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American Council for an Energy-Efficient Economy

Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets

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

ACEEE is a nonprofit organization dedicated to advancing energy efficiency as a means of promoting both economic prosperity and environmental protection. For more information, see http://aceee.org. ACEEE fulfills its mission by:

- 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.

About Energy and Environment Analysis, Inc. (EEA)

EEA, located in metropolitan Washington, D.C., is a nationally recognized consulting firm offering technical, analytical, and management consulting services to a diverse clientele. Founded in 1974 to perform economic, engineering, and policy analysis in the energy and environmental fields, EEA has exhibited leadership and innovation in investigating energy and environmental issues. The firm is well known for incisive analysis of environmental regulatory policy, emission trading issues, and corporate environmental strategy. In the energy field, EEA is nationally known for its analysis of natural gas supply, transportation, and market issues. It also provides strategic planning and regulatory support to all segments of the natural gas industry. For more information, see http://www.eea-inc.com.

About the Energy Foundation

The **Energy Foundation** is a partnership of major foundations interested in sustainable energy. It was launched in 1991 by The John D. and Catherine T. MacArthur Foundation, The Pew Charitable Trusts, and The Rockefeller Foundation. The Joyce Mertz-Gilmore Foundation joined as a funding partner in 1996, and The McKnight Foundation joined in 1998. In 1999, The David and Lucile Packard Foundation joined to support two programs: the U.S. Clean Energy Program (now the Climate Program) and the China Sustainable Energy Program. In 2002, the William and Flora Hewlett Foundation joined to support advanced technology transportation and clean energy for the West. For more information, see http://www.ef.org.

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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: Energy Efficiency and Renewable Energy Would Lower and Stabilize Natural Gas Prices and Also Save Gas and Electricity Consumers' Money

Summary Conclusions

According to a new analysis by ACEEE (with the assistance of EEA), energy efficiency and renewable energy could reduce natural gas prices and volatility. We looked at the price effects of aggressive, but readily achievable efficiency programs and renewable energy resources in the lower 48 states. We found that 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% and save consumers $15 billion/year in retail gas and electric power costs. Over the next 5 years, the cumulative savings to residential, commercial, and industrial consumers could exceed $75 billion.

These 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 study 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 America 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.

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 3 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 4 years. These residential consumers will begin to experience the price increases this fall with a national average of a 36% increase 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 5 years averaging $96/year.

Policy Solutions

Policy makers at the state and federal could take a number of concrete actions to realize the benefits that could 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
- Expanded federal funding for energy efficiency and renewable energy implementation programs at DOE and EPA
- Appliance efficiency standards
- Insuring more efficient buildings through codes

- Support of clean and efficient distributed generation
- Renewable portfolio standards
- Public awareness campaign by state and national leaders

Electric Efficiency Is Part of the Natural Gas Solution

Electric efficiency could also help the looming natural gas problems that are projected to send consumer gas bills soaring this coming winter. Much of the recent growth in natural gas use has been fueled by new natural gas-powered electricity generation (EIA/NGM 2003). 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 of the grid—such as what contributed 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. Generation of electricity by wind, solar, and farm-based biomass generation often displaces 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 5 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.

Study Shows that Energy Efficiency and Renewable Energy Could Reduce Gas Prices

ACEEE, with the assistance of Energy and Environmental Analysis, Inc. (EEA), explored the impact of energy efficiency and renewable energy on reducing natural gas prices and volatility (Elliott et al. 2003). ACEEE developed estimates of reasonably achievable natural gas savings in the continental United States. These estimates were entered into a model of natural gas markets developed by EEA (2003). This model projects both regional and national effects of changes in natural gas consumption from a baseline. The results of the model showed a decrease in natural gas prices for all consumers resulting from increased energy efficiency and renewable energy use.

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 even modest savings could relieve.

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. 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.

> Small changes in natural gas consumption have disproportionately large impacts on natural gas prices

These ACEEE estimates served as an input matrix to the EEA natural gas model. It evaluates natural 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 will be used to produce a baseline assessment.
The model was used to analyze four policy scenarios:

1. National (48 states) with natural gas and electric efficiency measures and renewable energy resources
2. Pacific West (California, Oregon, and Washington) with natural gas and electric efficiency and renewable energy resources
3. Northeast/PJM region (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont) with natural gas and electric efficiency and renewable energy resources
4. New York State with renewable energy resources

In each state or regional scenario, the measures were applied in only the states of interest. 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 Model

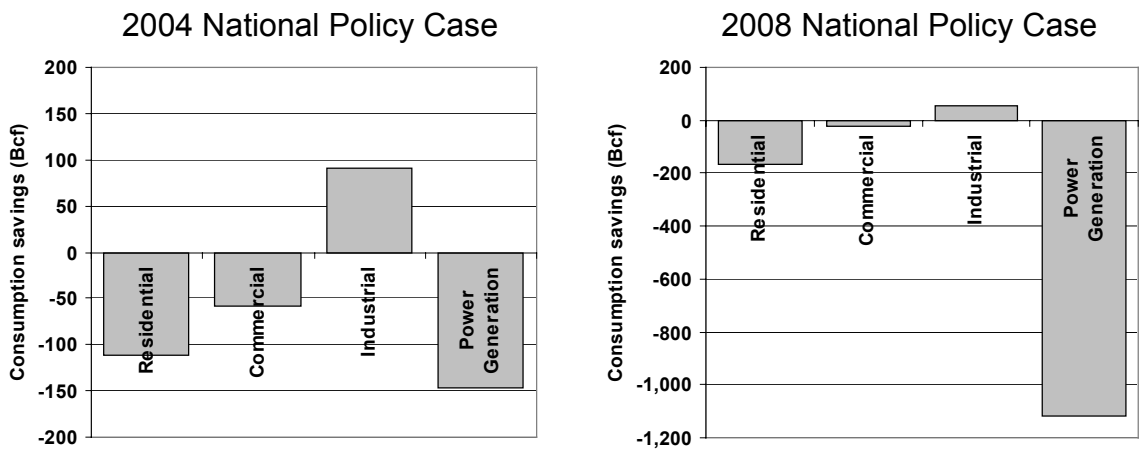
EEA's *Gas Market Data and Forecasting System* is a full supply/demand equilibrium model of the North American gas market. The model solves for monthly natural gas prices throughout North America, given different supply/demand conditions, the assumptions for which are specified by the user. Overall, 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 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).

Efficiency and Renewables Reduce Gas Consumption

Our analysis indicated 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 1). The power generation sector would represent the largest national natural gas savings in both 2004 and 2008 (see Figure 1). This reflects the combined effects of electric efficiency savings by all consumers and expanded use of renewables that would displace gas-fired electricity generation.

Figure 1. 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 appliances.[1] These savings are projected to grow over the 5 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, even though commercial gas savings are more modest than from the other sectors.

> The power generation sector would represent the largest national natural gas savings.

[1] See Elliott, Shipley, Nadel and Brown (2003) for details on the savings measures considered in this analysis.

Table 1. Changes in Natural Gas Consumption under Different Policy Scenarios

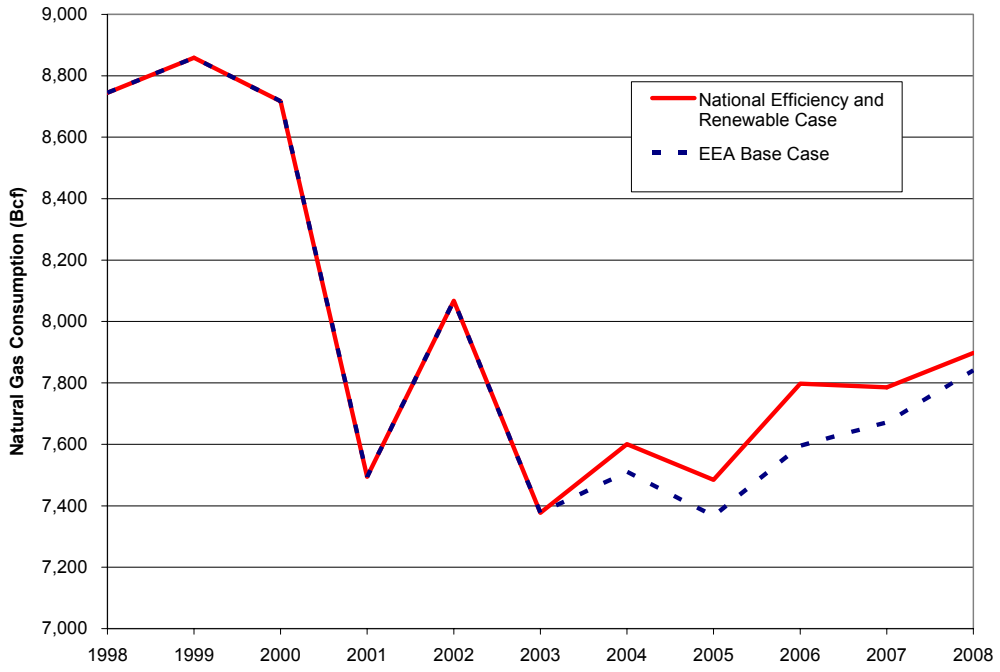
	Change from EEA Base Case in 2004		Change From EEA Base Case in 2008	
	Bcf	Percent	Bcf	Percent
Total Demand				
EEA July 2003 Base Case				
ACEEE: National	-238	-1.1%	-1,349	-5.5%
ACEEE: Pacific West	-31	-0.1%	-290	-1.2%
ACEEE: Northeast/PJM	-31	-0.1%	-230	-0.9%
ACEEE: NY Renewables	0	0.0%	-9	0.0%
Residential				
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 2). "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 stay low and more industry would remain in business relative to the base case, industrial demand would increase slightly. The industrial increases in gas use would be greatest in the first 3 years of the analysis when the projected declines in the base case are most severe.

Because gas prices would stay low and more industry would remain in business

Figure 2. Efficiency and Renewable Energy Frees Gas for Industrial Use



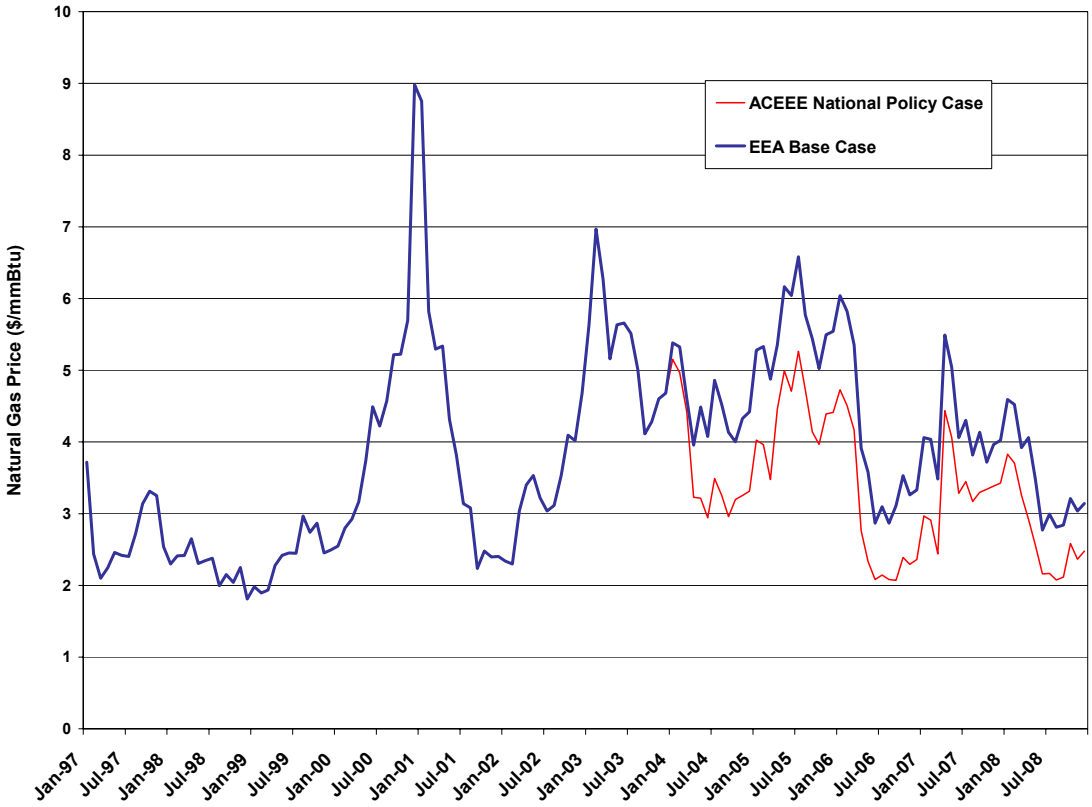
Four different scenarios were examined in detail by ACEEE and EEA. First, a scenario in which all 48 states in the continental United States implemented energy efficiency and renewable energy was examined. In the other three scenarios, we looked at the effects of implementing efficiency or renewable energy in just one region or state. Table 1 displays the change in natural gas consumption on a national level for each of the scenarios.

Natural Gas Saving Reduce Prices

Modest savings from energy efficiency and renewables energy generation would have large impacts on the price of natural gas. The national reference Henry Hub wholesale price would be reduced by almost $0.90/MMBtu or 20% in 2004, and by 22% in 2008 (see Figure 3) due to energy efficiency and renewable energy use (see Table 2).

Efficiency and renewables energy would reduce wholesale prices by 20% in 2004

Figure 3. Energy Efficiency and Renewable Energy Reduce Wholesale Gas Prices



Modest savings from energy efficiency and renewables energy generation would have large impacts on the price of natural gas.

Table 2. 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%

These wholesale price changes translate directly into consumer savings. Table 3 displays the total consumer savings in the 5-year study period of an aggressive nationwide energy efficiency and renewables scenario, where $75 billion in natural gas savings would be passed on to residential, commercial, and industrial customers.

Table 3. Cumulative End-Use Consumer Savings (Million Dollars) (2004–2008)

	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 4 displays what this type of scenario would mean specifically for residential customers. The data in this table represents the annual savings per residence. While these are annual savings numbers, the great majority of these savings would be obtained during the peak winter heating season.

Wholesale price changes translate directly into consumer savings.

Table 4. Average Annual Savings 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

The potential impacts vary by state, with those most dependent on gas 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 that we 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.

Florida

In Florida, total consumption would be reduced by 0.2% in 2004 and 8.7% by 2008. Most of the savings in 2008 would result from a decrease of 11% in gas consumption by the power industry. Wholesale prices at the South Florida hub would be reduced by 18.5% in 2004 and 21.6% in 2008. Residential and commercial natural gas customers would see their bills reduced by about 8% in 2008, while industrial customers would experience a 9% reduction. The average residential gas customer would experience a bill reduction of almost $27/year for the 5 years

modeled. Average annual total retail savings for residential, commercial, and industrial customers would be $122 million for the state.

Washington State

For Washington State, total consumption would be reduced by 3.1% in 2004 and 5.7% by 2008. Most of the savings in 2008 would result from a reduction of 12.3% in gas consumption by the power industry. Residential customers would see their bills reduced by about 11% in 2008, while commercial and industrial customers would experience 8% and 23% reductions. The average residential gas customer would have a bill reduction of over $108/year for the 5 years modeled. Average annual total retail savings for residential, commercial, and industrial customers would be $233 million for the state.

Illinois

In Illinois, total consumption would be reduced by 1.7% in 2004 and 2.9% by 2008. Most of the savings in 2008 would result from a reduction of 16.4% in gas consumption by the power industry. Wholesale prices at the Chicago hub would be reduced by 19.2% in 2004 and 22% in 2008. Residential customers would see their bills reduced by about 13% in 2008, while commercial and industrial customers would experience 11% and 12% reductions. The average residential gas customer would see a bill reduction of over $146/year for the 5 years modeled. Average annual total retail savings for residential, commercial, and industrial customers would be $818 million for the state.

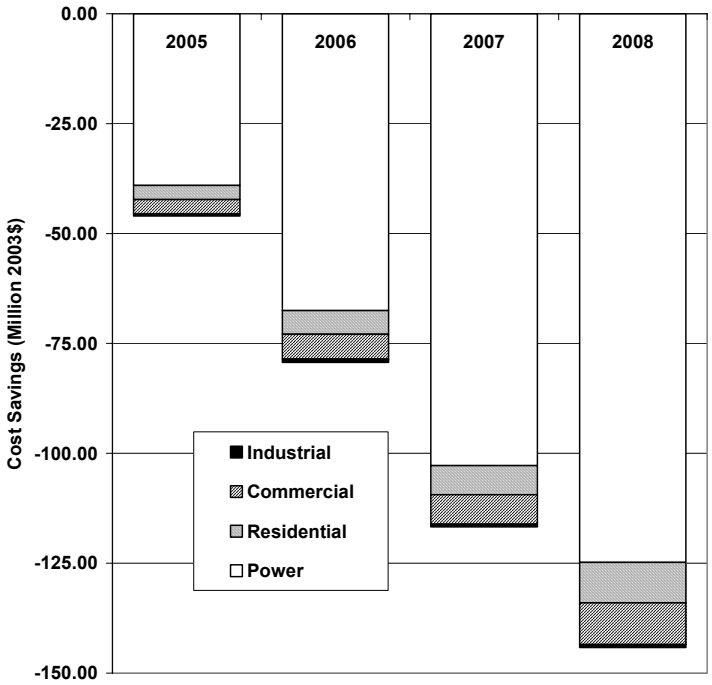
Regional Gas Savings Would Have National Impacts

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 similar impacts on the New York City and New England hub prices of natural gas in the region, as can be seen in Table 2. Under this scenario, the average New York State residential gas customer would save about $60 annually on the gas bill. Likewise, the Pacific West scenario would have marked price-impact on the Southern California Hub wholesale price, as would be expected. At the retail level, the average California residential natural gas customer would save about $37/year, and the combined state residential, commercial, and industrial would average over $900 million annually for the 5 years studied. In addition, these regional efforts would have national price impacts—for example, the Northeast/PJM scenario would produce a 6.1% reduction in Southern California Hub pricing in 2004 and the average California residential gas customer would save $12.74.

Expanded Renewables in New York State Would Reduce Gas Prices

In the most geographically narrow scenario we explore expanding 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 4). 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

Figure 4. Natural Gas Cost Savings from Expanded Renewables in New York State



would be reduced 0.25% for a savings of $19 million in 2008. As the share of renewable power generation would expand, this saving would continue to increase as well.

How to Make Energy Efficiency and Renewable Energy a Reality: Suggested Policy Strategies

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 here. 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.

> A portfolio of strategies would be most likely to achieve quick and sustained gas savings from energy efficiency and renewable energy resources.

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 (Elliott, Shipley, and Brown 2003).

> Government and public institutions must be prepared to provide people and businesses with direction and resources that target their energy and interests.

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, such as New York. The other states without renewable portfolio standards should be encouraged to implement them.

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. A national renewable portfolio standard should also establish a minimum commitment that allows states to adopt higher standards.

In addition, it is important that the existing production tax credit for renewable energy sources (now slated to expire at the end of September) be extended through at least 2006. In addition, the credits should be expanded to include other renewable energy technologies, as has been proposed in the Senate Energy Bill.

Public Awareness Campaign by State and National Leaders

Our state and national leaders are in a unique position to raise public awareness of energy efficiency and renewables. Witness the public attention focused on natural gas price issues in the wake of Chairman Allan 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.

Conclusions

Natural gas and electric efficiency and renewable energy resources should be important components in our response to our current natural gas price problems. 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) ports could be built. Due to energy efficiency and renewable energy resources' low cost and environmental impacts, they also can be an important part of the long-term solution. If we don't address the natural gas price problem, we will hurt 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.

Natural gas and electric efficiency and renewable energy resources should be important components in our response to our current natural gas price

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