230	146
NE	-79	-249	610	538	252
NV	-55	190	886	553	548
NH	5	-27	-11	-50	-75
NJ	-312	-858	710	-1,004	-358
NM	1,789	2,583	3,003	1,257	146
NY	-427	-1,176	759	-1,433	-409
NC	2,662	3,178	5,753	5,508	4,463
ND	-33	4	434	348	187
OH	536	-303	6,653	6,000	3,457
OK	3,528	5,150	6,832	4,162	3,440
OR	-527	1,273	-702	-2,167	-3,227
PA	772	497	2,847	1,266	2,305
RI	27	-148	-62	-280	-418
SC	2,418	2,886	5,166	5,002	4,025
SD	-39	-72	29	8	-42
TN	913	-471	1,061	1,233	-384
TX	41,717	64,970	67,436	23,936	13,864
UT	-55	188	802	586	314
VT	2	-11	-5	-21	-32
VA	1,592	1,840	3,739	3,254	2,332
WA	-733	1,797	-893	-3,001	-4,199
WV	1,077	1,285	2,442	2,228	1,863
WI	-491	-1,111	1,539	979	-394
WY	-174	288	1,531	1,007	457
US	91,689	121,031	205,051	115,302	57,993

CHANGE IN POWER GENERATION GAS DEMAND

MMcf	2004	2005	2006	2007	2008
AL	-7,292	-17,506	-922	-53,928	-47,251
AZ	4,919	6,250	22,140	5,152	9,948
AR	4,637	-2,365	5,346	1,844	2,409
CA	-41,332	-107,921	-134,976	-210,744	-255,315
CO	4,699	6,455	14,260	3,807	8,198
CT	-3,400	-5,531	-8,615	-12,781	-15,981
DE	-1,819	-4,473	-9,895	-18,711	-31,726
DC	0	0	0	0	0
FL	-3,472	-25,496	-34,201	-74,709	-91,475
GA	-10,901	-25,624	-1,660	-64,510	-55,548
ID	-1,498	-1,563	-2,073	-4,351	-4,187
IL	-1,901	-2,286	-7,000	-14,703	-15,298
IN	6,944	6,216	10,342	11,694	8,693
IA	-389	-843	-1,587	-2,664	-3,363
KS	1,441	-503	1,727	457	689
KY	-3,811	-8,635	-506	-20,974	-17,989
LA	9,625	-4,601	8,355	482	403
ME	0	0	0	0	0
MD	-1,464	-2,533	-1,304	-7,855	-7,872
MA	-11,774	-19,156	-29,838	-44,264	-55,350
MI	8,226	6,564	10,887	13,408	9,270
MN	-1,151	-2,234	-3,305	-4,589	-5,909
MS	22,909	-6,199	18,788	11,535	9,801
MO	-3,305	-6,079	-9,442	-13,371	-17,347
MT	-1,493	-2,571	-3,979	-5,607	-7,580
NE	-549	-1,023	-1,537	-2,186	-2,820
NV	-10,592	-24,133	-47,842	-63,367	-79,972
NH	-206	-335	-521	-773	-967
NJ	-3,738	-1,231	-12,733	-17,644	-30,892
NM	-374	853	1,150	-1,574	-13
NY	-1,870	-892	-5,176	-38,014	-44,280
NC	-4,057	-10,232	-714	-26,055	-22,125
ND	-6	-10	-16	-22	-30
OH	12,307	10,491	14,584	16,616	12,754
OK	7,911	-2,763	9,485	2,508	3,784
OR	-11,472	-8,191	-14,703	-25,022	-24,270
PA	-2,931	-3,817	-9,957	-18,959	-32,360
RI	-4,182	-6,804	-10,598	-15,722	-19,659
SC	-3,225	-8,916	-182	-22,116	-18,809
SD	-117	-254	-478	-803	-1,014
TN	-3,317	-7,517	-441	-18,258	-15,660
TX	-80,248	-15,527	-124,404	-193,097	-232,148
UT	-3,548	-1,801	-4,740	-5,341	-6,266
VT	-14	-24	-37	-54	-68
VA	-909	-3,043	511	-8,578	-7,619
WA	-6,032	-2,641	-7,369	-10,160	-10,361
WV	2,245	2,468	3,916	4,281	3,392
WI	-339	-348	-864	-1,892	-1,908
WY	-355	-409	-549	-837	-1,048
US	-147,216	-306,732	-370,670	-952,447	-1,115,164

CHANGE IN RESIDENTIAL GAS PRICE
Real$/Mcf

	2004	2005	2006	2007	2008
AL	-0.68	-1.21	-1.13	-0.87	-0.75
AZ	-0.72	-1.20	-1.12	-0.84	-0.78
AR	-0.67	-1.21	-1.12	-0.85	-0.73
CA	-0.75	-1.19	-1.11	-0.84	-0.86
CO	-0.70	-1.09	-0.91	-0.49	-0.58
CT	-0.62	-1.16	-1.11	-0.88	-0.77
DE	-0.66	-1.22	-1.15	-0.88	-0.77
DC	-0.67	-1.21	-1.14	-0.88	-0.77
FL	-0.71	-1.19	-1.11	-0.88	-0.77
GA	-0.65	-1.19	-1.11	-0.81	-0.68
ID	-0.69	-1.15	-0.98	-0.64	-0.73
IL	-0.65	-1.18	-1.10	-0.82	-0.72
IN	-0.66	-1.21	-1.14	-0.87	-0.76
IA	-0.65	-1.16	-1.07	-0.78	-0.70
KS	-0.68	-1.19	-1.09	-0.81	-0.73
KY	-0.64	-1.21	-1.14	-0.85	-0.73
LA	-0.69	-1.22	-1.13	-0.86	-0.75
ME	-0.69	-1.24	-1.19	-0.95	-0.85
MD	-0.67	-1.21	-1.14	-0.87	-0.76
MA	-0.69	-1.24	-1.19	-0.95	-0.85
MI	-0.67	-1.20	-1.12	-0.84	-0.73
MN	-0.64	-1.16	-1.08	-0.79	-0.66
MS	-0.66	-1.19	-1.11	-0.84	-0.73
MO	-0.66	-1.19	-1.10	-0.82	-0.75
MT	-0.69	-1.16	-1.07	-0.79	-0.73
NE	-0.66	-1.14	-1.04	-0.74	-0.75
NV	-0.70	-1.14	-1.01	-0.71	-0.84
NH	-0.69	-1.24	-1.18	-0.95	-0.84
NJ	-0.65	-1.21	-1.15	-0.88	-0.77
NM	-0.71	-1.21	-1.12	-0.85	-0.82
NY	-0.67	-1.21	-1.15	-0.89	-0.78
NC	-0.64	-1.21	-1.15	-0.89	-0.76
ND	-0.69	-1.16	-1.08	-0.80	-0.72
OH	-0.65	-1.20	-1.13	-0.86	-0.75
OK	-0.68	-1.19	-1.09	-0.81	-0.73
OR	-0.67	-1.15	-1.07	-0.81	-0.68
PA	-0.65	-1.21	-1.14	-0.87	-0.76
RI	-0.69	-1.23	-1.18	-0.94	-0.84
SC	-0.63	-1.21	-1.15	-0.89	-0.76
SD	-0.65	-1.17	-1.08	-0.78	-0.70
TN	-0.65	-1.21	-1.14	-0.87	-0.75
TX	-0.68	-1.18	-1.10	-0.81	-0.70
UT	-0.67	-1.07	-0.87	-0.45	-0.55
VT	-0.70	-1.25	-1.20	-0.96	-0.86
VA	-0.66	-1.20	-1.13	-0.86	-0.75
WA	-0.67	-1.16	-1.08	-0.83	-0.69
WV	-0.66	-1.22	-1.15	-0.88	-0.76
WI	-0.65	-1.18	-1.10	-0.82	-0.70
WY	-0.68	-1.07	-0.86	-0.45	-0.54
US	-0.67	-1.19	-1.11	-0.83	-0.74

CHANGE IN COMMERCIAL GAS PRICE
Real$/Mcf

	2004	2005	2006	2007	2008
AL	-0.74	-1.21	-1.12	-0.86	-0.76
AZ	-0.81	-1.20	-1.11	-0.83	-0.80
AR	-0.71	-1.21	-1.11	-0.84	-0.74
CA	-0.85	-1.19	-1.09	-0.84	-0.88
CO	-0.72	-1.09	-0.90	-0.50	-0.58
CT	-0.71	-1.20	-1.13	-0.90	-0.81
DE	-0.69	-1.22	-1.15	-0.88	-0.77
DC	-0.73	-1.21	-1.13	-0.87	-0.77
FL	-0.81	-1.19	-1.10	-0.86	-0.78
GA	-0.71	-1.19	-1.10	-0.81	-0.71
ID	-0.72	-1.14	-0.97	-0.64	-0.73
IL	-0.68	-1.19	-1.11	-0.83	-0.73
IN	-0.67	-1.21	-1.14	-0.86	-0.76
IA	-0.67	-1.17	-1.08	-0.78	-0.70
KS	-0.76	-1.19	-1.07	-0.80	-0.74
KY	-0.68	-1.21	-1.13	-0.85	-0.74
LA	-0.74	-1.21	-1.11	-0.85	-0.75
ME	-0.75	-1.24	-1.17	-0.93	-0.85
MD	-0.73	-1.21	-1.13	-0.86	-0.77
MA	-0.75	-1.24	-1.17	-0.93	-0.84
MI	-0.68	-1.20	-1.12	-0.84	-0.73
MN	-0.67	-1.17	-1.09	-0.80	-0.68
MS	-0.73	-1.20	-1.10	-0.84	-0.74
MO	-0.69	-1.19	-1.09	-0.81	-0.75
MT	-0.70	-1.16	-1.07	-0.79	-0.73
NE	-0.80	-1.10	-0.96	-0.73	-0.72
NV	-0.78	-1.12	-0.98	-0.71	-0.84
NH	-0.75	-1.24	-1.17	-0.94	-0.85
NJ	-0.71	-1.22	-1.14	-0.88	-0.79
NM	-0.81	-1.21	-1.11	-0.85	-0.84
NY	-0.77	-1.22	-1.14	-0.88	-0.81
NC	-0.73	-1.21	-1.13	-0.87	-0.77
ND	-0.70	-1.16	-1.08	-0.80	-0.72
OH	-0.66	-1.20	-1.13	-0.86	-0.75
OK	-0.76	-1.19	-1.07	-0.80	-0.74
OR	-0.72	-1.15	-1.08	-0.82	-0.71
PA	-0.68	-1.21	-1.14	-0.87	-0.77
RI	-0.74	-1.24	-1.17	-0.93	-0.84
SC	-0.76	-1.21	-1.11	-0.86	-0.77
SD	-0.67	-1.17	-1.08	-0.78	-0.71
TN	-0.69	-1.22	-1.13	-0.86	-0.76
TX	-0.79	-1.19	-1.09	-0.81	-0.73
UT	-0.69	-1.07	-0.88	-0.46	-0.56
VT	-0.76	-1.25	-1.18	-0.94	-0.85
VA	-0.72	-1.20	-1.12	-0.85	-0.76
WA	-0.72	-1.16	-1.09	-0.84	-0.72
WV	-0.71	-1.22	-1.14	-0.87	-0.77
WI	-0.66	-1.18	-1.10	-0.82	-0.71
WY	-0.69	-1.07	-0.87	-0.46	-0.55
US	-0.72	-1.18	-1.09	-0.83	-0.75

CHANGE IN INDUSTRIAL GAS PRICE
Real$/Mcf

	2004	2005	2006	2007	2008
AL	-0.87	-1.20	-1.08	-0.83	-0.76
AZ	-0.90	-1.20	-1.09	-0.83	-0.80
AR	-0.85	-1.20	-1.06	-0.82	-0.76
CA	-0.91	-1.23	-1.13	-0.87	-0.92
CO	-0.86	-1.05	-0.81	-0.51	-0.55
CT	-0.91	-1.24	-1.12	-0.90	-0.86
DE	-0.86	-1.22	-1.10	-0.86	-0.80
DC	0.00	0.00	0.00	0.00	0.00
FL	-0.88	-1.20	-1.16	-0.86	-0.80
GA	-0.90	-1.20	-1.10	-0.84	-0.79
ID	-0.86	-1.11	-0.95	-0.71	-0.75
IL	-0.83	-1.18	-1.06	-0.81	-0.75
IN	-0.85	-1.21	-1.10	-0.85	-0.78
IA	-0.85	-1.16	-1.04	-0.78	-0.74
KS	-0.88	-1.18	-1.05	-0.80	-0.75
KY	-0.86	-1.21	-1.09	-0.83	-0.77
LA	-0.85	-1.20	-1.06	-0.82	-0.76
ME	-0.91	-1.25	-1.13	-0.91	-0.86
MD	-0.90	-1.21	-1.12	-0.85	-0.80
MA	-0.91	-1.25	-1.13	-0.91	-0.86
MI	-0.83	-1.19	-1.08	-0.82	-0.76
MN	-0.86	-1.18	-1.07	-0.82	-0.75
MS	-0.86	-1.20	-1.08	-0.83	-0.76
MO	-0.86	-1.17	-1.04	-0.79	-0.76
MT	-0.86	-1.16	-1.05	-0.81	-0.75
NE	-0.86	-1.14	-1.01	-0.77	-0.74
NV	-0.86	-1.11	-0.96	-0.74	-0.89
NH	-0.92	-1.25	-1.13	-0.91	-0.87
NJ	-0.87	-1.23	-1.11	-0.88	-0.82
NM	-0.90	-1.21	-1.09	-0.84	-0.86
NY	-0.86	-1.22	-1.11	-0.88	-0.84
NC	-0.90	-1.21	-1.11	-0.85	-0.80
ND	-0.86	-1.17	-1.06	-0.82	-0.75
OH	-0.82	-1.20	-1.09	-0.84	-0.77
OK	-0.88	-1.18	-1.05	-0.80	-0.75
OR	-0.87	-1.18	-1.08	-0.83	-0.78
PA	-0.85	-1.21	-1.10	-0.86	-0.79
RI	-0.90	-1.23	-1.12	-0.89	-0.85
SC	-0.90	-1.21	-1.11	-0.85	-0.80
SD	-0.86	-1.18	-1.06	-0.81	-0.76
TN	-0.87	-1.21	-1.09	-0.84	-0.77
TX	-0.89	-1.19	-1.06	-0.82	-0.75
UT	-0.86	-1.05	-0.83	-0.51	-0.59
VT	-0.94	-1.28	-1.15	-0.94	-0.90
VA	-0.89	-1.20	-1.11	-0.85	-0.80
WA	-0.87	-1.17	-1.07	-0.84	-0.78
WV	-0.89	-1.21	-1.11	-0.85	-0.79
WI	-0.85	-1.20	-1.10	-0.84	-0.77
WY	-0.85	-1.04	-0.81	-0.50	-0.56
US	-0.87	-1.19	-1.07	-0.81	-0.77

CHANGE IN POWER GENERATION GAS PRICE
Real$/Mcf

	2004	2005	2006	2007	2008
AL	-0.87	-1.25	-1.23	-0.84	-0.85
AZ	-0.99	-1.24	-1.03	-0.83	-0.77
AR	-1.00	-1.21	-1.03	-0.83	-0.76
CA	-0.95	-1.22	-1.11	-0.86	-0.89
CO	-0.99	-1.01	-0.77	-0.55	-0.55
CT	-0.86	-1.21	-1.04	-0.85	-0.81
DE	-1.03	-1.30	-1.32	-0.91	-1.01
DC	0.00	0.00	0.00	0.00	0.00
FL	-0.92	-1.20	-1.12	-0.85	-0.82
GA	-0.88	-1.26	-1.24	-0.85	-0.85
ID	-0.80	-1.08	-1.08	-0.70	-0.87
IL	-1.10	-1.19	-1.05	-0.81	-0.89
IN	-1.02	-1.34	-0.96	-0.84	-0.70
IA	1.43	-7.80	-6.16	-5.87	-5.21
KS	-1.03	-1.18	-1.02	-0.83	-0.76
KY	-0.85	-1.22	-1.27	-0.81	-0.87
LA	-0.98	-1.19	-1.03	-0.84	-0.76
ME	-0.89	-1.26	-1.08	-0.94	-0.86
MD	-0.98	-1.23	-1.17	-0.86	-0.85
MA	-0.89	-1.25	-1.08	-0.93	-0.85
MI	-0.99	-1.29	-0.93	-0.82	-0.69
MN	0.30	-6.96	-5.77	-5.16	-4.59
MS	-1.05	-1.21	-1.04	-0.85	-0.75
MO	0.36	-6.24	-5.02	-4.50	-4.06
MT	-0.86	-1.13	-1.07	-0.71	-0.75
NE	0.06	-5.82	-4.78	-4.30	-3.90
NV	-0.95	-1.13	-0.94	-0.82	-0.96
NH	-0.89	-1.26	-1.09	-0.95	-0.86
NJ	-1.10	-1.28	-1.05	-0.90	-0.89
NM	-0.99	-1.21	-1.08	-0.85	-0.91
NY	-1.03	-1.28	-1.03	-0.89	-0.83
NC	-0.89	-1.29	-1.26	-0.87	-0.87
ND	-0.85	-1.11	-1.05	-0.68	-0.72
OH	-0.96	-1.28	-0.94	-0.83	-0.69
OK	-1.03	-1.18	-1.00	-0.82	-0.76
OR	-0.72	-0.95	-1.05	-0.56	-0.71
PA	-1.02	-1.28	-1.27	-0.91	-0.98
RI	-0.88	-1.25	-1.08	-0.93	-0.85
SC	-0.91	-1.28	-1.26	-0.87	-0.87
SD	0.67	-7.14	-5.68	-5.40	-4.86
TN	-0.88	-1.29	-1.24	-0.86	-0.85
TX	-0.97	-1.20	-1.01	-0.82	-0.77
UT	-0.76	-0.98	-0.75	-0.41	-0.53
VT	-0.91	-1.28	-1.10	-0.97	-0.89
VA	-1.00	-1.23	-1.25	-0.85	-0.91
WA	-0.73	-1.02	-1.06	-0.60	-0.72
WV	-0.94	-1.28	-0.95	-0.84	-0.70
WI	-1.12	-1.18	-1.05	-0.82	-0.88
WY	-0.77	-0.92	-0.70	-0.37	-0.50
US	-0.95	-1.22	-1.11	-0.86	-0.87

CHANGE IN RESIDENTIAL GAS CONSUMER COSTS
Millions of $

	2004	2005	2006	2007	2008
AL	-38	-64	-60	-48	-43
AZ	-35	-55	-52	-43	-42
AR	-39	-64	-60	-50	-47
CA	-500	-745	-696	-571	-587
CO	-106	-159	-138	-87	-104
CT	-39	-64	-62	-54	-51
DE	-8	-13	-13	-10	-10
DC	-12	-21	-20	-16	-15
FL	-13	-20	-19	-15	-14
GA	-107	-185	-174	-132	-117
ID	-18	-28	-25	-18	-21
IL	-406	-672	-633	-504	-469
IN	-137	-232	-221	-176	-162
IA	-62	-103	-96	-74	-70
KS	-57	-93	-85	-65	-61
KY	-52	-92	-87	-69	-63
LA	-40	-67	-62	-50	-46
ME	-1	-2	-2	-1	-1
MD	-74	-120	-115	-95	-89
MA	-115	-184	-179	-155	-149
MI	-296	-506	-475	-372	-333
MN	-112	-188	-178	-140	-125
MS	-27	-43	-41	-35	-34
MO	-91	-152	-140	-107	-102
MT	-17	-28	-26	-20	-19
NE	-33	-54	-49	-36	-37
NV	-29	-46	-42	-32	-38
NH	-7	-12	-11	-10	-9
NJ	-192	-333	-321	-264	-245
NM	-34	-54	-51	-42	-43
NY	-382	-621	-600	-506	-477
NC	-52	-91	-87	-71	-64
ND	-10	-15	-14	-11	-11
OH	-278	-474	-447	-355	-323
OK	-54	-88	-81	-62	-58
OR	-40	-64	-61	-51	-47
PA	-239	-395	-378	-314	-295
RI	-18	-30	-29	-25	-24
SC	-22	-40	-38	-31	-28
SD	-10	-17	-16	-12	-12
TN	-56	-97	-92	-74	-67
TX	-177	-283	-267	-215	-199
UT	-53	-78	-67	-46	-53
VT	-3	-4	-4	-4	-3
VA	-73	-119	-115	-97	-92
WA	-69	-112	-107	-89	-80
WV	-22	-38	-36	-28	-25
WI	-121	-201	-191	-153	-142
WY	-14	-19	-17	-12	-14
US	-4,391	-7,188	-6,779	-5,446	-5,159

CHANGE IN COMMERCIAL GAS CONSUMER COSTS
Millions of $

	2004	2005	2006	2007	2008
AL	-20	-30	-27	-20	-17
AZ	-29	-41	-36	-27	-26
AR	-28	-44	-40	-31	-28
CA	-241	-328	-294	-230	-243
CO	-50	-70	-58	-33	-39
CT	-43	-69	-65	-53	-50
DE	-4	-7	-7	-5	-5
DC	-16	-24	-22	-17	-15
FL	-43	-60	-53	-41	-37
GA	-43	-67	-59	-42	-36
ID	-11	-17	-14	-10	-11
IL	-165	-260	-235	-175	-158
IN	-69	-115	-106	-79	-70
IA	-34	-55	-49	-36	-33
KS	-32	-45	-39	-27	-25
KY	-29	-48	-43	-32	-28
LA	-21	-31	-28	-20	-18
ME	-3	-4	-4	-3	-3
MD	-50	-77	-70	-54	-50
MA	-76	-113	-106	-88	-85
MI	-141	-236	-218	-165	-146
MN	-74	-121	-110	-82	-71
MS	-19	-28	-26	-20	-19
MO	-48	-75	-66	-47	-43
MT	-11	-16	-15	-11	-10
NE	-23	-30	-24	-17	-17
NV	-23	-32	-28	-20	-24
NH	-8	-13	-12	-10	-9
NJ	-142	-230	-215	-171	-159
NM	-27	-38	-35	-28	-29
NY	-344	-517	-478	-382	-359
NC	-34	-53	-48	-36	-32
ND	-9	-13	-12	-9	-8
OH	-135	-229	-210	-158	-139
OK	-34	-50	-43	-30	-28
OR	-26	-39	-36	-28	-25
PA	-115	-190	-177	-137	-123
RI	-13	-20	-19	-16	-15
SC	-17	-26	-23	-17	-15
SD	-8	-12	-11	-8	-7
TN	-41	-66	-60	-45	-39
TX	-168	-243	-218	-167	-154
UT	-31	-45	-38	-25	-30
VT	-3	-4	-4	-3	-3
VA	-60	-93	-87	-69	-64
WA	-44	-66	-62	-48	-42
WV	-19	-32	-29	-22	-20
WI	-67	-110	-102	-77	-70
WY	-12	-17	-15	-10	-12
US	-2,704	-4,152	-3,775	-2,876	-2,690

CHANGE IN INDUSTRIAL GAS CONSUMER COSTS
Millions of $

	2004	2005	2006	2007	2008
AL	-148	-215	-192	-142	-143
AZ	-13	-17	-13	-10	-12
AR	-73	-89	-88	-74	-73
CA	-650	-942	-792	-626	-705
CO	-58	-67	-56	-30	-43
CT	-22	-32	-29	-25	-25
DE	-18	-26	-23	-18	-17
DC	0	0	0	0	0
FL	-56	-75	-63	-41	-49
GA	-102	-132	-118	-79	-91
ID	-25	-30	-23	-18	-21
IL	-211	-305	-246	-186	-191
IN	-217	-317	-252	-193	-198
IA	-71	-99	-80	-62	-64
KS	-73	-91	-84	-66	-66
KY	-71	-107	-92	-70	-71
LA	-560	-701	-691	-563	-552
ME	-11	-16	-14	-12	-11
MD	-24	-32	-24	-17	-20
MA	-46	-69	-63	-58	-59
MI	-166	-240	-201	-150	-151
MN	-76	-107	-90	-71	-69
MS	-75	-114	-95	-72	-74
MO	-50	-69	-55	-42	-43
MT	-8	-9	-8	-6	-6
NE	-29	-40	-31	-24	-25
NV	-6	-6	-2	-2	-4
NH	-7	-9	-9	-7	-7
NJ	-40	-60	-49	-47	-42
NM	-6	-1	-5	-10	-19
NY	-34	-52	-40	-45	-38
NC	-60	-78	-65	-42	-49
ND	-18	-25	-21	-16	-16
OH	-228	-341	-277	-209	-210
OK	-95	-115	-100	-83	-86
OR	-66	-74	-82	-74	-74
PA	-146	-213	-184	-149	-135
RI	-1	-3	-3	-4	-4
SC	-60	-77	-68	-46	-51
SD	-3	-4	-3	-2	-3
TN	-89	-136	-116	-88	-91
TX	-1,522	-1,857	-1,803	-1,485	-1,443
UT	-30	-35	-26	-15	-20
VT	-3	-4	-4	-3	-3
VA	-48	-64	-55	-39	-44
WA	-71	-78	-89	-81	-79
WV	-33	-43	-39	-27	-29
WI	-113	-164	-134	-105	-106
WY	-28	-30	-17	-10	-16
US	-5,562	-7,407	-6,611	-5,227	-5,344

CHANGE IN POWER GENERATION GAS CONSUMER COSTS
Millions of $

	2004	2005	2006	2007	2008
AL	-133	-246	-190	-422	-385
AZ	-162	-191	-126	-143	-127
AR	-27	-73	-39	-36	-38
CA	-1,090	-1,898	-1,820	-2,186	-2,312
CO	-55	-40	-23	-31	-24
CT	-67	-105	-103	-124	-129
DE	-40	-67	-96	-119	-170
DC	0	0	0	0	0
FL	-648	-963	-1,018	-1,001	-1,026
GA	-130	-229	-195	-288	-263
ID	-21	-27	-31	-37	-38
IL	-89	-100	-122	-140	-129
IN	11	9	3	28	3
IA	-2	-13	-15	-21	-23
KS	-18	-29	-21	-18	-18
KY	-35	-69	-47	-106	-94
LA	-124	-224	-162	-145	-147
ME	-71	-101	-87	-75	-69
MD	-37	-54	-46	-85	-82
MA	-176	-281	-251	-296	-280
MI	-99	-131	-112	-73	-86
MN	-8	-36	-38	-42	-45
MS	-48	-174	-111	-74	-102
MO	-23	-51	-63	-80	-94
MT	-28	-48	-57	-62	-75
NE	-3	-18	-18	-19	-21
NV	-231	-395	-502	-632	-730
NH	-2	-4	-3	-4	-3
NJ	-183	-199	-204	-207	-234
NM	-38	-39	-38	-40	-37
NY	-431	-497	-473	-554	-545
NC	-48	-94	-72	-141	-126
ND	0	0	0	0	0
OH	70	67	59	100	53
OK	-84	-152	-95	-87	-90
OR	-144	-160	-196	-179	-179
PA	-67	-82	-144	-210	-326
RI	-85	-133	-126	-149	-149
SC	-38	-74	-67	-90	-82
SD	1	-17	-15	-16	-15
TN	-37	-72	-43	-117	-103
TX	-1,550	-1,507	-1,706	-1,846	-1,805
UT	-27	-17	-26	-28	-29
VT	-1	-2	-1	-1	-1
VA	-25	-42	-34	-58	-54
WA	-100	-100	-126	-108	-110
WV	10	12	11	20	10
WI	-28	-30	-31	-32	-31
WY	-5	-6	-5	-5	-6
US	-6,170	-8,702	-8,621	-9,973	-10,366

Appendix C-Changes in Natural Gas Consumption, Price and Expenditures for National EE/RE Scenario

The result for the base-case and the four policy scenarios are available in Microsoft Excel format on the ACEEE web site at: http://aceee.org/energy/efnatgas-study.htm.