Impacts of Energy Efficiency And Renewable Energy On Natural Gas Markets: Updated and Expanded Analysis

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Glossary of Terms

Energy and Power Units

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

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

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

Therm = 100,000 Btu

Decatherm = 10 Therms = 1 MMBtu

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

Kilowatt (kW) = 1,000 Watts

Megawatt (MW) = 1 million Watts

Kilowatt-hour (kWh) = 3,412 Btu

Megawatt-hour (MWh) = 1,000 kWh

Natural Gas Units

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

Thousand cubic feet (Mcf) = ~ one million Btu

Million cubic feet (MMcf) = ~ one billion Btu

Billion cubic feet (Bcf) = ~ one trillion Btu

Trillion cubic foot (Tcf) = ~ one Quad

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

Market Terms

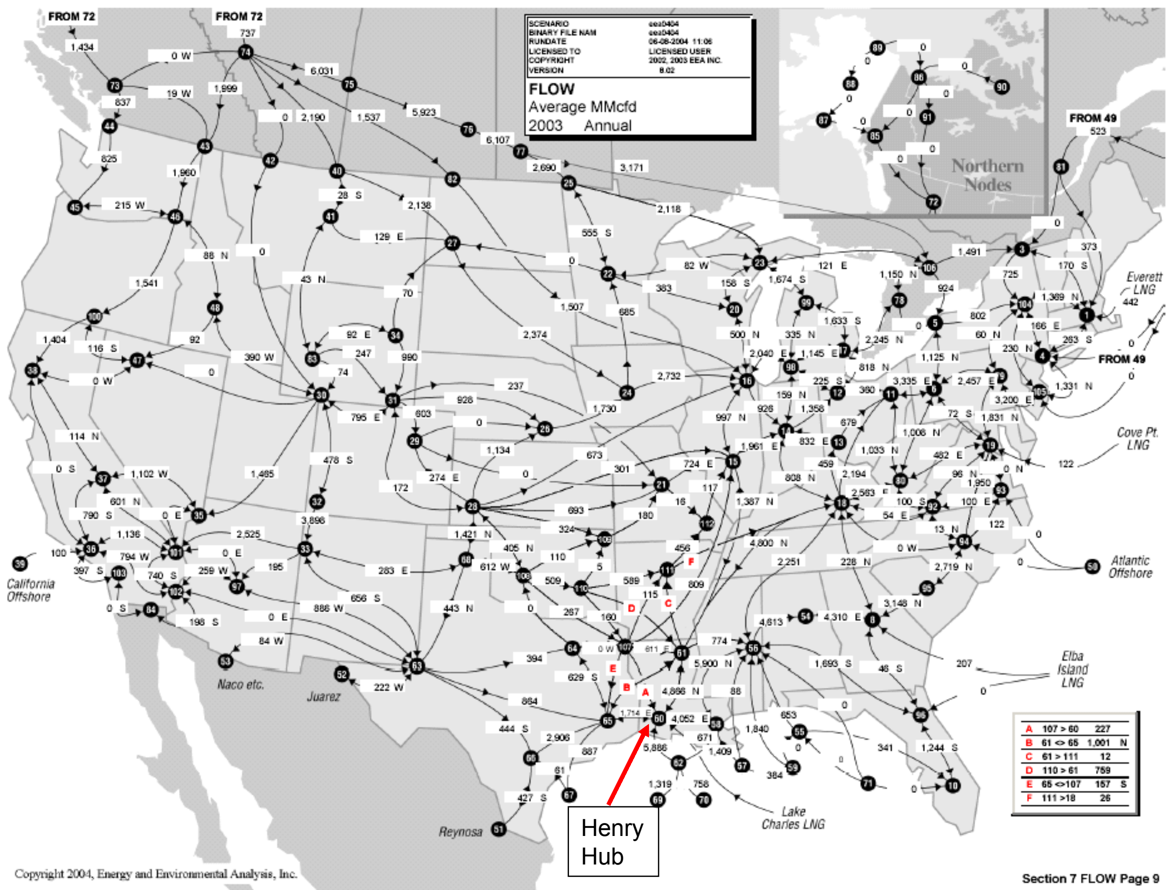
Distributed generation: electric power generation located at or near the point of use.

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

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

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

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



Executive Summary

Background

The North American natural gas markets in recent years have been unexpectedly tight, which has led to record prices and volatile market conditions, causing significant harm to gas-intensive industries and families dependent on gas heat. ACEEE responded to this challenge beginning in 2003 with a series of analyses showing that increasing our commitment to energy efficiency would reduce wholesale gas prices and improve our economic health. Our December 2003 report showed that, if policy initiatives to increase investment in energy efficiency and renewable energy were implemented, gas prices would fall by about 20% within five years, saving over $100 billion. Our findings were in-line with the recommendations of the National Petroleum Council's major report on the future of natural gas in the United States and the Secretary of Energy's call for increased focus on energy efficiency. However, no significant policy action has been taken to date.

During the intervening eighteen months, markets have remained tight, though a relatively warm winter in 2003–04 and an unusually cool summer in 2004 avoided the more serious market disruptions that many market watchers feared. Concerns increased in the fall of 2004 as hurricanes disrupted the production of gas in the Gulf of Mexico, global oil prices soared (particularly for heating oil), and forecasts for a colder than normal winter sent natural gas prices to record levels. Since the fall, natural gas prices have declined from their record levels as a result of an unseasonably warm winter and resulting declines in heating oil prices, in spite of continued pressure from high oil prices. In the view of most analysts, natural gas markets remain fundamentally tight, as reflected in rising long-term price forecasts.

Scenarios and Findings

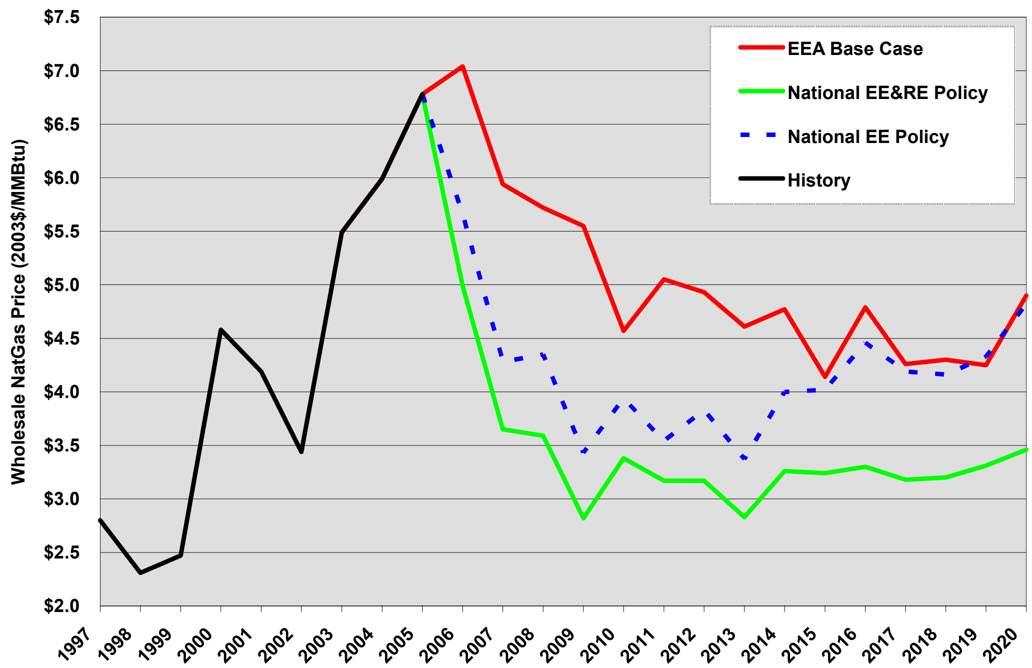
For the analysis for this report, we ran three scenarios to explore both the national and regional impacts of expanded energy efficiency and renewable energy impacts. Table ES-1 lists the measures considered in the three scenarios, and the results are all relative to the May 2004 Energy and Environmental Analysis, Inc. (EEA) reference price and consumption forecast.

Table ES-1. Measures Included in Each Policy Scenario Considered in this Analysis

Scenario	Energy Efficiency	Renewable Energy
National EE&RE	Lower 48	Lower 48
National EE	Lower 48	None
Midwest EE	IL, IN, IA, MI, MN, MO, OH, WS	None

Compared with our 2003 study, this updated analysis reflects a further tightening in natural gas markets. As a result, the price response to changes in natural gas demand from energy efficiency and renewable energy investments is greater than in the previous analysis (see Figure ES-1). With this report, we also extended the analysis period from five years in the 2003 analysis to 15 years. As was seen in the 2003 study, a significant price response is seen in the first five years of the analysis period as a result of current, very tight natural gas markets. In the initial five years, energy efficiency produces most of the benefits. However, as we move into the second five years, the importance of renewable energy increases, with renewables becoming the dominant incremental effect in the final years of the study.

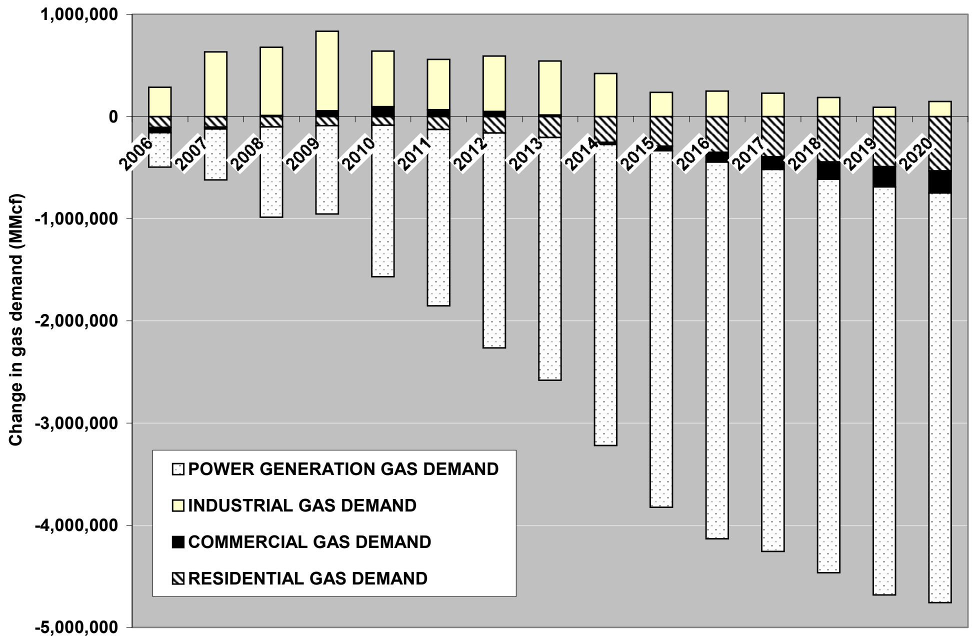
Figure ES-1. Change in the Wholesale Natural Gas Price as a Result of Expanded Energy Efficiency and Renewable Energy Investments



The price effects from changing consumption with energy efficiency and renewable energy diminish as new resources are projected to become available (e.g., Alaska gas and/or additional LNG) and markets begin to rebalance. The reductions in demand, however, continue to accumulate for the entire period (see Figure ES-2), producing significant cost savings to consumers in spite of the reduced price response. It is important to note that while efficiency investments are made in the industrial sector, total industrial gas consumption increases as a result of increases in industrial activity made possible by the lower gas prices—the avoiding of natural gas "demand destruction" that translates into plant layoffs and closures.

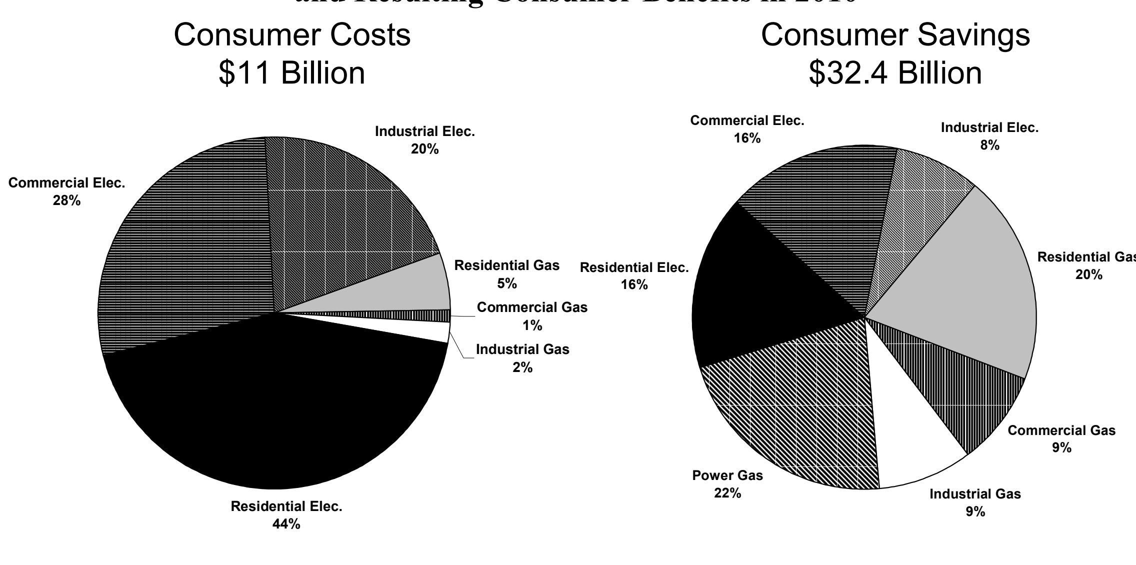
Projecting which new supply resources become available is perhaps the most important consideration in the market outlook after 2010, so we have decreasing confidence in the model results as we progress further into the study period. In particular, choices such as whether to build the Alaska natural gas pipeline are likely to have a defining impact on the North American natural gas market in the post-2015 period. These choices all have substantial lead times and are unlikely to be made on strictly economic grounds and so create significant uncertainty in the price forecast.

Figure ES-2. Change in Natural Gas Consumption for National EE&RE Scenario by End-Use Sector



Consumers experience savings from reduced energy consumption and falling natural gas prices as markets are rebalanced. The energy efficiency measures proposed in this analysis are cost-effective based on reduced consumption alone, without the added benefits of reduced prices. It is important to note that while the direct benefits of energy efficiency investment flow to participating customers, the benefits of falling prices accrue to all customers. The national energy efficiency scenario will cost consumers $11 billion annually in 2010 and result in over $32 billion in consumer savings (see Figure ES-3).

Figure ES-3. Total Investment Costs for Energy Efficiency Investments and Resulting Consumer Benefits in 2010



Policy Recommendations and Next Steps

This study demonstrates more clearly than ever the price impacts and other economic benefits impacts that would flow from a rigorous new policy commitment to energy efficiency and renewables. Policy makers at the state and federal level could take a number of concrete actions to realize these benefits. No single policy strategy will achieve the results outlined here. Rather, a portfolio of policies is needed to achieve quick and sustained savings from energy efficiency and renewable energy resources. These policy strategies include:

- Energy efficiency performance targets for utilities
- Expanded federal funding for energy efficiency and renewable energy deployment programs at DOE and EPA, including ENERGY STAR®
- Accelerated appliance efficiency standards at both the federal and state levels
- Insuring more efficient new buildings through energy codes
- Better policies for rapid deployment of clean and efficient distributed generation technologies
- Renewable portfolio standards
- Public awareness campaigns by state and national leaders, coordinated with increased funding for implementation programs

Public and private leaders need to "step up to the podium" and issue a call to action for the policies and programs needed to realize the benefits from increased use of energy efficiency and renewable energy. With Congressional action nearing on energy policy, our leaders must act now if we are to blunt the effects of high gas prices in the next few years. The policies recommended in this report are relatively low cost and practical, but they require our state and federal governments to commit resources.

Acknowledgments

This work was made possible by a grant from the Energy Foundation. The authors express their appreciation to the 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, Harvey Vidas, and Frank Brock of EEA for their help with planning, executing, and interpreting this analysis. In addition, the authors express their appreciation to the numerous reviewers who provided comments and suggestions for undertaking this report and refining the final draft. 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.

Introduction

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

Changes in Natural Gas Markets

When we began our research in the summer of 2003, natural gas markets in the United States were experiencing a period of unprecedented price volatility resulting from a fundamental imbalance between supply and demand. We discussed these market conditions in detail in a white paper (Elliott et al. 2003a) and a December report (Elliott et al. 2003b). During the intervening eighteen months, markets remained tight, though a relatively warm winter in 2003–04 and an unusually cool summer in 2004 avoided the more serious market disruptions that many market watchers feared. Concerns increased in the fall of 2004 as hurricanes disrupted production of gas in the Gulf of Mexico, global oil prices soared particularly for heating oil, and forecasts for a colder than normal winter sent natural gas prices to record levels. At that time, ACEEE prepared a market update (Elliott 2004) that looked at prevailing market supply and demand conditions. Since that market update, natural gas prices declined from their record levels (see Figure 1) as a result of an unseasonably warm winter and resulting declines in heating oil prices. In the view of most analysts, natural gas markets remain fundamentally tight, as reflected in rising long-term price forecasts (see Figure 2). Most analysts caution that recent mild weather conditions have concealed tight supply market fundamentals and that extreme or even normal weather could result in significant market disruptions.

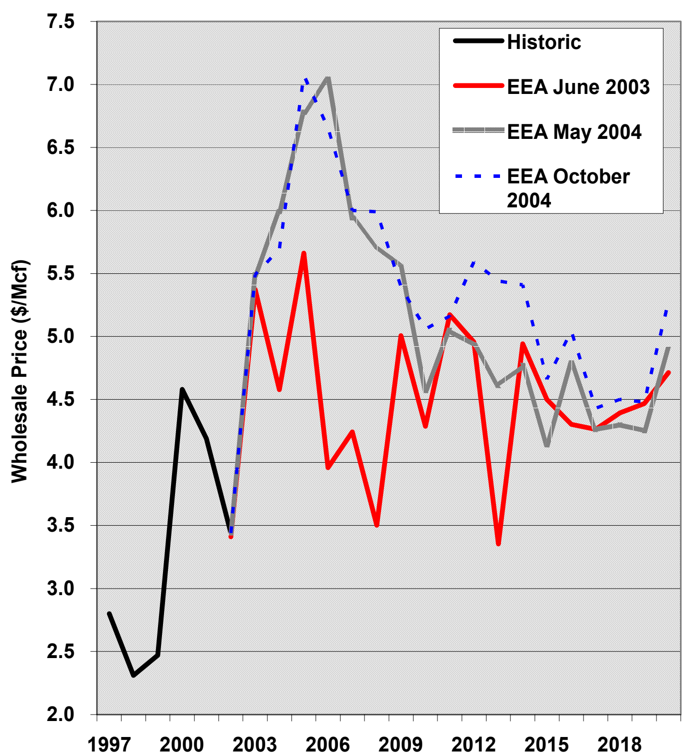
Figure 1. Daily Spot NYMEX Natural Gas Prices

Source: NYMEX 2005

Changes in the National Energy Policy Environment

While policy makers have acknowledged the severity of problems in natural gas markets and have largely agreed with ACEEE's analysis (Elliott et al. 2003b), as well as those by the National Petroleum Council (2003) and others, few if any policy measures have been taken. In part this reflects the energy policy stalemate that has stymied federal energy legislation for the past four years. It may also reflect recent moderation in natural gas price trends resulting from the aforementioned mild weather. As of this writing, signs are emerging in Washington that Congressional energy legislation may be enacted in 2005. It is still unclear if policy measures that address the fundamental supply/demand imbalances in natural gas markets will be included.

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



Source: EEA 2003, 2004

Overview of the Analysis

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

As with the 2003 analysis, this effort used the Energy and Environmental Analysis, Inc. North American Gas Market Model.[1] In this case we used EEA's May 2004 natural gas market forecast as the reference case for our analysis rather than the June 2003 forecast used in the previous analysis. The differences between these two forecasts can be seen in Figure 2. A description of the changes in the natural gas market that occurred between these two forecasts can be found in Elliott (2004). Since this analysis begin, EEA has released an October 2004 forecast (it is also presented in Figure 2), though the changes in this latest forecast are fairly modest compared with the changes between May 2003 and June 2004).

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

Methodology

As with our 2003 analysis (Elliott et al. 2003b), ACEEE provided EEA with detailed data to be used as assumptions in the model about reductions in natural gas and electricity consumption. These consumption reductions were provided at a state level of aggregation and were expressed relative to reference forecasts. In addition, ACEEE provided EEA with an alternative forecast of the share of electricity generated from renewable energy in the thirteen electric supply regions in the EEA model that approximate the National Electric Reliability Council's Sub-Regions. The forecasts used for this analysis were somewhat different than those used in the previous analysis because of the longer-time horizon used in this analysis. In our 2003 analysis we considered a five-year horizon. In this analysis we delayed the start of the analysis period by two years (2004 to 2006) and analyzed the effect of measures for 15 years. In addition, we assumed that renewable energy measures would begin to have an impact in the first rather than the second year of the analysis.

Energy Efficiency Assumptions

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

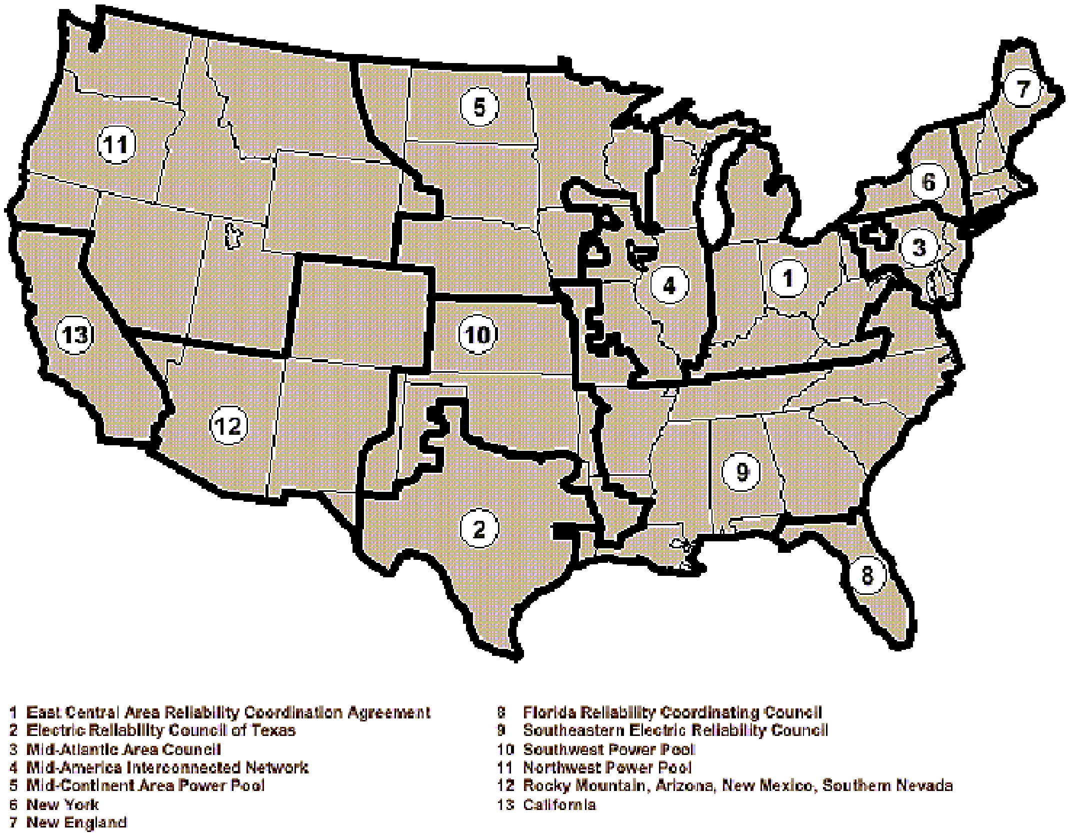
[1] For a more detailed description and history of the EEA model, see http://www.energy.ca.gov/2005_energypolicy/documents/2004-12-16_workshop/2004-12-16_EEA_MARKET_MODEL.PDF.
.

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

Renewable Energy Assumptions

While the assumptions for the energy efficiency impacts were extrapolations of our 2003 analysis (Elliott et al. 2003a, 2003b), we made significant modifications to the renewable energy impacts to accommodate the longer analysis horizon. As with the previous analysis, we generated our renewable assumptions for the electric supply regions corresponding to those used by the Energy Information Administration (EIA). The EIA regions for the most part correspond to the National Electric Reliability Council (NERC) sub-regions (see Figure 3). The EEA model used similar regions with the exception of Nevada, which was placed in the same region as California rather than with the upper West as in the EIA and NERC mappings. For a more detailed discussion, see Elliott et al. (2003a).

Figure 3. National Energy Modeling System Electricity Supply Regions



Source: EIA 2002

Table 1. State-by-State Electricity and Gas Consumption Reductions

	Electricity Savings (vs. Baseline)				Natural Gas Savings (vs. Baseline)			
	2006	2010	2015	2020	2006	2010	2015	2020
State	1 year	5 year	10 year	15 year	1 year	5 year	10 year	15 year
Alabama	1.5%	3.3%	5.6%	7.9%	1.2%	2.8%	4.8%	6.8%
Arizona	2.0%	4.3%	7.0%	9.8%	2.0%	4.1%	6.8%	9.5%
Arkansas	1.6%	3.4%	5.7%	7.9%	1.2%	2.8%	4.8%	6.8%
California	2.9%	6.0%	10.0%	13.9%	2.3%	5.1%	8.6%	12.1%
Colorado	2.0%	4.3%	7.0%	9.8%	2.0%	4.1%	6.8%	9.5%
Connecticut	2.9%	6.1%	10.1%	14.2%	2.3%	4.8%	8.0%	11.1%
Delaware	2.0%	4.4%	7.4%	10.5%	1.7%	3.9%	6.5%	9.2%
Florida	2.2%	4.3%	7.0%	9.7%	1.5%	3.5%	5.9%	8.3%
Georgia	2.0%	2.8%	3.8%	4.7%	1.4%	3.1%	5.3%	7.5%
Idaho	2.3%	5.0%	8.3%	11.7%	2.0%	4.3%	7.3%	10.3%
Illinois	2.4%	5.2%	8.7%	12.2%	2.0%	4.2%	7.0%	9.9%
Indiana	2.3%	5.2%	8.7%	12.3%	1.7%	3.9%	6.5%	9.2%
Iowa	2.4%	4.6%	7.3%	10.0%	1.9%	4.2%	7.1%	10.0%
Kansas	1.6%	3.4%	5.7%	8.0%	1.3%	2.8%	4.7%	6.6%
Kentucky	1.5%	3.4%	5.7%	8.1%	1.3%	2.8%	4.7%	6.7%
Louisiana	1.6%	4.2%	7.6%	10.9%	1.2%	2.8%	4.9%	7.0%
Maine	2.8%	5.8%	9.6%	13.4%	2.0%	4.6%	7.9%	11.2%
Maryland	2.4%	5.5%	9.3%	13.1%	2.0%	4.2%	6.9%	9.6%
Massachusetts	3.0%	5.6%	8.9%	12.2%	2.3%	4.8%	8.1%	11.3%
Michigan	1.9%	4.5%	7.8%	11.0%	1.9%	4.0%	6.6%	9.3%
Minnesota	2.3%	4.6%	7.5%	10.3%	2.0%	4.2%	7.0%	9.8%
Missouri	1.6%	3.4%	5.6%	7.9%	1.3%	2.7%	4.6%	6.4%
Mississippi	1.5%	3.6%	6.3%	8.9%	1.2%	2.8%	4.8%	6.8%
Montana	1.8%	3.8%	6.3%	8.8%	1.6%	3.6%	6.0%	8.4%
Nebraska	1.6%	3.8%	6.5%	9.3%	1.3%	2.7%	4.6%	6.4%
Nevada	1.9%	4.4%	7.4%	10.5%	1.7%	3.5%	5.8%	8.1%
New Hampshire	2.4%	5.4%	9.3%	13.2%	1.9%	4.1%	6.8%	9.5%
New Jersey	2.9%	5.4%	8.4%	11.4%	2.3%	4.8%	7.9%	11.0%
New Mexico	1.6%	4.0%	7.0%	10.1%	1.3%	2.8%	4.7%	6.6%
New York	2.9%	5.3%	8.4%	11.4%	2.3%	4.8%	7.8%	10.9%
North Carolina	1.6%	3.4%	5.6%	7.8%	1.2%	2.8%	4.7%	6.6%
North Dakota	1.6%	3.7%	6.4%	9.1%	1.2%	2.7%	4.6%	6.4%
Ohio	1.9%	4.0%	6.7%	9.4%	1.6%	3.5%	5.8%	8.1%
Oklahoma	1.6%	4.4%	7.9%	11.3%	1.2%	2.8%	4.8%	6.8%
Oregon	2.7%	5.2%	8.4%	11.5%	2.3%	5.1%	8.6%	12.1%
Pennsylvania	1.9%	4.8%	8.3%	11.9%	2.0%	4.3%	7.1%	9.9%
Rhode Island	2.9%	5.2%	8.1%	11.0%	2.4%	4.9%	8.1%	11.2%
South Carolina	1.5%	3.4%	5.6%	7.9%	1.2%	2.8%	4.8%	6.7%
South Dakota	1.6%	3.8%	6.5%	9.2%	1.3%	2.7%	4.5%	6.3%
Tennessee	1.9%	5.0%	8.8%	12.5%	1.6%	3.6%	6.0%	8.5%
Texas	2.9%	5.8%	9.5%	13.1%	2.1%	5.2%	8.9%	12.7%
Utah	2.3%	5.3%	8.9%	12.6%	2.0%	4.3%	7.2%	10.0%
Vermont	2.9%	5.4%	8.5%	11.7%	2.3%	4.8%	8.0%	11.2%
Virginia	2.0%	4.6%	7.7%	10.9%	1.6%	3.5%	5.8%	8.1%
Washington	2.2%	4.4%	7.0%	9.7%	2.0%	4.3%	7.2%	10.1%
West Virginia	1.5%	4.2%	7.5%	10.8%	1.3%	2.7%	4.6%	6.5%
Wisconsin	2.8%	5.5%	8.9%	12.2%	2.3%	4.9%	8.3%	11.6%
Wyoming	1.7%	3.4%	5.5%	7.6%	1.6%	3.6%	6.1%	8.6%
US—TOTAL	2.2%	4.7%	7.7%	10.7%	1.9%	4.1%	7.0%	9.8%

For the most part we took the near-term renewable market share projections used in our 2003 analysis and extended them to a fifteen-year horizon. However, in several regions this technique produced unrealistically high forecasts in the out-years, greater than the most commonly accepted resource estimates. In these cases, we used the longer-term targets most widely discussed in those regions and interpolated renewable market share for the intervening years on a linear basis. In particular, we used the targets proposed by Gov. Schwarzenegger (2003, 2004) in California of 20% in 2010 and 33% in 2020 and also used proposed renewable portfolio standard (RPS) targets in Oregon, Washington, and Texas (UCS 2004b). The renewable share of the electricity market for each region is presented in Table 2.

Table 2. Renewables as a Percentage of Total Electricity Sales

	Year			
EEA Electricity Supply Zone	**2006**	**2010**	**2015**	**2020**
New England	2.2%	8.3%	15.2%	21.7%
New York	0.9%	4.1%	7.7%	11.1%
MAAC	0.6%	3.0%	5.8%	8.4%
SERC	0.6%	2.8%	5.2%	7.2%
Florida	0.9%	4.0%	7.3%	10.1%
ECAR	0.3%	1.4%	2.7%	3.9%
Main	2.2%	9.6%	18.1%	26.0%
MAPP	2.5%	10.7%	20.0%	28.3%
SPP	0.1%	0.3%	0.6%	0.9%
ERCOT	0.8%	2.7%	4.9%	6.9%
WSCC CA/NV	9.2%	20.0%	26.9%	33.0%
WSCC NW	1.7%	7.8%	14.4%	20.0%
WSCC Rockies	2.1%	8.7%	15.8%	22.0%

Note: Assumptions used in EEA model scenarios

Scenarios Considered

For this analysis we ran three scenarios to explore both the national and regional impacts of expanded energy efficiency and renewable energy impacts. The measures considered in the three scenarios are presented in Table 3, and the results are all relative to the May 2004 EEA reference case. The results for the Midwest scenario are presented in greater detail in another ACEEE report (Kushler, York, and Witte 2005).

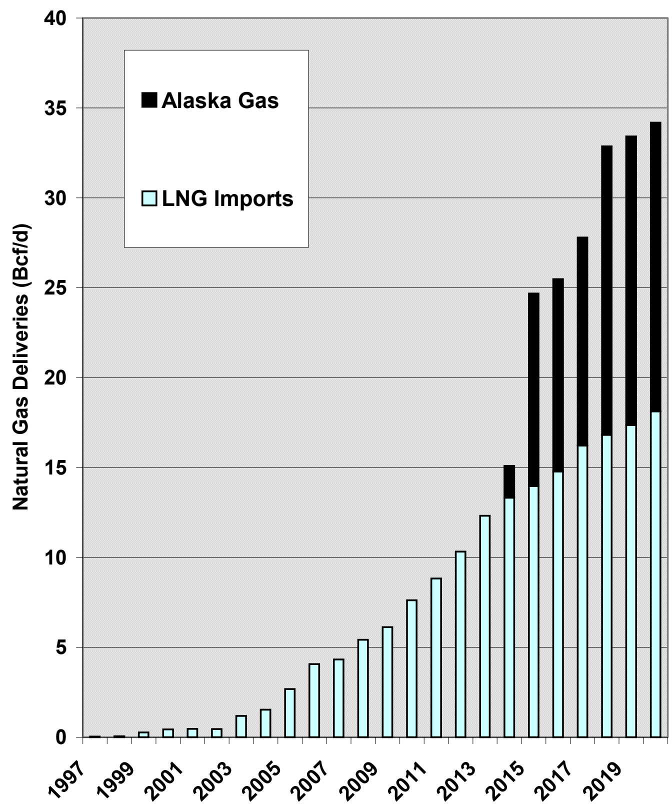
Table 3. Measures Included in Each Policy Scenario Consider in this Analysis

Scenario	Energy Efficiency (EE)	Renewable Energy (RE)
National EE&RE	Lower 48	Lower 48
National EE	Lower 48	None
Midwest EE	IL, IN, IA, MI, MN, MO, OH, WS	None

Resource Assumptions in the Scenarios

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

Figure 4. LNG Imports and Alaska Pipeline Deliveries of Gas in EEA Reference Case



Source: EEA 2004

In the reference case, LNG is projected to increase from the current level of about 1.5 Bcf/d to over 18 Bcf/d by 2020 (see Figure 4 and Table 4). The Alaska gas pipeline is assumed to begin delivering gas to the U.S. market in 2014, with a full delivery rate of 5.9 Bcf/d reached in 2018.

In the national energy efficiency and renewable energy scenario, gas demand is reduced enough that the Alaska gas is not required to meet domestic demand and required LNG imports are reduced by 1 Bcf/d in 2015 and by almost 2 Bcf/d in 2020. In reality, the policy decision to build the Alaska pipeline will be based on both economic and non-economic considerations. So if the pipeline is built, this scenario would change, and LNG imports would likely be reduced by a corresponding amount.

In the national energy efficiency scenario, once again gas demand is reduced enough that the Alaska pipeline does not need to be "built." However, since this scenario does not reduce gas demand as much as the EE/RE scenario, about 1 Bcf/d of addition LNG was required over the EE&RE scenario and a 1.0 Bcf/d LNG import facility was relocated from Southern California to the Gulf Coast to balance demand.

In Midwest EE scenario, the reductions in demand were not large enough to affect the amount of LNG or Alaska gas required to meet market demand, so those resource levels are the same as in the reference case (see Table 4).

Table 4. Assumptions about Alaska Pipeline and LNG Resources

	2003	2004	2005	2006	2010	2015	2020
LNG Imports[a]							
EEA May 2004 Reference Case	1.2	1.5	2.7	4.1	7.6	14.0	18.1
National EE&RE	1.2	1.5	2.7	4.1	7.6	13.1	16.1
National EE[c]	1.2	1.5	2.7	4.1	7.6	13.1	17.1
Midwest EE	1.2	1.5	2.7	4.1	7.6	14.0	18.1
Alaska Gas[b]							
EEA May 2004 Reference Case	—	—	—	—	—	3.9	5.9
National EE&RE	—	—	—	—	—	—	—
National EE	—	—	—	—	—	—	—
Midwest EE	—	—	—	—	—	3.9	5.9

Notes:
[a] Net of U.S. LNG imports and exports (includes a small amount of LNG exports from Alaska)
[b] Net flow of gas on last leg of Alaska pipeline
[c] Relocated 1.0 Bcf/d LNG import facility from Southern California to Gulf Coast

Modeling Results

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

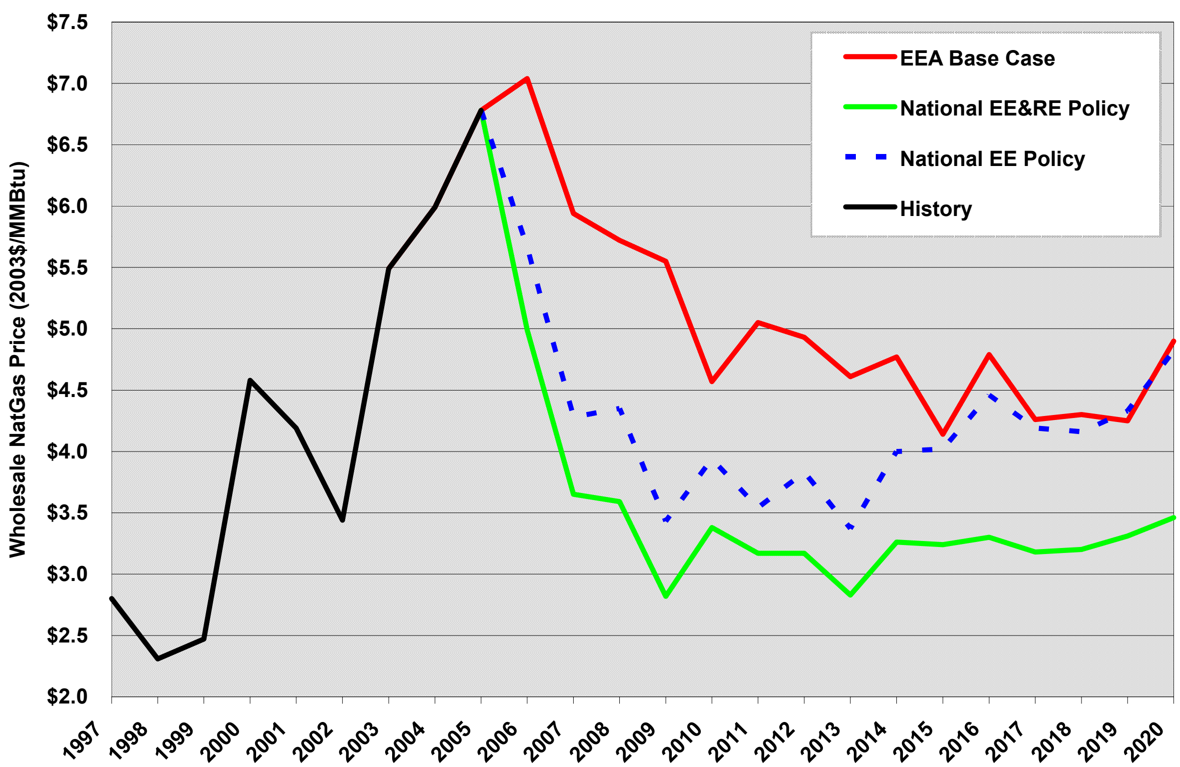
Also, as was seen in the 2003 analysis, energy efficiency and renewable energy deployed at the regional level had national impacts on wholesale natural gas prices, albeit more modest impacts than those of the national level scenarios.

National Energy Efficiency and Renewable Energy Scenarios

As noted in Table 3, we ran two scenarios at the national level (lower-48 states): one including both the energy efficiency and renewable energy (EE&RE) impacts; and one including only the energy efficiency (EE) measures. As can be seen in Figure 5, both scenarios have a dramatic impact on the Henry Hub wholesale natural gas price in the near term. As would be expected, the combined EE&RE measures have a greater impact, decreasing prices by $2.05 per Mcf, or 37%, in the first year, with the price effect diminishing to $1.19 per Mcf or 20% by 2010, when natural gas markets are forecast to come into better balance. Under this scenario, the wholesale price stabilizes at $3 to $3.50 per Mcf for the remainder of the modeling period, and prices in the reference case decline to the $4.50 to $5.00 per Mcf range by 2015 before beginning to increase at the end of the model period; this is largely an artifact of the model. As noted in the previous section, the differences between these long-term price scenarios result from the resource choices that the model makes with the EE&RE scenario reducing demand to the point that no Alaska gas and less LNG is required to balance the national gas markets. Because of the limited granularity of the model's resource choices, it is not clear that there would in reality be significant differences between these prices in the out-years after 2015. At some point in the out-years of any such analysis, one would reasonably assume that the combined effects of policy decisions and market forces would balance market fundamentals, reducing the impact of policy interventions on the margin.

In the EE-only case, the wholesale price is reduced in 2006 by $1.38 per Mcf, or 25%, in the first year, diminishing to $0.36 per Mcf or 11% by 2010. The price then stabilizes at $3.50-$4 per Mcf for the next five years before beginning to increase into the same range as the reference case for the remainder of the analysis period. As noted earlier, while Alaska gas is not required to balance national markets, additional LNG is required post-2015 compared with the EE&RE case.

Figure 5. Effects of Energy Efficiency and Renewable Energy on the Henry Hub Wholesale Price of Natural Gas



Impacts on Retail Energy Prices

As with the wholesale prices, the maximum reductions in retail prices in all sectors for both national scenarios occur in 2009 (see Table 5). Through 2010, the EE scenario achieves about two-thirds of the savings achieved with the combined EE&RE scenario. This reflects a combination of the very tight near-term natural gas markets with the time required to ramp-up the renewable investments. However, beyond 2010 prices result more from larger resource choices than from EE/RE impacts on the margin. As a result, we cannot say that retail prices beyond 2010 under the EE case are significantly different from the reference case. However, with the inclusion of significant renewable resources, a lower retail price future beyond 2010 is projected, reflecting a less constrained overall resource market.

Table 5. Retail Price of Natural Gas by Sector under National Scenarios

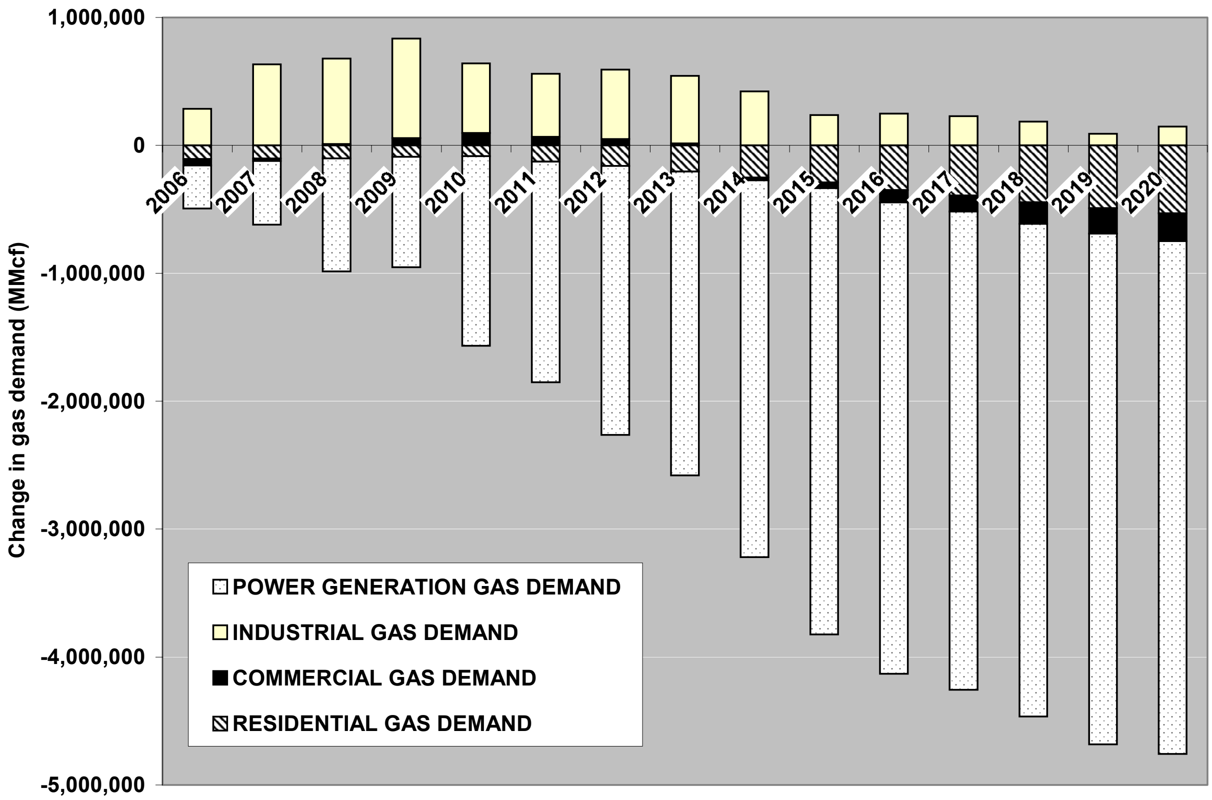
$/Mcf	2005	2006	2007	2008	2009	2010	2015	2020
Residential								
Reference Case	10.88	11.10	10.06	9.50	9.44	8.57	7.17	7.55
EE Case	10.88	10.05	8.50	8.21	7.53	7.59	7.55	7.77
EE&RE Case	10.88	9.53	7.79	7.49	6.82	7.04	6.68	6.49
Commercial								
Reference Case	9.72	9.93	8.85	8.42	8.32	7.43	6.21	6.76
EE Case	9.72	8.80	7.30	7.12	6.35	6.55	6.55	6.89
EE&RE Case	9.72	8.24	6.61	6.39	5.68	5.99	5.69	5.61
Industrial								
Reference Case	7.67	7.88	6.73	6.57	6.39	5.44	4.64	5.44
EE Case	7.67	6.54	5.14	5.22	4.28	4.78	4.76	5.19
EE&RE Case	7.67	5.85	4.51	4.44	3.65	4.20	3.95	3.98
Power Generation								
Reference Case	7.27	7.49	6.33	6.26	6.09	5.11	4.36	5.20
EE Case	7.27	6.09	4.76	4.88	3.91	4.50	4.52	5.00
EE&RE Case	7.27	5.36	4.10	4.03	3.25	3.83	3.70	3.81

Impacts on Consumption

In the combined EE&RE scenario, the residential and power generation sectors experience progressive reductions in gas consumption over the entire 15-year analysis period (see Figure 6). In the commercial sector, we see an initial modest consumption reduction followed by a modest increase through 2013, then followed by decreasing consumption relative to the reference case. We postulate that the change in commercial consumption results from some fuel switching back to gas from other fuel, such as higher priced heating oil, before the full impact of the efficiency measures take hold in this sector. Reductions in gas use in the electric power generation sector expand rapidly until they slow about 2015, reflecting increased displacement of coal generation by natural gas through 2015 as a result of natural gas's reduced relative price.

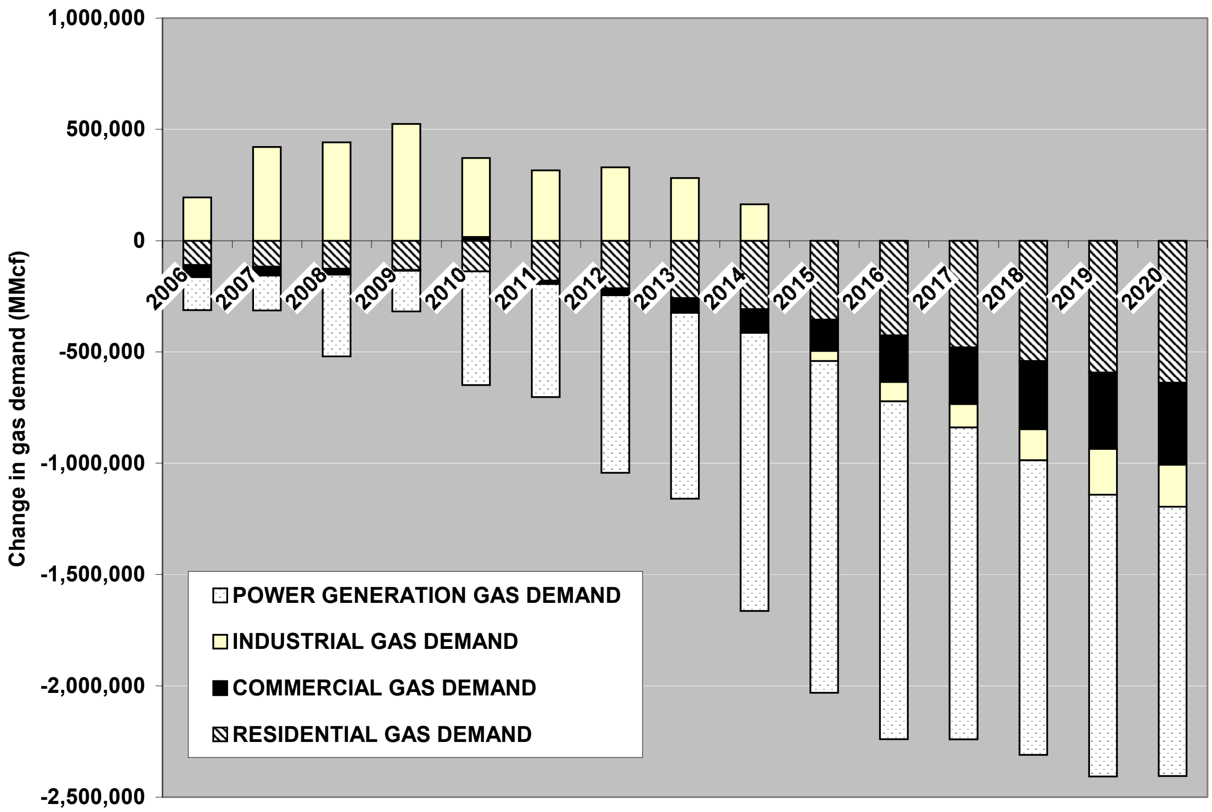
As we found in 2003 (Elliott et al. 2003b), industrial consumption is higher throughout the period relative to the reference case, with this increased consumption peaking in 2009 at about 11% when the depression in retail industrial gas prices is the greatest at almost 43%. After 2009, the consumption increase declines relative to the reference case to less than 2% after 2018 as the price drop becomes less significant. We postulate that this effect is a result of avoided "demand destruction," a natural gas industry term of art that characterizes decreases in consumption that result from end-use consumers either reducing their economic activity or in extreme cases, shutting down. As has been noted in the literature (Elliott et al. 2003b; National Petroleum Council 2003), we have seen significant industrial demand destruction in natural gas-intensive industries in recent years, attributable in large part to natural gas price increases. With the significant decreases experienced in this scenario, we see robust economic recovery in these industries, manifesting in increased gas consumption.

Figure 6. Change in Natural Gas Consumption for National EE&RE Scenario by End-Use Sector



In the EE-only case, the avoided industrial demand destruction is about two-thirds that in the EE&RE case (see Figure 7). As would be expected, the gas savings in power generation are significantly less, particularly in the latter years because electric generation is not as heavily displaced by renewables as in the combined scenario.

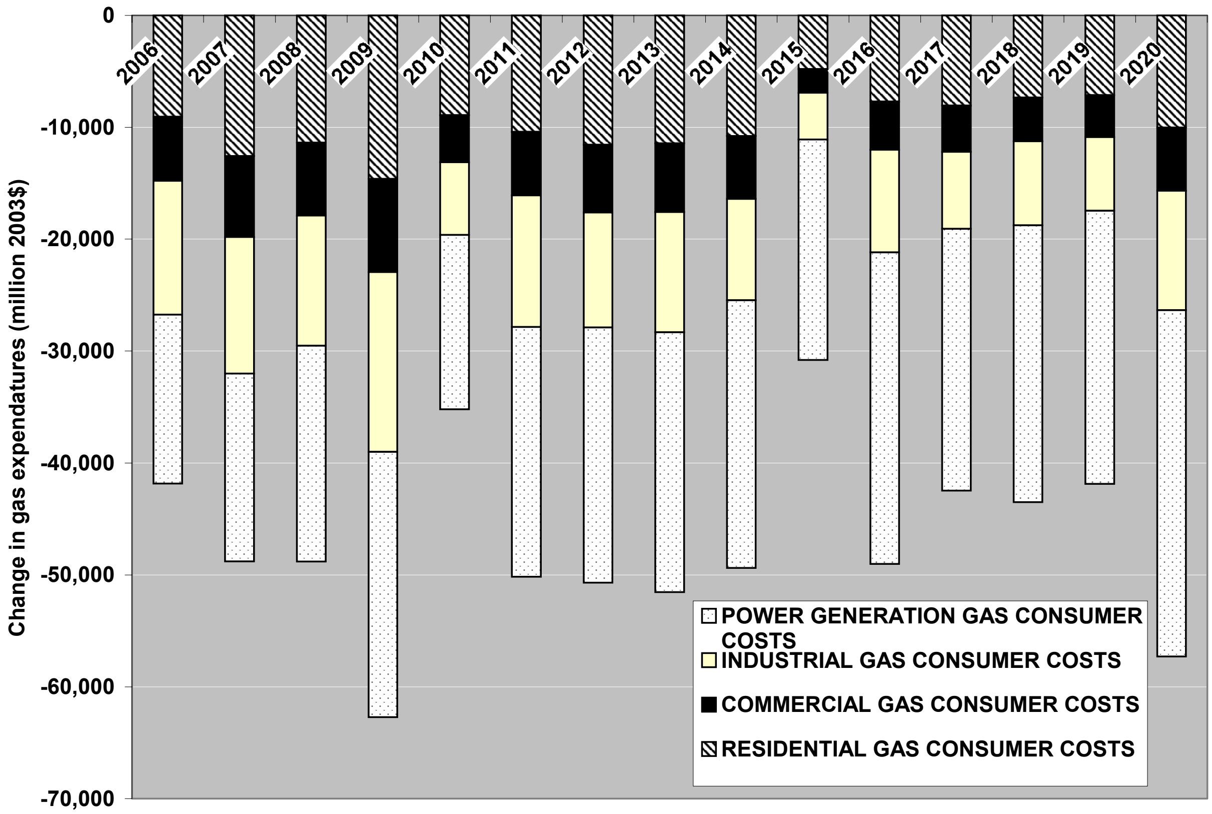
Figure 7. Change in Natural Gas Consumption for National EE Scenario by End-Use Sector



Impacts on Consumer Energy Expenditures

Consumer energy expenditures are the product of changes in both consumption and prices. Consumer consumption is partly driven by combinations of changes in economic activity in various sectors and the sectors' energy efficiency. As shown in Figure 8, even though net industrial gas consumption increases as a result of increased industrial activity, the sector's net natural gas expenditures decline as a result of the significant price decreases. The greatest decreases occur in 2009, corresponding to the greatest price decrease. As the relative magnitude of price reductions decreases, the drop in net expenditures also diminishes as price effects become less significant, before increasing again in the out-years as consumption reductions become the dominant factor and more than offset declining price effects. It is worth noting that even those who do not benefit from efficiency directly will benefit from lower gas prices as a result of actions that others take. Natural gas customers also benefit from natural gas savings in the electricity sector as a result of lower gas prices made possible by the reduced demand.

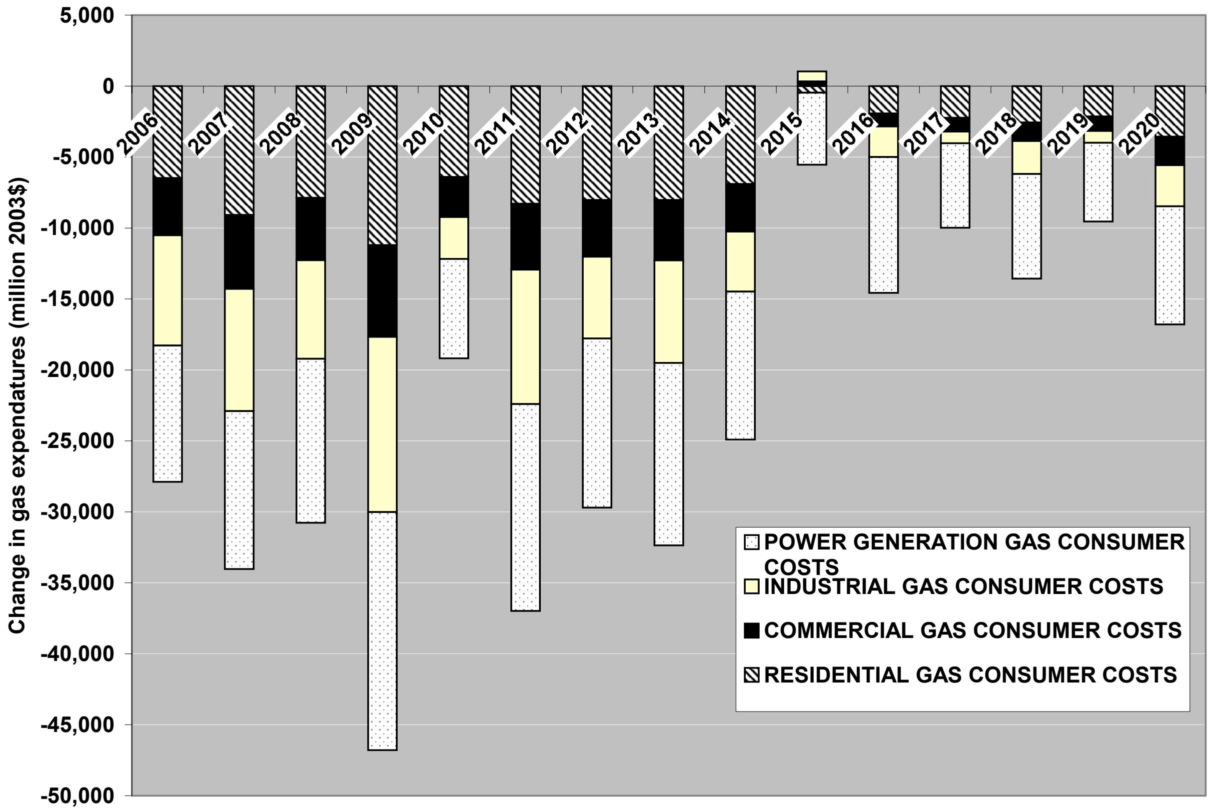
Figure 8. Changes in Total Natural Gas Expenditures by Sector in the National EE&RE Scenario



This same relative impact pattern can be seen in the national EE-only scenario results where the expenditure reductions decline as the price impacts diminish after 2009 (see Figure 9), with the longer-term expenditure change resulting only from increased energy efficiency impacts alone. While less dramatic than the $40–50 billion net annual savings after 2015 in the EE&RE case, these savings still reflect a substantial $10–15 billion net annual savings.

From these observations we can conclude that the expenditure savings are dominated by price effects in the early years, while net consumption effects begin to dominate in the out-years. It is also important to reiterate that all the efficiency investments considered in the analysis are cost-effective in their own right irrespective of any price effects, so the price effects could arguably be characterized as a societal benefit to all consumers generated by governments and consumers making the energy efficiency investments.

Figure 9. Changes in Total Natural Gas Expenditures by Sector in the National EE Scenario



Energy Efficiency Case Costs and Benefits for the EE scenario

The costs are the same for the end-use consumers (residential, commercial, and industrial) for both the EE-only and the EE&RE scenarios. We assume the cost of installation of renewable energy generation technologies will be borne by the utility sector rather that the end users. Table 6, Table 7, and Table 8 show the total annual costs, including both technical measure and programmatic and administrative costs,[2] for producing the electricity and natural gas consumption reductions displayed in Table 1.

Table 6. Total Annual Natural Gas Efficiency Consumer Costs (Million 2003$)

	2006	2010	2015	2020
Residential	$279	$589	$1,026	$1,519
Commercial	$50	$107	$190	$281
Industrial	$80	$209	$386	$574
Total (R+C+I)	$409	$905	$1,602	$2,375

[2] Programmatic and administrative costs represent those activities associated with promotion of energy efficiency and oversight of the programs but do not include any incentives that are considered part of the direct measure costs.

Table 7. Total Annual Electricity Efficiency Consumer Costs (Million 2003$)

	2006	2010	2015	2020
Residential	$2,623	$4,743	$7,880	$11,645
Commercial	$1,412	$3,071	$5,535	$8,499
Industrial	$813	$2,210	$4,289	$6,795
Total (R+C+I)	$4,848	$10,024	$17,704	$26,939

Table 8. Total (Both Electricity and Natural Gas) Annual Energy Efficiency Consumer Costs (Million 2003$)

	2006	2010	2015	2020
Residential	$2,902	$5,332	$8,907	$13,165
Commercial	$1,463	$3,179	$5,725	$8,780
Industrial	$892	$2,419	$4,675	$7,369
Total (R+C+I)	$5,257	$10,930	$19,307	$29,314

Table 9, 10, and Table 11 display the direct reductions in expenditures that consumers will experience under both the EE and EE&RE scenarios. The benefits were calculated based on state-by-state sectoral natural gas and electricity prices. The benefits do not reflect the potential reduction in retail electricity price that may occur in a lower natural gas price environment. However, in the natural gas savings we do report the avoided expenditures in the power sector resulting from reduced gas consumption and prices. Energy efficiency alone is shown to result in over $54 billion in annual consumer benefit, while costing only $8.5 billion annually. The combined results of energy efficiency and renewable energy result in $67 billion in annual consumer benefit while costing just $37 billion.

Table 9. Total Annual Natural Gas Efficiency Consumer Benefits (Million 2003$)

	2006	2010	2015	2020
Residential—EE	$ 6,485	$6,410	$ 457	$3,563
Commercial—EE	$ 4,030	$ 2,825	$ (335)	$2,014
Industrial—EE	$7,758	$2,935	$(697)	$2,898
Power Sector—EE	$9,613	$7,013	$5,077	$8,323
Total (R+C+I+P)—EE	$27,886	$19,183	$4,502	$16,798
Residential—EE&RE	$8,980	$8,840	$4,712	$9,902
Commercial—EE&RE	$5,730	$4,201	$2,124	$5,651
Industrial—EE&RE	$11,960	$6,494	$4,185	$10,662
Power Sector—EE&RE	$337	$1,481	$3,488	$4,007
Total (R+C+I+P)—EE&RE	$27,007	$21,016	$14,509	$30,222

Table 10. Total Annual Electricity Efficiency Consumer Benefit (Million 2003$)

	2006	2010	2015	2020
Residential	$2,501	$5,297	$9,447	$14,439
Commercial	$2,449	$5,326	$9,597	$14,736
Industrial	$966	$2,628	$5,100	$8,079
Total (R+C+I)	$5,916	$13,251	$24,144	$37,254

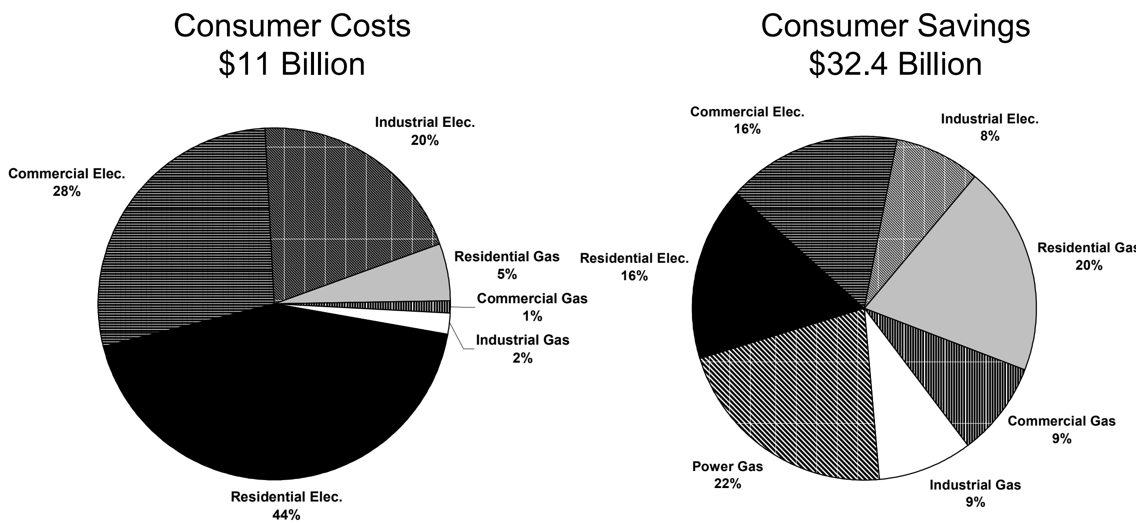
Table 11. Total Annual Natural Gas and Electricity Total Consumer Benefits (Million 2003$)

	2006	2010	2015	2020
Residential—EE	$8,986	$11,708	$9,904	$18,002
Commercial—EE	$6,479	$8,151	$9,262	$16,750
Industrial—EE	$8,724	$5,562	$4,403	$10,977
Power Sector—EE*	$9,613	$7,013	$5,077	$8,323
Total (R+C+I)—EE	$33,802	$32,434	$28,646	$54,052
Residential—EE&RE	$11,481	$14,137	$14,160	$24,342
Commercial—EE&RE	$8,178	$9,527	$11,721	$20,388
Industrial—EE&RE	$12,926	$9,122	$9,285	$18,741
Power Sector—EE&RE*	$337	$1,481	$3,488	$4,007
Total (R+C+I)—EE&RE	$32,922	$34,267	$38,654	$67,478

* Power sector is gas savings only.

The costs for the energy efficiency scenarios are dedicated primarily to providing electric efficiency. The benefits, however, are felt almost equally on gas and electric markets. Figure 10 shows the share of costs and benefits among the end-use sectors for the year 2010.

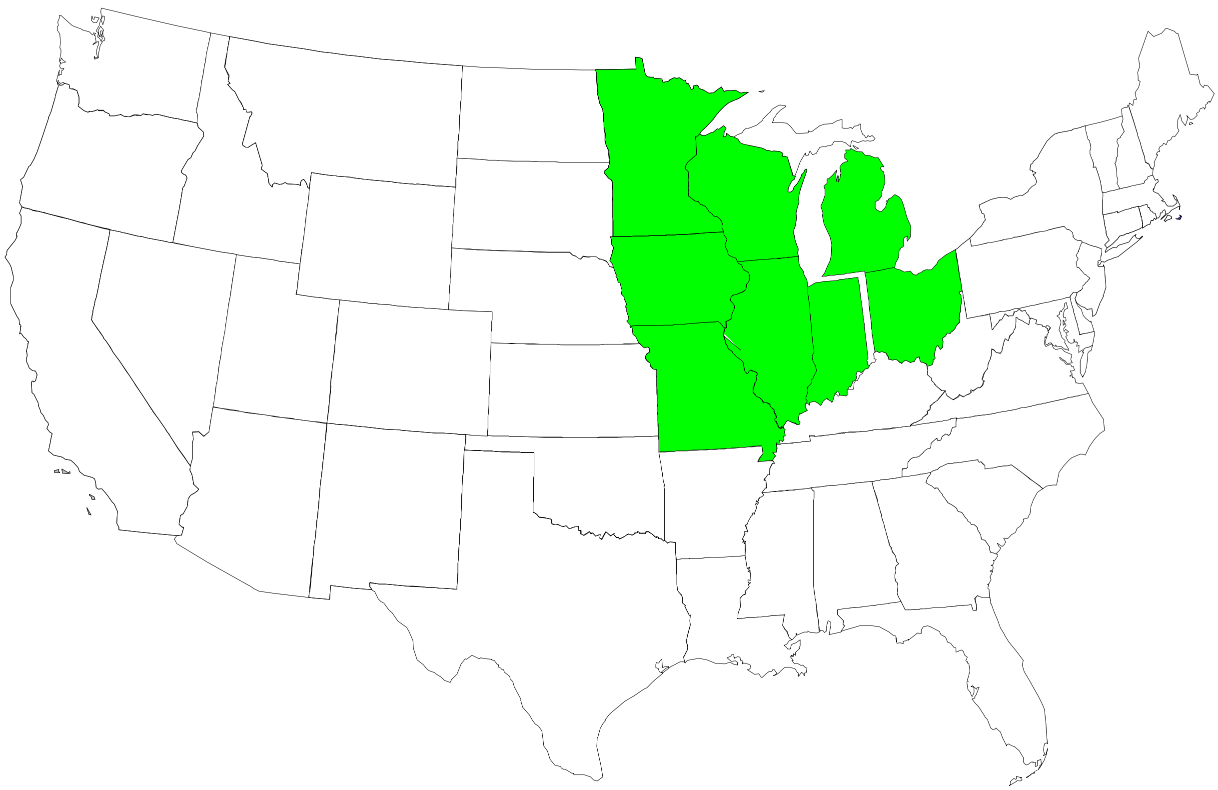
Figure 10. Costs and Benefits for EE Scenario in 2010



Midwest Energy Efficiency Scenario

The scenario of energy efficiency in the Midwest is covered in much greater detail in Kushler, York, and Witte (2005). For the purposes of this scenario, we looked at energy efficiency policies only in the Midwest region, defined as eight states: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin (see Figure 11). Consumption in this region represents about 20% of total national consumption.

Figure 11. Map of States in Midwest Regional Analysis



For a variety of reasons, natural gas is an especially important commodity for the Midwest region. Two factors are particularly noteworthy. First, compared to other areas of the nation, the Midwest has a large concentration of heavy industries that are very reliant on natural gas for both fuel and feedstock purposes. [3] Thus natural gas price increases have a disproportionate impact on the economy of this region.

Second, the Midwest has a very high saturation of natural gas-fueled space heating. Due to this high heating load, average residential natural gas bills in the Midwest are 3.6 times the national average (Elliott et al. 2003b). Moreover, in the cold Midwest climate, space heating can literally be a life and death issue.[4] Thus natural gas price increases are not only a painful economic problem in the Midwest, they can be a significant health and safety concern as well.

Impacts on Consumption

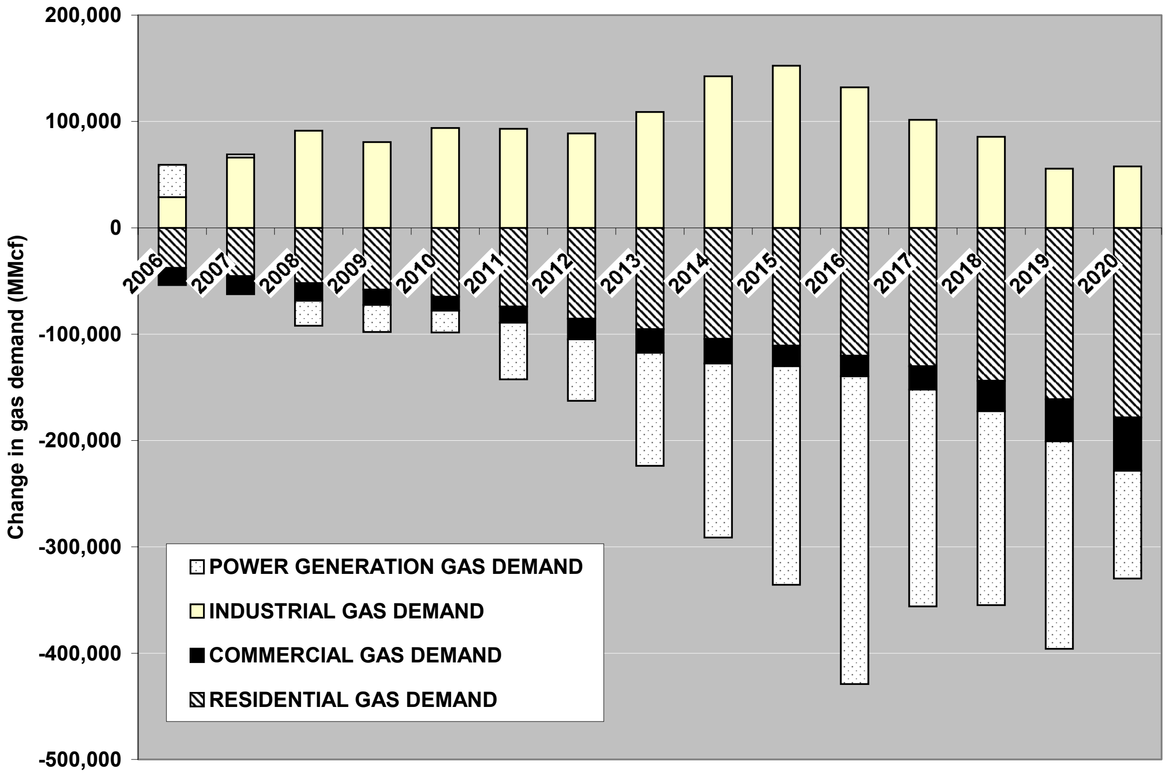
Under the Midwest EE scenario, we see more dramatic avoided industrial demand destruction than in the national scenarios as a result of the region's heavily industrial consumption base (see Figure 12). The increases in industrial consumption continue in spite

[3] For example, in the production of chemicals, fertilizer, and other products requiring natural gas as an input material.

[4] Virtually every Midwestern city will be familiar with tragic cases of households that perished due to fires or asphyxiation from using unsafe alternate heating devices when they could not afford to maintain their utility service.

of energy efficiency investments because of the increased industrial activity until 2015, when the increases begin to moderate as a result of the cumulative effects of efficiency investments. Some initial increase in natural gas power generation is seen in this case, though small in overall terms. Electric power gas consumption drops immediately and as in the national case, declines until 2016 when power generation consumption begins to increase again. Residential and commercial consumption drops throughout the study period, reflecting the increasing effects of energy efficiency investments.

Figure 12. Net Change in National Gas Consumption by Sector in the Midwest EE Case



Impacts on Energy Prices

Because of the robust gas transmission infrastructure in the Midwest, natural gas prices closely track the Henry Hub price (see Glossary). The initial impacts of energy efficiency on the wholesale price of natural gas start modestly, most likely due to the increase in industrial sector consumption in the region as natural gas is freed up to allow expansion of industrial activity (see Figure 13 and Table 12). However, price reductions continue to grow until 2015, in contrast to the national scenarios. At the retail level, price reductions are more pronounced for the industrial and power generation consumers than for residential and commercial customers, reflecting the closer coupling between wholesale and industrial and power generation markets (see Table 12 and Table 13).

Figure 13. Impact of EE in the Midwest on Henry Hub Natural Gas Prices

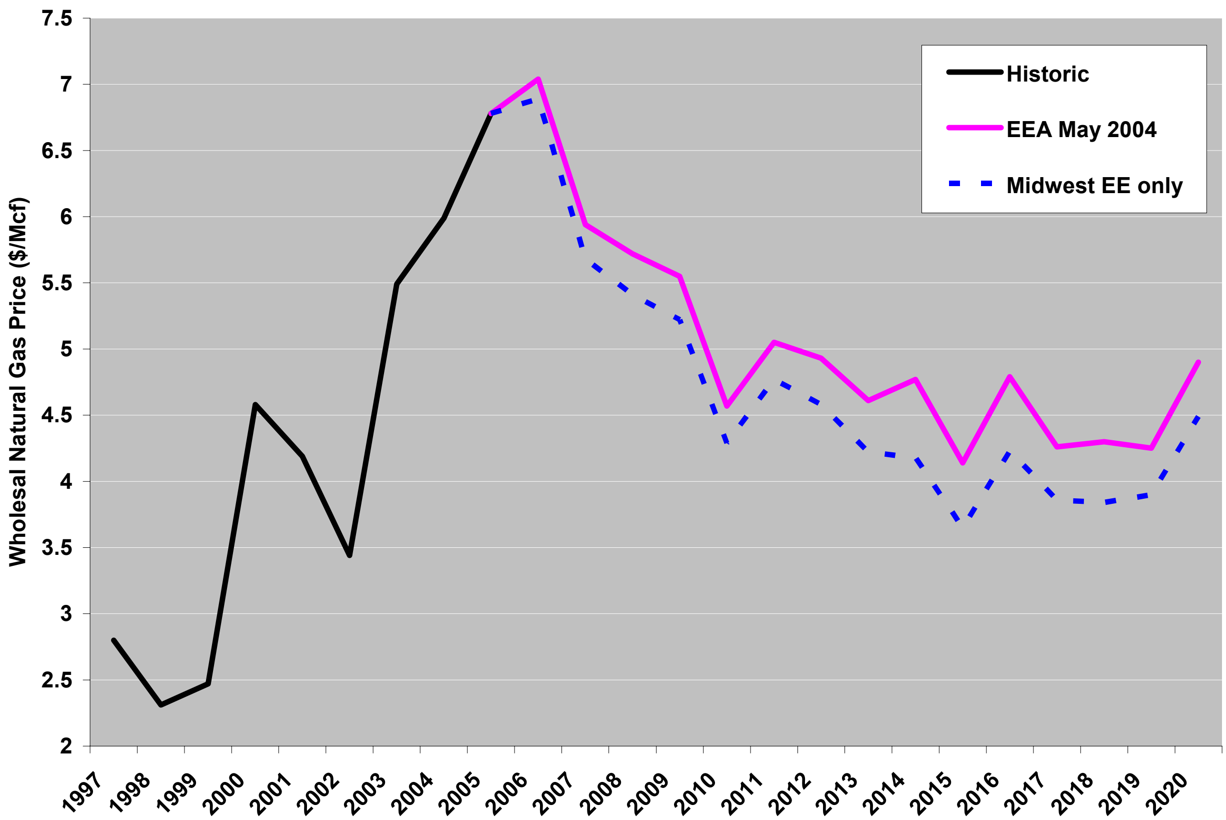


Table 12. Impact of EE Case on Retail Average Midwest Natural Gas Price

$/Mcf	2005	2006	2007	2008	2009	2010	2015	2020
Residential								
Reference Case	10.06	10.34	9.39	8.79	8.71	7.86	6.08	6.69
Midwest EE Case	10.06	10.24	9.19	8.48	8.38	7.58	5.68	6.38
Commercial								
Reference Case	9.02	9.30	8.32	7.78	7.68	6.83	5.19	5.87
Midwest EE Case	9.02	9.19	8.11	7.47	7.36	6.54	4.77	5.53
Industrial								
Reference Case	7.97	8.21	7.10	6.87	6.65	5.71	4.61	5.53
Midwest EE Case	7.97	8.07	6.86	6.56	6.31	5.42	4.17	5.14
Power Generation								
Reference Case	7.22	7.46	6.29	6.35	6.10	4.96	4.28	5.06
Midwest EE Case	7.22	7.28	5.94	6.02	5.66	4.59	3.52	4.65

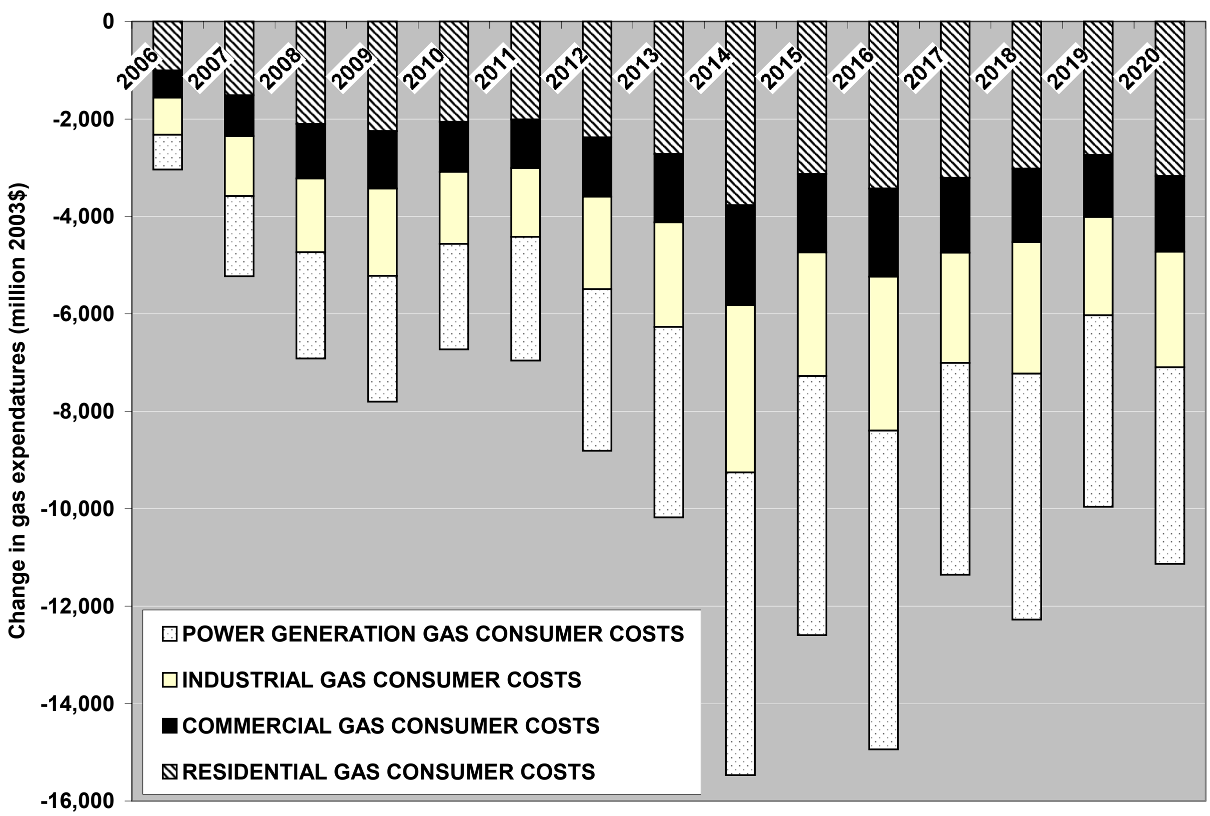
Table 13. Change in Wholesale and Retail Price Relative to EEA Forecast in Midwest EE Case

	2006	2007	2008	2009	2010	2015	2020
Wholesale	-2.1%	-4.4%	-5.4%	-5.9%	-6.1%	-5.5%	-11.7%
Residential	-1.0%	-2.1%	-3.5%	-3.7%	-3.6%	-3.2%	-6.6%
Commercial	-1.2%	-2.5%	-4.0%	-4.3%	-4.2%	-3.8%	-7.9%
Industrial	-1.7%	-3.4%	-4.6%	-5.2%	-5.1%	-4.6%	-9.7%
Power Generation	-2.5%	-5.4%	-5.2%	-7.2%	-7.4%	-6.8%	-12.0%

Impacts on Energy Expenditures

Because of the delayed price response in the Midwest EE case compared to the national EE scenario, the maximum reduction in expenditures occurs in the 2014-2016 period (see **Figure 14**). It is important to note also that in spite of the increase in industrial gas consumption, industrial gas expenditures are below the reference case for the entire analysis period.

Figure 14. Change in Sector Natural Gas Expenditures as a Result of Midwest EE Case

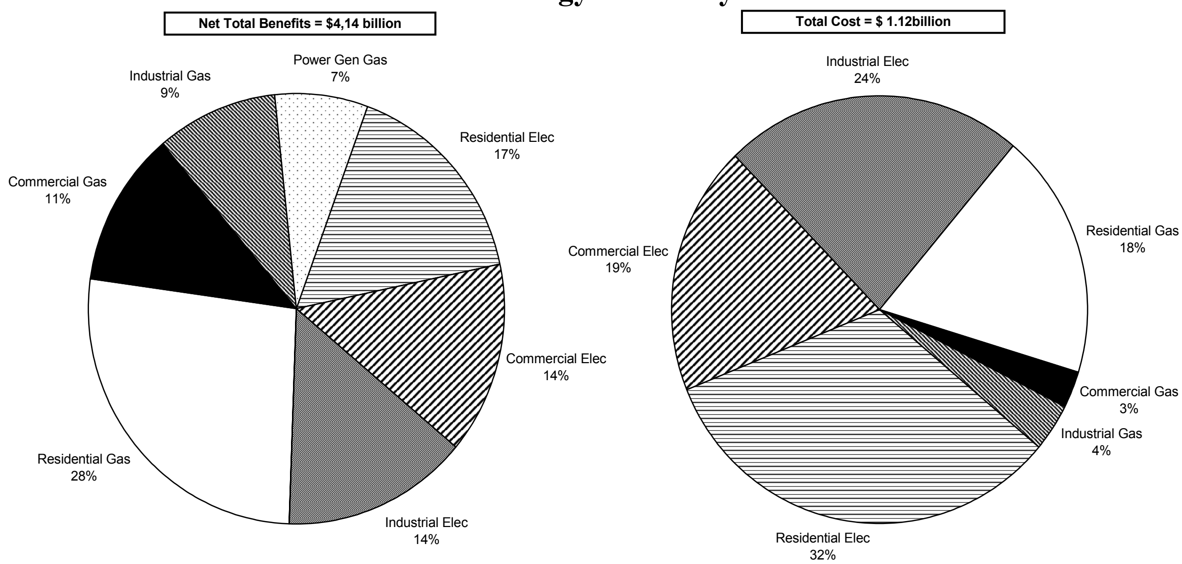


Implementation Costs and Net Benefits

ACEEE's Midwest natural gas report (Kushler, York, and Witte 2005) includes an extensive discussion of the implementation costs and benefits from regional investments in energy efficiency. Overall, the benefits are conservatively 3.7 times the total implemented costs (see

Figure 14). This assessment is conservative because it does not take into account any electricity price effects that might occur from the reductions in natural gas prices for electric power generators that are passed along to consumers. As with the national analyses, the efficiency investments are disproportionately weighted towards saving end-use electricity, while the benefits are weighted toward net gas expenditure reductions. Overall, the residential gas investment and benefits are more important in this region than in the national scenarios, in part because of the heavy dependence on gas for heating, as mentioned earlier.

Figure 15. Net Total Regional Energy Efficiency Investments and Expenditure Savings for Midwest Energy Efficiency Scenario



It is also important to note that the benefits from energy efficiency investments in the Midwest are not restricted to the Midwest region, but are experienced nationally. Because of the interconnected nature of North American natural gas markets, the wholesale price reductions benefit the entire country. For example, average national residential retail gas prices are reduced by more than 3% in 2010 and almost 6% in 2015. There are also measurable retail impacts in the non-participating states—for example, 6% industrial retail price reduction in Texas in 2010. While the non-participating states do experience some price effects, since they are not assumed to have made any efficiency investments, they do not experience the additional consumption-related expenditure reductions resulting from reductions in gas purchases seen among Midwest consumers.

Discussion of Modeling Results

Compared with our 2003 analysis (Elliott et al. 2003b), this updated analysis reflects a further tightening in natural gas markets. As a result, the price response to changes in natural gas demand from energy efficiency and renewable energy investments is greater than in the previous analysis. This analysis also extended the analysis period from five years as analyzed in 2003 to 15 years. As was seen in the previous analysis, a significant price response is seen in the first five years of the analysis period as a result of current, very tight natural gas markets. As new resources are projected to become available (e.g., Alaska gas and additional

LNG), markets rebalance and the price effects diminish, particularly in the last five years of the study period. Which of the alternative new supply resources become available is perhaps the most important consideration in the market outlook after 2010, so we have decreasing confidence in the model results as we progress further into the study period. In particular, as was noted in the introduction, choices such as whether to build the Alaska natural gas pipeline are likely to have a defining impact on the North American natural gas market in the post-2015 period (see National Petroleum Council 2003; NCEP 2003). These choices all have substantial lead times and are unlikely to be made on strictly economic grounds and so create significant uncertainty in the price forecast.

Our current analysis does allow us to answer a question raised about our previous analysis—what are the separate as well as combined impacts of energy efficiency and renewable energy investments? When we compare the national EE&RE and EE-only scenarios, we see that initially energy efficiency investments achieve about three-quarters of the price impacts associated with the combined EE&RE investments. However, as the installed base of renewable energy investments increases, particularly after five years, the price impact from the renewable investments becomes more important, stabilizing long-term natural gas prices. From this we can infer that energy efficiency and renewable energy are very complementary with respect to balancing natural gas markets, with energy efficiency being of critical near-term importance with renewable energy investments playing an important role in the longer-term, diversified resource portfolio. This is not to say that efficiency becomes unimportant in the long run; failure to sustain efficiency increases long term could send markets back into the current tight and volatile situation. This simply means that new supply options have a larger effect in the out-years.

As with our 2003 analysis, our regional scenario had significant impacts at both the regional and national levels. While price effects from regional scenarios were seen nationally, the analysis restricted the economic benefits from consumption reductions to the region in which the investments were made.

It is important to also reiterate that even in our most aggressive scenarios the analysis predicts a need for significant new natural gas supply resources to maintain market balance. This means that energy efficiency and renewable energy do not by themselves constitute a sufficient solution to long-term natural gas supply concerns. As noted above, the actual makeup of these supply resources can vary depending upon market decisions. However, this analysis still confirms that both energy efficiency and renewable energy should clearly be a major part of the nation’s energy resource portfolio. If they are not, we will experience higher gas prices, market instability, and greater economic damage in gas-dependent sectors of the economy.

Summary of Policy Recommendations

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

Energy Efficiency Public Benefits Funds and Performance Targets

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

Public benefits funds typically establish funding levels; energy savings in quantitative resource terms are a secondary consideration. However, it is also possible to base state efficiency programs on savings targets first and make funding considerations secondary. Establishing binding savings targets for utilities, as Texas and California have done (Kushler and Witte 2001), or including energy efficiency in a broader resource portfolio standard, as Pennsylvania has done, could expand the benefits of these kinds of programs. Financing for these programs could come from expanding public benefit funds or through regulated utility programs. The benefits of these programs are typically twice the level of program costs or greater, making them very cost-effective to consumers and businesses. Possible models for efficiency performance standards are contained in electricity legislation drafted in 2001 by the House Energy and Air Quality Subcommittee Chairman Joe Barton (Barton 2001).

Expanded Federal Funding for EE-RE 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 interests. The federal government should expand funding for existing energy efficiency and renewable energy programs at the U.S. Department of Energy (DOE) and Environmental Protection Agency (EPA). These agencies should be encouraged to partner with state and local governments, existing programs run by the public sector and utilities, and the private sector to leverage the agencies' funding for maximum impact.

The experience from the California response to the blackouts of 2001 dramatizes the crucial role that such programs can play in reducing energy prices and stabilizing markets (Kushler and Vine 2003). This experience indicates the potential impact that accelerated EE programs could have at the national level. Fortunately, effective federal deployment programs for energy efficiency already exist, such as the ENERGY STAR®, Industrial Best Practices, and other DOE Gateway Deployment initiatives. These and other federal, state, and regional initiatives should be used to accelerate market acceptance of these key technologies.

Appliance Efficiency Standards

Appliance standards have been one of the greatest energy policy successes over the past decade, transforming the energy use of many consumer and commercial products. While developing new standards from scratch takes a number of years, several important standards are waiting in the wings that could result in important energy savings in the mid term (see Nadel, Elliott, and Langer 2005). At the federal level, the energy bill currently under consideration in Congress includes standards on six products that would go into effect in the next few years. Consensus standards on five additional products should be added. In addition, three federal rulemakings are underway that should move forward as quickly as possible; 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 up to 10 products (some the same as in federal legislation). 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 regulations, administered at the local level, define how new residential and commercial buildings are constructed and in some cases what upgrades need to be made when major renovations take place. The International Code Council and other bodies have developed model building codes that represent the current state of the art in design and construction practice. Buildings built to these codes have reduced heating and cooling requirements, and commercial office buildings require much less electricity for lighting (Prindle et al. 2003). Some localities have already adopted these codes, but others need to be encouraged to move quickly to implement them.

Support of Clean and Efficient Distributed Generation

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

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 customer incentives (Elliott 2001).

Renewable Portfolio Standards

A renewable portfolio standard 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 18 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 (Donovan et al. 2001; ELPC 2001; Greene 2003; Marston 2003). The other states without renewable portfolio standards should be encouraged to implement them, as has been proposed by several regional initiatives (Beck et al. 2001; ELPC 2001; Nielsen 2003, 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 2002, the Senate passed a renewable portfolio standard requiring major electricity companies to obtain 10% of their electricity from renewable energy sources by 2020 (Daschle and Binghaman 2002. 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 credits for renewable energy sources be extended through at least 2007. Grants and loans for renewable energy were part of the *Farm Bill of 2002* passed by the 107th Congress, and it is important that funding for future years be continued. Other tax credits and grants at both the state and federal levels for other renewable technologies should also be implemented, as has been proposed in the Senate Energy Bill. Several states (e.g., Oregon, Massachusetts, New York, and California) have designated that system benefit charges should be used in part 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 (e.g., Greenspan 2003). 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 affect significant savings is limited, however, as was learned in the Northwest in 2002 (see Elliott et al. 2003b). Once a market has adapted to higher electricity prices it is difficult to motivate public action. The lesson learned is that policy makers must quickly mobilize the resources needed to support the public's actions, as they were in California (Kushler and Vine 2003), if maximum results are to be achieved.

Summary and Conclusions

The importance of energy efficiency and renewable energy resources as resources for rebalancing natural gas markets has increased over the part 18 months, as political inaction has led to further tightening of natural gas markets. Our analysis has demonstrated that readily achievable levels of resource investments in EE and RE technologies can have profound near- and-mid-term impacts on energy prices and on the nation's economic health, particularly in the most vulnerable sectors (energy-intensive manufacturing companies, farmers, and low- income residential consumers). The policy recommendations ACEEE made in 2003 remain the same, and the case for implementing these policies has only become more compelling in the intervening period as the economic impact of high natural gas prices has increased.

While energy efficiency remains the only viable near-term policy option for addressing the current supply-demand imbalance, this analysis show that efficiency alone is not sufficient to address long-term market imbalances. A diverse portfolio of supply options including renewable energy, alternative gas supplies (both domestic and imported), and other supply strategies are needed to achieve long-term market stability.

Unfortunately, the period of low energy prices that began in the late 1980s has ended, and almost all forecasts suggest that future prices will be higher than we became accustomed to over the past 20 years. We should not be deluded by the prospect of modest declines in energy prices from their current very high levels. Even at somewhat lower energy prices, the wealth transfer from energy consumers to producers, both domestic and foreign, would have a major debilitating impact on the U.S. economy.

Clearly, there are policy solutions to the market situation, and energy efficiency and renewable energy represent important first and intermediate steps. The sooner that policy leadership is shown at both the national and state level, the sooner consumers will begin to realize the benefits of lower energy prices.

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