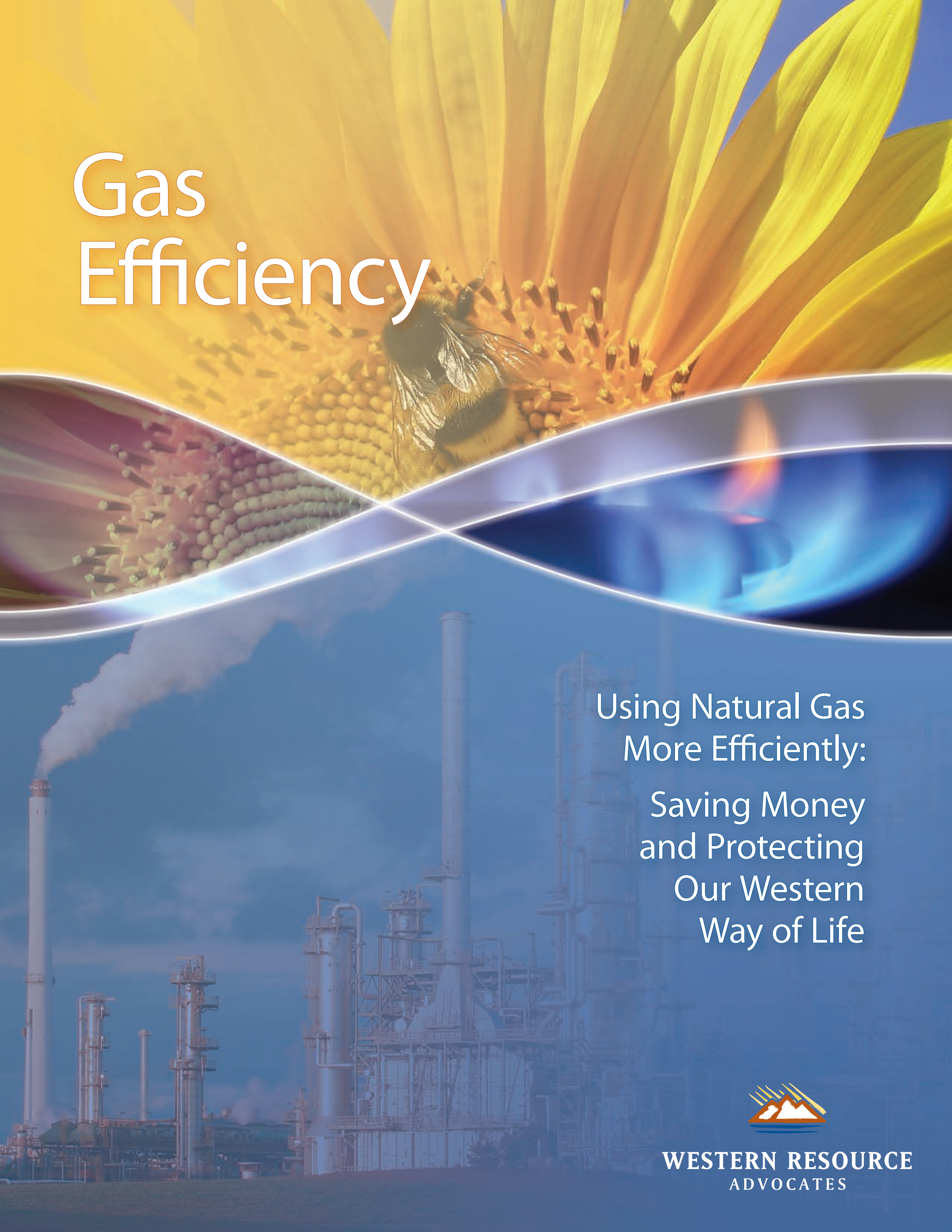

Gas Efficiency

Using Natural Gas More Efficiently:

Saving Money and Protecting Our Western Way of Life

WESTERN RESOURCE ADVOCATES

Foreword

Since 1991, Western Resource Advocates (WRA), formerly the Land and Water Fund of the Rockies, has promoted a sustainable vision of the West that is built on protection of the region's land, air and water — the essence of our Western way of life. In planning for our energy future, we envision implementation of policies to ensure that:

- Cost-effective investments in energy efficiency have been made in the residential, commercial, and industrial sectors;
- Renewable energy resources, including wind energy, solar power, and geothermal resources make a significant contribution to meeting the demand for electrical energy;
- Poorly controlled coal-fired power plants have been retrofitted with state-of-the-art pollution controls; and
- Natural gas exploration and development occurs consistent with the protection of wildlife habitat and wild places, water and air quality, and a heritage of ranching and wild, open spaces.

This report shows how a national commitment to using natural gas more efficiently would reduce demand, save money, make our industries more competitive, and reduce the intense pressures to develop oil and gas in places, and ways, that damage the West's long-term sustainability.

This report was made possible by a generous grant from the William and Flora Hewlett Foundation, whose support in many ways is essential to WRA's work. We are especially grateful to Rhea Suh for her continuing encouragement and support.

The principal author of this report was David Berry, Senior Policy Advisor. Also contributing in important ways were Jim Martin, Executive Director; John Nielsen, Energy Program Director; Mike Chiropolos, Lands Program Director; Bob Randall, Senior Attorney; and Howard Geller of the Southwest Energy Efficiency Project. We also gratefully acknowledge the invaluable assistance of Anita Schwartz, Penny Anderson, and Andria Bronsten.

All views and opinions expressed in this report are those of Western Resource Advocates and do not necessarily reflect the views of reviewers or funders. Any errors are the responsibility of WRA.

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Produced and written by Western Resource Advocates

Graphic Design, Cover Design:
Jeremy Carlson, Carlson Design
www.jeremycarlson.com

This report is available electronically at
www.westernresourceadvocates.org

Copies of Gas Efficiency may also be obtained by contacting:
Western Resource Advocates
2260 Baseline Road, Suite 200
Boulder, CO 80302
Tel: 303.444.1188 x231
Fax: 303.786.8054
info@westernresources.org

WESTERN RESOURCE
ADVOCATES

Western Resource Advocates' (WRA) mission is to protect and restore the land, air and water resources of the Rocky Mountain states. Our team of lawyers, scientists and economists is working to promote a clean energy future for the Interior West that reduces pollution and the threat of global warming; to restore degraded river systems and to encourage urban water providers to use existing water supplies more efficiently so we can sever the link between population growth and construction of new environmentally damaging water projects; and to protect public lands across the region from the twin threats of energy development and off-road-vehicle travel. Across our programs, we work to empower local conservation groups and seek out opportunities to partner with others who share our goal of protecting the western way of life.

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Contents

Executive Summary

The United States depends on natural gas for many purposes. It heats an increasing number of our homes. It is increasingly used to generate electricity. And it is used in manufacturing processes and as a feedstock for making products such as fertilizers. Clearly, natural gas is an integral part of our energy infrastructure.

However, in the last several years the price of natural gas roughly doubled as supplies have tightened. High prices are straining residential consumers' and businesses' budgets, driving some jobs overseas, and are forcing a re-evaluation of the role natural gas plays in generating electricity even as we are trying to reduce pollution from electrical energy production.

Intense natural gas exploration and development activities here in the Intermountain West threaten to transform parts of the West from wide-open spaces that are home to grizzlies, mountain lions, pronghorn antelope, mule deer, and elk to places dominated by pump jacks, pipelines, roads, and compressor stations. Even then, the gap between supply and demand for natural gas in the United States will grow.

Canyon ablaze in fall color, Roan Plateau, Colorado.
© 2003, Colorado Environmental Coalition

This report shows there is a better way. A concerted initiative to encourage **efficiency** investments that could significantly and cost-effectively reduce the demand for natural gas needed for our homes, stores, factories, and power plants. In particular, we found that:

- We could reduce natural gas use in our homes by 5–25 percent;
- We could reduce natural gas usage in the commercial sector by 7–11 percent;
- In industry, savings could be as high as 11 percent;
- Cost savings by the year 2020 may exceed $11 billion — far more than offsetting the cost of making these energy efficiency investments;
- A combination of efficiency and renewable energy investments would reduce natural gas usage in generating electrical energy just in the Interior West by 47 percent by 2020; and
- Reductions in demand due to energy efficiency and renewable energy could significantly reduce the price of natural gas.

Demand reductions would make our industries more competitive in the world marketplace and ease the energy cost burden on American families. They would reduce pollution. They can be implemented quickly and begin yielding energy savings immediately — there are no long lead times in drilling for efficiency. Finally, by reducing demand for natural gas we could create some breathing room so federal land managers could plan more carefully and manage energy development better so that we can **both** produce energy from the public lands and protect our Western way of life.

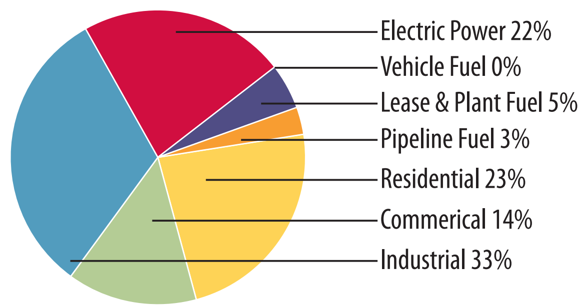
I. Consumption and Production Patterns

The first thing we need to know is how much natural gas the U.S. has historically used, and where that gas comes from. We also need to know what we have been paying for gas, and what the future costs may be.[1]

A. Historical Consumption and Production Patterns

Natural gas is used throughout our economy. Twenty-three percent of natural gas is used in our homes, for heating and other purposes. As shown in Figure 1, which shows the consumption patterns by sector for 2003,[2] the electric power industry uses about the same amount of natural gas as the residential sector. Industrial and commercial enterprises also are major consumers of natural gas. Smaller amounts of gas are used in pipeline transportation (primarily in compressors), to power vehicles, and as part of the process of producing natural gas in the field (this is known as plant and lease fuel and consists of gas used in well, field, and drilling operations, dehydrators, field compressors, and natural gas processing).

Fig. 1. U.S. Natural Gas Consumption by Sector: 2003



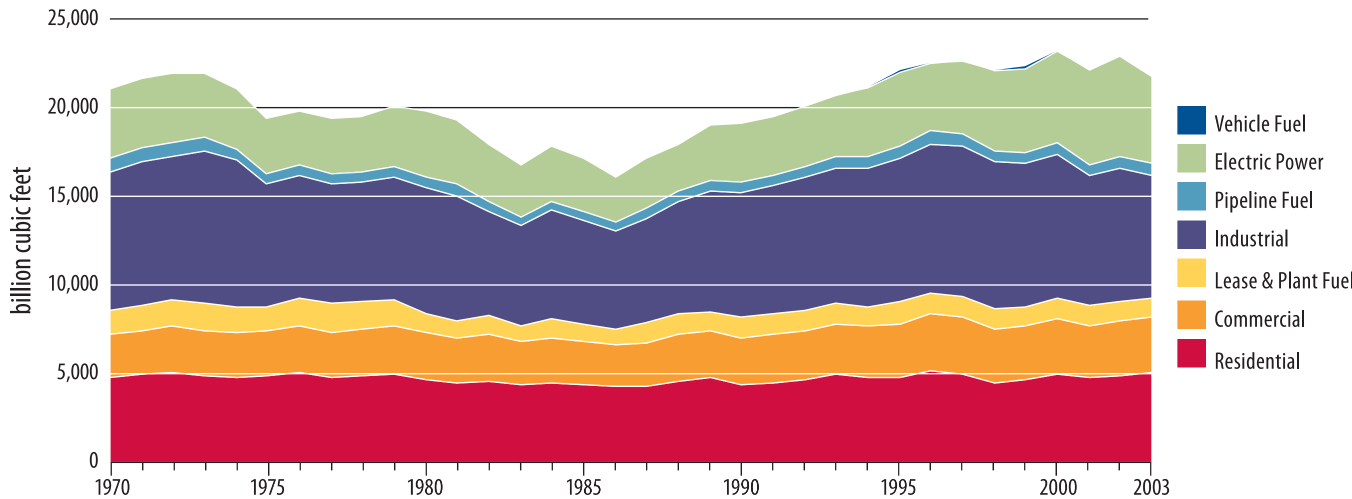
Total = 21,897 billion cubic feet

Measuring the quantity of natural gas

In the gas industry, the quantity of gas production or consumption is typically presented in terms of cubic feet, millions of Btu, and therms. One cubic foot of natural gas (at standard temperature and pressure) contains about 1028 Btu of heat content. One therm is 100,000 Btu. One million Btu is written as MMBtu.

1. This report relies on the U.S. Department of Energy's Energy Information Administration for data and a forecast of gas supplies and disposition.
2. Energy Information Administration, *Annual Energy Review 2003*, Table 6.5.

Fig. 2. U.S. Natural Gas Consumption: 1970–2003



Somewhat surprisingly, while consumption of natural gas has fluctuated over the past 30-plus years (Figure 2), consumption in 2003 was only 3.6 percent higher than it was in 1970.[3] Industrial and electric power consumption dipped in the 1980s as a result of high prices and fuel use restrictions, but in recent years electric power plant consumption of natural gas has increased.

Of course, different end users need natural gas for different purposes. Residential and commercial consumers use natural gas primarily for space heating (Table 1).[4] Major industrial uses of natural gas are in stand-alone boilers, combined heat and power facilities, and process heat, and as feedstocks for the manufacture of such compounds as ammonia, methanol, and ethylene.[5]

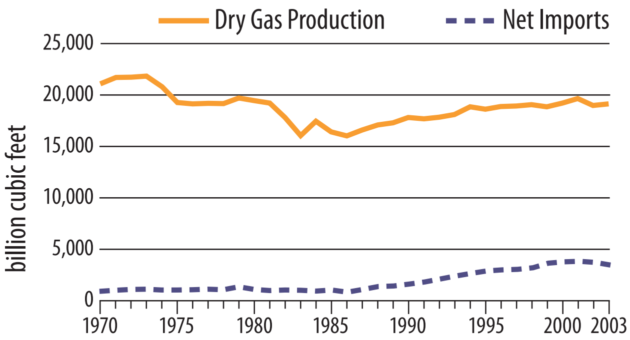
Table 1. Breakdown of Natural Gas End Uses in the United States

End Use	Commercial Sector 1999	Residential Sector 2001
Water heating	14%	24%
Space heating	73%	69%
Cooking	10%	Included in other
Other	3%	8%

Note: totals may not sum due to rounding.

3. *Ibid*.
4. Energy Information Administration, *2001 Residential Energy Consumption Survey: Household, Energy Consumption and Expenditures Tables*, Table 1. Energy Information Administration, *End-Use Consumption by Principal Building Activity*, Table 2. www.eia.doe.gov/emeu/cbecs/enduse_consumption/pba.html.
5. National Petroleum Council, *Balancing Natural Gas Policy*, Vol. II, Integrated Report, September 2003: pp. 34–39.

Fig. 3. U.S. Natural Gas Production and Net Imports

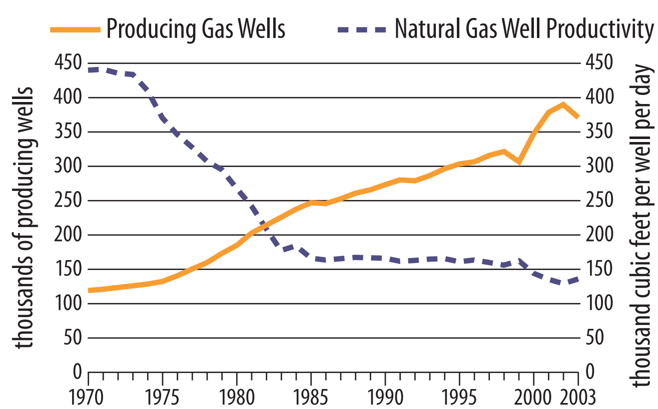


While **demand** for natural gas has been relatively stable over the last thirty years, domestic gas **production** has declined slightly over the past 35 years (Figure 3).[6] Net imports (imports minus exports) played a small role until recent years; but by 2003 about 15 percent of U.S. consumption of natural gas was met by net imports.[7] Canada has been by far the largest foreign supplier of U.S. natural gas.[8]

Natural gas well productivity has declined dramatically over time, as measured in thousands of cubic feet of gas withdrawals per well per day (Figure 4). The natural gas industry has been able to maintain a steady level of output, but it has done so by relying on an increasing number of gas wells whose average output per well has been decreasing.[9]

Natural gas **well productivity has declined dramatically over time**. The natural gas industry has been relying on an increasing number of gas wells whose average output per well has been decreasing.

Fig. 4. U.S. Natural Gas Well Productivity



6. Data from Energy Information Administration, *Annual Energy Review 2003*, Table 6.1.
7. Energy Information Administration, *Annual Energy Review 2003*, Table 6.3.
8. Energy Information Administration, *Annual Energy Review 2003*, Table 6.3. About 44 percent of Canadian gas production is exported to the U.S.: Canadian Gas Association, *Understanding the North American Natural Gas Market*, Ottawa, 2003. The second largest foreign supplier to the U.S. is Trinidad and Tobago which provides liquefied natural gas. U.S. exports go primarily to Mexico and Canada.
9. Data on producing wells and average productivity from Energy Information Administration, *Annual Energy Review 2003*, Table 6.4.

B. Projected Consumption and Supply

What does the future hold? Will we use more natural gas and where will it come from? Figure 5 shows a widely used forecast of domestic demand for natural gas (the Energy Information Administration's *Annual Energy Outlook 2005*). It shows that **unless we change the way we use natural gas**, demand is expected to increase in all sectors, with the most rapid growth rates occurring in the electric power and vehicle fuel sectors.[10]

Overall, the average annual compound growth rate in consumption from 2003 to 2025 is forecast to be 1.5 percent — taking us from 22 trillion cubic feet (TCF) in 2003 to more than 30 TCF in the year 2025.

Fig. 5. Gas Consumption Will Increase Slowly

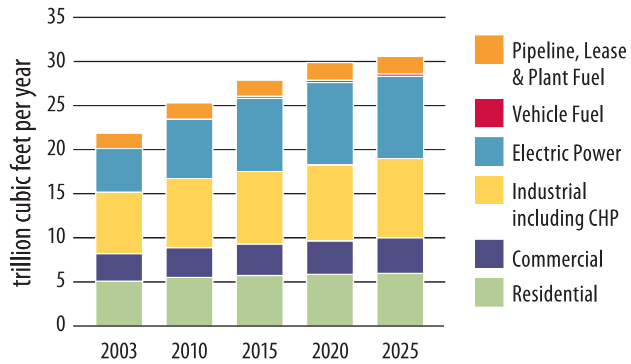
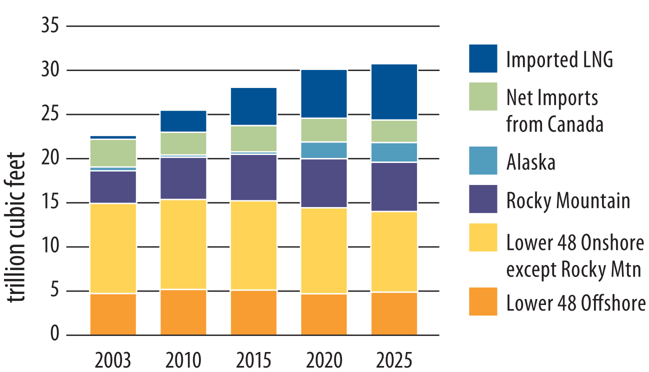


Fig. 6. Forecast of U.S. Gas Supply: Rocky Mountain Gas and LNG Will Increase in Importance



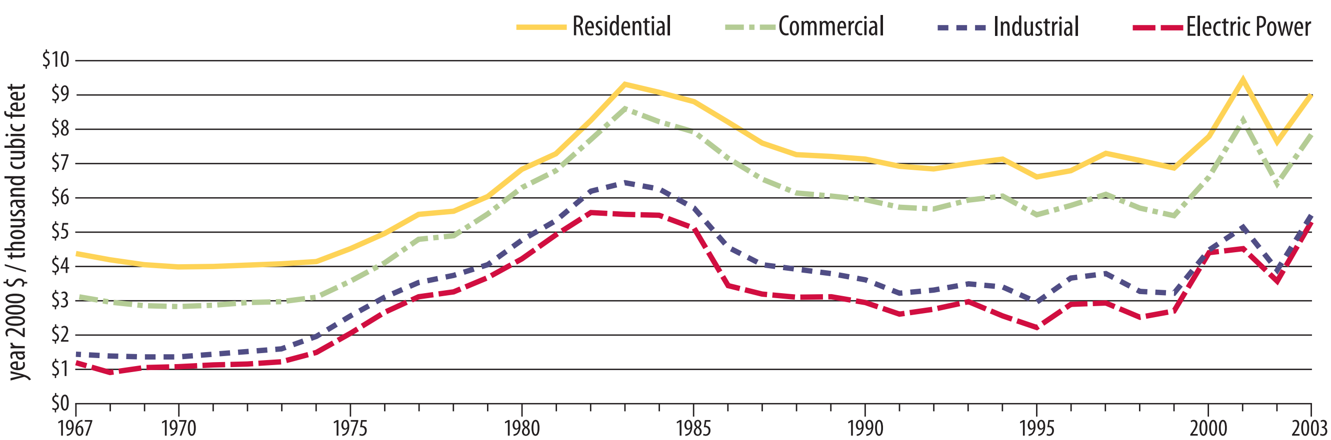
Given the projected demand for gas, what do we know about supplies of natural gas over that planning horizon? Figure 6 shows the forecast of gas supplies, and we have summarized some salient points below.[11]

- Offshore gas production in the lower 48 states is expected to **peak around 2010** and then decline slowly.
- Lower 48 onshore gas production outside the Rocky Mountain region is expected to **decline slowly**.
- In contrast, the Rocky Mountain region and Alaska are expected to exhibit **growing natural gas production**. The Rocky Mountain region contains major unconventional natural gas resources consisting of tight gas sandstones,[12] and coalbed methane[13] as well as conventional gas resources.[14] (See Appendix A for a brief overview of unconventional gas resources.)

10. Energy Information Administration, *Annual Energy Outlook 2005*, Table A13.
11. Energy Information Administration, *Annual Energy Outlook 2005*, Tables A13 and A14, and Supplemental Table 102.
12. The American Gas Association defines tight sands as gas-bearing geologic strata that hold gas too tightly for conventional extraction processes to bring it to the surface at economic rates without special stimulation.
13. Energy Information Administration, Ted McCallister, "Impact of Unconventional Gas Technology in the Annual Energy Outlook 2000," Energy Information Administration, Issues in Midterm Analysis and Forecasting 2000. For a description of coalbed methane, see U.S. Geological Survey, "Coalbed Methane — An Untapped Energy Resource and an Environmental Concern," USGS Fact Sheet FS-019-97. Gas shales are also considered unconventional resources. Gas shales are concentrated in the eastern United States.

Although imports — from Canada and of liquefied natural gas (LNG) — are expected to make up the **gap between U.S. demand and U.S. supplies**, net imports from Canada are **likely to decline**[15] while **imports of LNG from a number of other nations will have to grow dramatically**. However, to accommodate increasing LNG imports, additional terminals and other infrastructure will have to be constructed.[16]

Fig. 7. Natural Gas Prices Are Volatile and Generally Rising (Constant Dollars)



C. Price of Natural Gas

Most people don't pay much attention to natural gas demand and supply trends. However, they cannot ignore how those trends affect their pocketbooks — and they must wonder where prices might be headed after several years of above-average prices.

The price of natural gas paid by various end users has fluctuated greatly over the last thirty years, **but has tended to increase over time** (Figure 7). This figure shows gas prices in constant dollars, *i.e.*, with the effects of inflation removed.[17] Across all sectors, prices hit peaks in the early 1980s and again in 2003, the latest year shown on the graph. Prices for the next few years **are expected to remain high.**[18]

14. Gas markets are regional because of the configuration of the pipeline system. Thus, gas produced in the west is, at present, largely consumed in the west and western demand is largely met from western producing areas and from western Canada. The National Petroleum Council forecast also shows increased production in the Rocky Mountain region: *Balancing Natural Gas Policy*, 2003: vol. II, p. 107.
15. Imports from Canada may fall in the future as Canadian reserves become depleted and as Canadian domestic demand increases. Energy Information Administration, *Annual Energy Outlook 2005 (Early Release) — Overview*. National Petroleum Council, *Balancing Natural Gas Policy*, Volume II, p. 208.
16. National Petroleum Council, *Balancing Natural Gas Policy*, Volume II. There are currently only 4 LNG terminals, with none on the west coast.
17. Price data are from the Energy Information Administration, *Annual Energy Review 2003*, Table 6.8. Prices paid by end users consist of prices for the commodity itself plus transportation, storage, and distribution costs.
18. The Energy Information Administration *Short-Term Energy Outlook — February 2005* forecasts a price of $5.71 per MMBtu ($5.87 per thousand cubic feet) for gas consumed by the electric power sector in 2006 and a price of $10.46 per thousand cubic feet for residential natural gas for 2006. Prices are in nominal dollars.

II. Impacts of Natural Gas Production on Western Lands and Water

These data raise the question of how the United States will meet demand for natural gas in the future. Alternatives range from dramatically increasing imports to increasing drilling on sensitive lands in the Rockies and off the East and West coasts, to making significant new investments in using natural gas supplies more efficiently. We believe it makes more sense to significantly increase investments in end-use efficiency to reduce demand while maintaining a balanced approach to natural gas production in the American West.

But before we make a choice among these alternatives, we need to understand how natural gas production affects western lands and water.[19]

If federal land managers — such as the U.S. Forest Service and the Bureau of Land Management (BLM) — permit natural gas exploration and development in a certain area, a wide range of environmental impacts typically occur. Exploration and development requires the construction of well pads, which are up to four acres in size and must be cleared of vegetation, along with access roads and pits for drilling wastes. If the exploration wells are successful, field development will require the construction of additional well pads and roads to access them, as well as underground gathering systems to collect the natural gas and move it to a pipeline. In turn, large compressor stations are needed to force the gas through the pipelines to their ultimate market. Coalbed methane recovery generally requires dewatering the coal formation, resulting in very large amounts of "produced water" that can harm water quality,

> More than 42 million acres of public lands are under lease, and in the last fiscal year a record 6,130 drilling permits were issued.

19. For information on these issues see: U.S. Geological Survey (USGS), "Water Produced with Coal-Bed Methane," Fact Sheet FS-156-00, November 2000. USGS, "Coal-Bed Methane: Potential and Concerns," Fact Sheet FS-123-00, October 2000. C.A. Rice, M.S. Ellis, and J.H. Bullock, Jr., "Water Co-produced with Coalbed Methane in the Powder River Basin, Wyoming: Preliminary Compositional Data," USGS, Open File Report 00-372, 2000. U.S. Geological Survey, "Coalbed Methane — An Untapped Energy Resource and an Environmental Concern," USGS Fact Sheet FS-019-97. Thomas Darin and Amy Beatie, "Debunking the Natural Gas 'Clean Energy' Myth: Coalbed Methane in Wyoming's Powder River Basin," *Environmental Law Reporter*, 31 ELR 10566, 2001. Gary C. Bryner, "Coalbed Methane Development in the Intermountain West: Producing Energy and Protecting Water," *Wyoming Law Review*, Vol. 4 no. 2, pp. 541-557, 2004. Gary C. Bryner, "Coalbed Methane Development: The Costs and Benefits of an Emerging Energy Resource," *Natural Resources Journal*, Vol. 43, no. 2, pp. 519-560, 2003. James Viellenave, John Fontana, and Anthony Gorody, "Environmental Risk Assessment Methods Useful for Coalbed Methane Development: Cost-Effective Ways to Manage Risk," International Petroleum Environmental Conference, October 25, 2002. Steve Regele and Judd Stark, "Coal-Bed Methane Gas Development in Montana: Some Biological Issues," September 2000, available at http://www.deq.state.mt.us/coalbedmethane/Issues.asp. Abe Horpestad, Don Skaar, and Helen Dawson, "Water Quality Impacts from Coal Bed Methane Development in the Powder River Basin, Wyoming and Montana," December 18, 2001, available at http://www.deq.state.mt.us/coalbedmethane/Issues.asp. Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003), December 2004. U.S. PIRG, *America's Environment at Risk*, Washington, D.C.: April 2004. U.S. Department of the Interior, Bureau of Land Management, Rock Springs Field Office, *Final Environmental Impact Statement for the Jack Morrow Hills Coordinated Activity Plan/Proposed Green River Resource Management Plan Amendment*, June 2004.

vegetation, and agricultural operations. Some unconventional gas deposits cannot be recovered until the underground reservoir is hydraulically "fractured" by pumping large quantities of "fraccing" materials into the producing formation under high pressures. Fraccing is a potential threat to drinking water and public health.

The roads and well pads that accompany development fragment wildlife habitat and obstruct migration corridors. Multiple small sources of air pollution can, in the aggregate, degrade air quality in nearby communities as well as in pristine areas such as downwind national parks and wilderness areas. Water contamination poses a threat to local residents, natural ecosystems, and agricultural lands.

Both President Bush's and President Clinton's administration put in place policies to rapidly ramp up production of natural gas from public

Sunset near Otero Mesa
Photo: Steve Capra

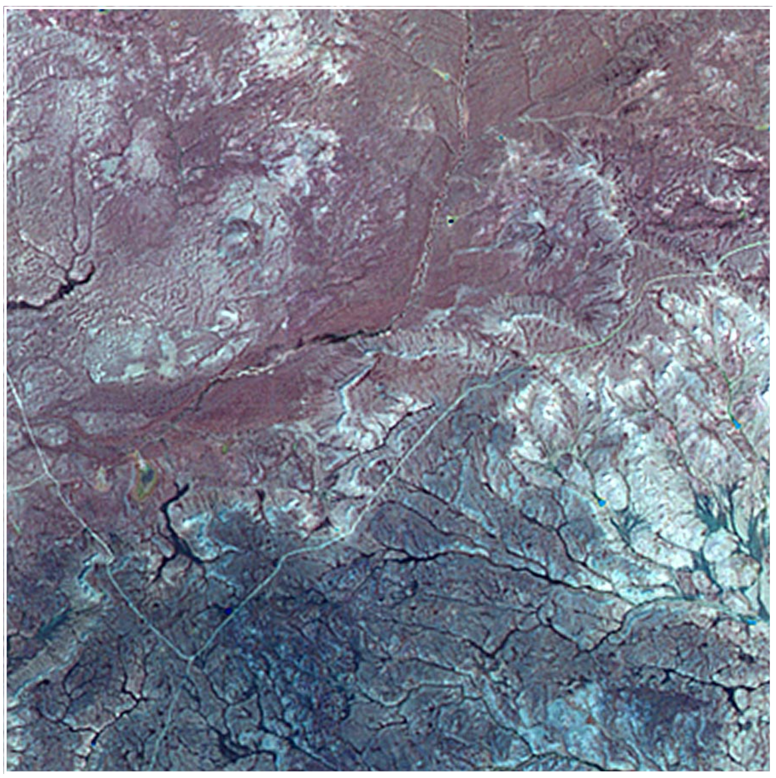
The intense, almost frenetic pace of development on the West's public lands threatens to forever change large areas of wild lands and previously undeveloped ranch lands.

lands in the Interior West. As a result, almost ninety percent of the onshore federal lands within the Rocky Mountain Overthrust Belt that overlays natural gas resources is available for leasing and development for oil and natural gas and much of the natural gas exploration activity is occurring in the Rocky Mountain region. More than 42 million acres of public lands are under lease, and in the last fiscal year a record number of drilling permits was issued (6,130).[20] Vast lands in the Powder River Basin of Wyoming and Montana, the San Juan Basin of New Mexico and Colorado, and the Upper Green River Valley in Wyoming are the subject of intense development in search of natural gas supplies, with potentially profound impacts for degraded water quality, impaired wildlife habitat and migration corridors, and increased air pollution.[21] The intense, almost frenetic pace of development on the West's public lands threatens to forever change large areas of wild lands and previously undeveloped ranch lands — places like the HD Mountains of Southwest Colorado, Otero Mesa of southern New Mexico, and the Roan Plateau of central Colorado.

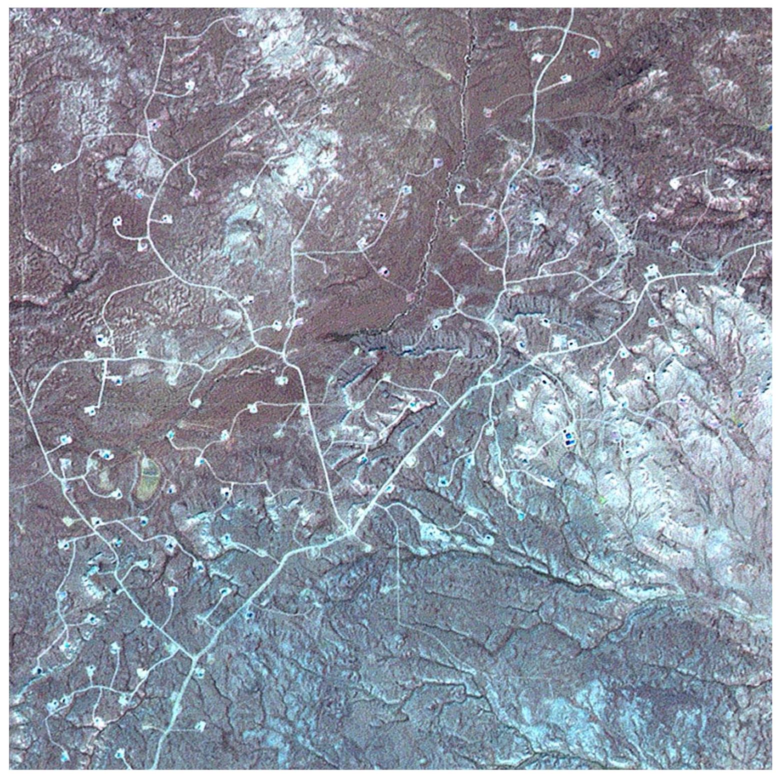
20. In a 2003 report required by the Energy Policy and Conservation Act, the Bureau of Land Management and other federal agencies found that while twelve percent of natural gas in five specific basins is off limits to development (equivalent to 16 trillion cubic feet), eighty-eight percent is available for development either under standard or specific stipulations. United States Departments of the Interior, Agriculture and Energy, *Scientific Inventory of Onshore Federal Lands' Oil and Gas Resources and Reserves and the Extent and Nature of Restrictions or Impediments to Their Development* (Jan. 2003).
21. Testimony Prepared for the United States Senate Committee on Energy and Natural Resources Hearings on Natural Gas, January 24, 2005, David Alberswerth & Peter A. Morton, Ph.D., The Wilderness Society.

Wyoming's Green River Basin. "Tight gas" resources are being developed rapidly in places like the Upper Green River basin in Wyoming. The Upper Green country of Wyoming is part of the Greater Yellowstone ecosystem. It is located just south of Grand Teton National Park between the Wind River and Gros Ventre mountain ranges, and pro-vides habitat for more than 100,000 mule deer, pronghorn antelope, and other big game. The longest migration corridor in the lower 48 states — used by pronghorn antelope — traverses part of the Upper Green and is imperiled by unprecedented drilling densities that disturb as much land as is left untouched. In the Upper Green, scientists are concerned that development is approaching the point where wildlife populations and migration corridors will be irretrievably impacted. On February 15, 2005, a group of fifty wildlife professionals wrote to the Secretary of the Interior to express their concerns and to urge the Department to take a more careful and cautious approach to energy development in the Interior West.

1986



1999



A Changing Landscape.

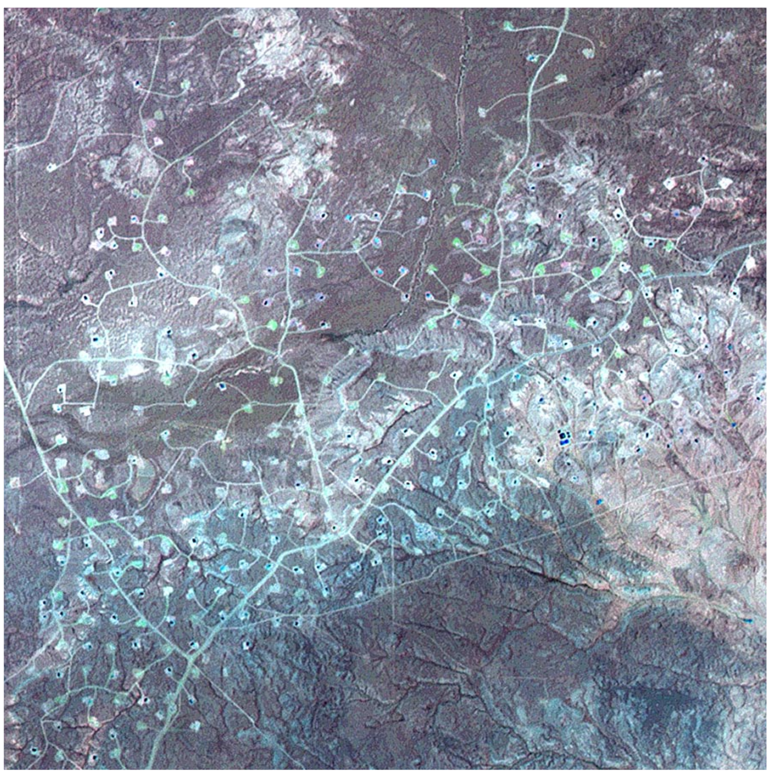
In the Jonah Field in Wyoming's upper Green River Valley, tight gas sand development requires the drilling of multiple wells in close proximity, functionally industrializing the entire landscape.

Landsat-7 Enhanced Thematic Mapper (ETM) satellite images by SkyTruth, www.skytruth.org.

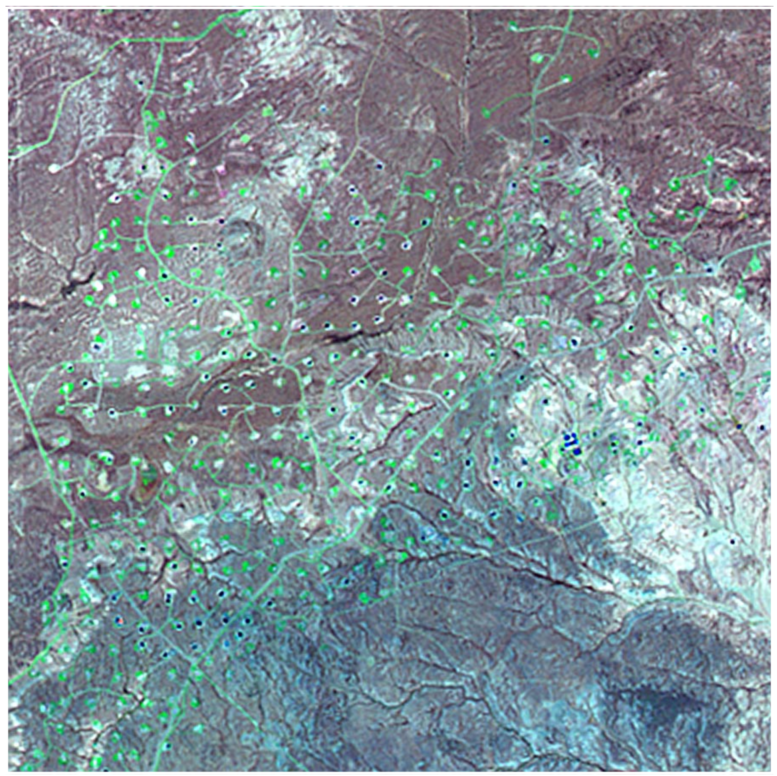
Graded well pads and connecting access roads are clearly visible. Each pad covers an area of 3-4 acres. Open pits of waste drilling fluids appear as blue spots on many of the pads. Bright green coloration in later images indicate that grass or other vegetation has recently been planted and some form of reclamation is being attempted. Area shown is about 7 miles across. More than 400 well pads have been installed; BLM has just released plans to allow the installation of over 3,000 additional well pads in this area. Note that drilling has now spread well beyond the area shown in this image, to the east, northeast and southwest.

The San Juan Basin. The Bureau of Land Management recently approved a plan authorizing as many as 9,970 new wells on federal lands during the next twenty years — over and above the 18,000 active oil and gas wells already in New Mexico's San Juan Basin. This energy development will disturb 44,300 acres of land and result in the emission of 62,000 tons of nitrogen oxides into the atmosphere annually — in an area that has already borne the brunt of intense energy development. The HD Mountains on the northern edge of the San Juan Basin in Colorado — home to some of the most majestic remaining stands of old-growth Ponderosa pine in the area — are also being considered for natural gas extraction. The Forest Service proposes to approve drilling 79 well pads and building 36 miles of roads through the 40,000-acre HD Mountains Roadless Area, and nearly twice that many wells on adjacent federal lands, despite local government opposition based on risks to water resources, wildlife habitat, and home values.

2001



2004



The Powder River Basin. So far, not much coalbed methane development (about 400 wells) has occurred in Montana, but a recent Federal court decision directs the Bureau of Land Management to consider phased development of a projected 26,000 wells in the Montana portion of the Powder River basin over the next ten years. This expansion would require as many as 9,000 miles of new roads, 15,000 miles of new pipelines, and 4,000 wastewater impoundments — affecting as much as 4.7 million acres of wildlife habitat. The Powder River Basin in Wyoming has already been impacted by intense coalbed methane development, and the Bureau of Land Management envisions as many as 51,000 new wells in the next ten years.

III. Smarter Natural Gas Use to Extend Supplies and Reduce Costs

Wherever you look, there are abundant opportunities for using natural gas more efficiently — in our homes and businesses, in our factories, and in the electricity generation industry. This report argues that aggressive investments in energy efficiency, taken as a whole, would save consumers money **and** reduce pressure on our public lands. To show you how we reached that conclusion, in this section we will:

- Describe some of the available opportunities for efficiency investments in our homes, factories, and stores (parts A and B);
- Review some other studies that estimate the percentage reductions in natural gas demand that could be achieved in the residential, commercial, and industrial sectors (part C);
- Estimate the achievable potential for nationwide natural gas savings (part D); and
- Describe potential savings of natural gas in the electric industry (part E).

In section IV, we will then review how reducing demand translates into lower prices for natural gas. Finally, in section V we describe what a national program to promote smarter use of natural gas might look like.

But first, what do we mean by energy efficiency? When we use that term, we do not mean adding another sweater while turning down the thermostat. Rather, **we mean using technologies, designs, and practices that reduce natural gas use without reducing the quantity or quality of the heating and other services that natural gas provides**.

Table 2. Common Natural Gas Efficiency Measures in Residential and Commercial Applications

Residential Sector	Commercial Sector
• Water heater blankets	• Double pane Low-E windows
• Pipe wrap	• Tank insulation
• Low flow showerheads	• High-efficiency gas water heater
• Faucet aerators	• High-efficiency furnace/boiler
• Duct insulation	• Roof and wall insulation
• Duct sealing	• HVAC tune up
• Programmable thermostats	• HVAC temperature reset
• HVAC testing and repair	• HVAC steam balance
• Attic weatherization	• Hot water circulation controls
• Wall weatherization	• Solar water heating
• High-efficiency furnace	• Infrared conveyer oven
• High-efficiency water heater	• Energy management system
• Horizontal axis clothes washers	
• Duct repair	
• ENERGY STAR dishwashers	
• Solar water heating	
• ENERGY STAR windows	

A. Gas Efficiency Opportunities in the Commercial and Residential Sectors

As we have shown previously in Figure 1, the commercial and residential sectors account for thirty-seven percent of the natural gas used in the U.S. There are numerous measures that could be implemented in these sectors to achieve greater efficiencies in natural gas use. Some specific measures are shown in Table 2.[22]

Drilling for Natural Gas in Our Homes Rather Than in Environmentally Sensitive Public Lands	
Example: Experts believe that Colorado's Roan Plateau could provide 45-53 billion cubic feet (BCF) of economically recoverable natural gas, or 46-55 trillion Btu.	**Alternatives**: Simply installing a gas water heater insulation blanket can save 2.2 million Btu (MMBtu) in a year. Adding a programmable thermostat can save 2.7 MMBtu on average. If just 15 percent of households in the Intermountain states (AZ, ID, MT, NV, NM, UT, CO and WY) added and used these simple devices over the course of 20 years, the gas savings would equal 74 trillion Btu. That's far more than could be produced in the Roan Plateau.
Example: Montana's wild and spectacular Rocky Mountain Front — home to grizzlies, big game, and mountain lions — could provide 289-397 BCF of economically recoverable natural gas (298-409 trillion Btu).	**Alternative**: Roughly 152,000 new homes are being built in the Intermountain region each year, according to 2001 census data. ENERGY STAR rated homes save 49 MMBtu per home annually due to reduced gas needs heating. If we conservatively assume (1) a savings of just 40 million Btu per year for each ENERGY STAR home, (2) that 80% of new homes in the Intermountain region will be gas heated, and (3) that just half of these new homes are ENERGY STAR rated – then this would result in saving 486 trillion Btus over 20 years. That is equivalent to more than even the most optimistic estimate of gas to be found in the Rocky Mountain Front.

Source for energy savings estimates: Southwest Energy Efficiency Project

22. One of the most effective ways to reduce energy use is to pursue comprehensive packages of applicable measures at a given site rather than focus on individual measures one at a time.

B. Gas Efficiency Opportunities in the Industrial Sector

There are many opportunities for implementing energy efficiency measures in large industries, but they tend to be process- and site-specific. Table 3 presents several examples of natural gas efficiency measures that can be implemented at individual industrial sites.

Table 3. Examples of Site-Specific Industrial Efficiency Measures

Case	Gas Efficiency Opportunities	Gas Savings
1. Copper Processing	• Replace heated troughs with unheated water cooled troughs for transporting liquid copper sulfide from the smelting furnace • Substitute landfill gas for natural gas for heating refinery electrolyte • Optimize concentrate dryer **Payback period: Less than one year for aggregate savings**	452,000 MMBtu per year
2. Paper Mill	• Recycle vacuum pump seal water and use vacuum pump seal water to heat water required for paper machine • Recover heat from dewatering process and de-inking plant • Reduce operating temperature in de-inking plant • Heat shower water with reboiler steam and vacuum pump seal water, heat de-ink pulpers with waste water **Payback period: 2.1 years for aggregate gas savings**	608,000 MMBtu per year
3. Chemicals	• Switch to high-efficiency burners • Increase return of condensate to boilers • Insulate steam system components, repair steam leaks in overhead lines, adjust fuel/air ratio in boiler, repair compressed gas leaks **Payback period: 0.5 months to 13 months for individual project components**	236,000 MMBtu per year
4. Aluminum Casting and Rolling	• Manage comfort heating system • Establish burner testing and maintenance program • Improve heat transfer from radiant tubes to annealing atmosphere in annealing furnaces **Payback period: 0.2 years to 2 years for gas components**	460,000 MMBtu per year

Sources: All examples are from U.S. Department of Energy, Energy Efficiency and Renewable Energy, Best Practices Plant-Wide Assessment Case Studies. Specific cases are as follows:

1. *Kennecott Utah Copper Corp., DOE/GO-102004-1808, July 2004.*
2. *Blue Heron Paper Co., DOE/GO-102004-1758, April 2004.*
3. *Bayer Polymers, DOE-GO-102003-1677, August 2003.*
4. *Pechiney Rolled Products, DOE/GO-102004-1889, July 2004.*

C. Review of Studies Estimating Achievable Savings Nationwide

Across the economy, opportunities are plentiful for using gas more wisely. What level of savings could realistically be achieved on a large scale if we adopt the kinds of measures identified above? This section examines several recent studies of the potential for reducing natural gas consumption. These studies[23] covered large parts of several western states (Washington, Oregon, Utah, and California), or examined savings in the United States as a whole. Each study compares one or more efficiency "scenarios" to a 'business-as-usual' scenario that represents the baseline level of gas consumption that would occur in the absence of any new programs and policies to promote gas efficiency.[24] Where possible, we selected aggressive, achievable, cost-effective efficiency scenarios as the basis for estimating the potential savings from natural gas efficiency programs and policies. Note that the studies assumed different time periods over which achievable potential could be reached — on the order of 10 to 20 years. More details on the assumptions and methodologies used in the individual studies are provided in Appendix B.

Here, we are focusing on achievable potential for energy savings — efficiency measures that make use of existing technology, are cost effective,[25] and could reasonably be expected to be implemented with aggressive policies and programs while recognizing that not all consumers will adopt economically beneficial measures and recognizing the high transaction costs of capturing the last increments of efficiency. **In short, we focus on what is do-able.**

23. Ecotope: *Natural Gas Efficiency and Conservation Measure Resource Assessment for the Residential and Commercial Sectors*, Prepared for the Energy Trust of Oregon, 2003. Puget Sound Energy, *Least Cost Plan Update August 2003*, Chapter IV. GDS Associates, *The Maximum Achievable Cost Effective Potential Gas DSM for Questar Gas*, March 22, 2004. Fred Coito and Mike Rufo, KEMA-Xenergy, Inc., *California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study*, 2003. Fred Coito and Mike Rufo, KEMA-Xenergy, *Inc., California Statewide Residential Sector Energy Efficiency Potential Study*, 2003. Interlaboratory Working Group, *Scenarios for a Clean Energy Future*, Oak Ridge National Laboratory, Lawrence Berkeley National Laboratory, and National Renewable Energy Laboratory, 2000: ORNL/CON-476, LBNL-44029, NREL/TP-620-29379.
24. Depending on the study, the baseline or business-as-usual case might be the current level of consumption or a forecast of future consumption taking into account naturally occurring conservation and continuation of existing programs and policies.
25. Cost effective measures are those whose incremental costs (i.e., costs above what consumers would have otherwise done, which could have been to do nothing) over their lifetimes are less than the costs of supplying and delivering natural gas during that same period. Whether a particular efficiency measure is cost effective depends on: the savings from using the measure; the incremental cost of the measure itself; program administration costs; and the cost of natural gas and additional infrastructure needed to deliver more gas. As noted above, gas prices have been volatile historically and have tended to rise over time (Figure 7). Higher gas prices will increase the achievable potential savings and lower gas prices will decrease the achievable potential.

Fig. 8. Summary of Gas Savings Potential

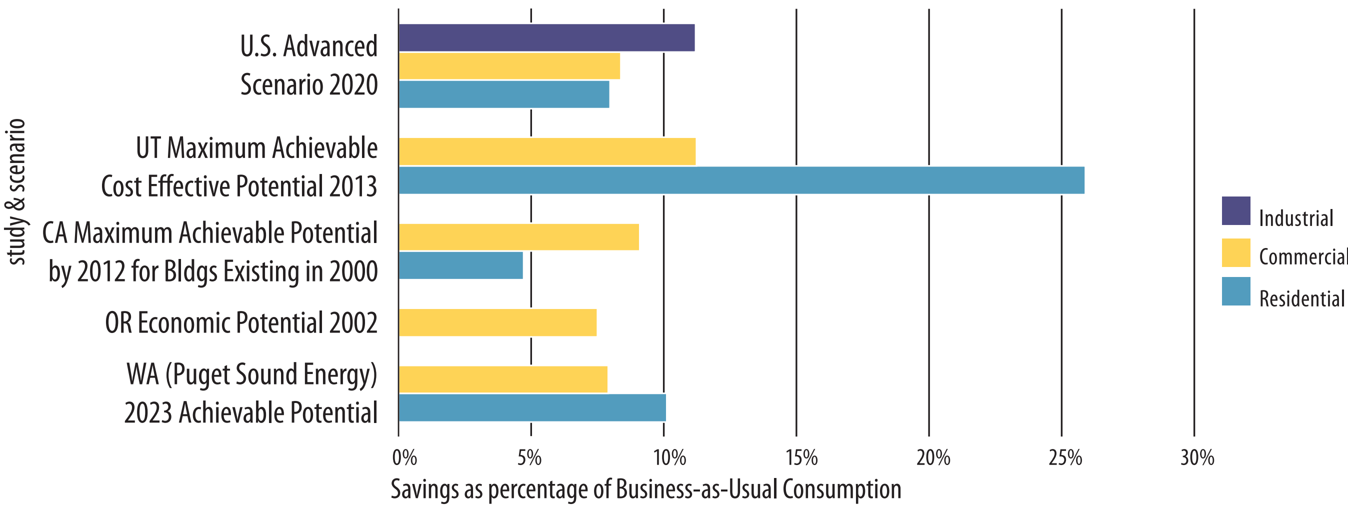


Figure 8 is a graphic representation of what these studies found. **Most important, all of these studies suggest that significant cost-effective and technologically achievable savings are waiting to be seized. And the efficiency scenarios are generally less costly than the business-as-usual scenarios. In other words, the efficient path is generally the less costly path.**

Specifically, these studies show that:

- Residential sector savings range **from a low of 5 percent to a high of 26 percent** compared to the business-as-usual consumption;
- Commercial sector savings would be **between approximately 7 percent and 11 percent** of business-as-usual consumption; and
- For the industrial sector, the Interlaboratory Working Group (IWG) estimated savings in 2020 under the advanced scenario for the United States at about **11.2 percent**.[26]

The IWG study, which covers the entire U.S., found that efficiency investments would yield significant savings **in every sector**. The Oregon and Washington studies yielded similar results for the commercial sector. The Utah study suggested that large savings are available in the residential sector while the California study came out on the lower end of the range for residential savings, in part because of California's history of energy efficiency programs.

> The efficient path is generally the less costly path.

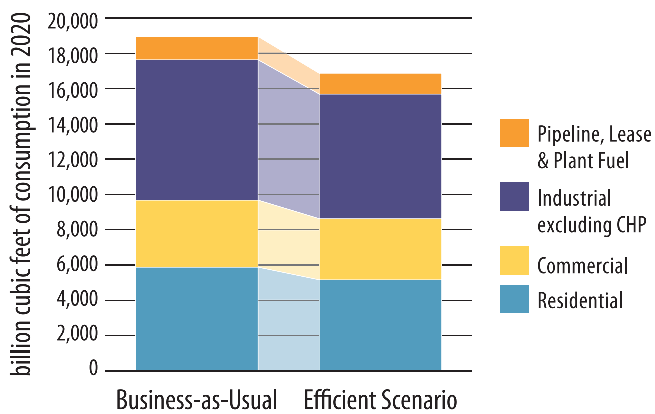
26. This excludes the effects of increased combined heat and power production. Combined heat and power projects are facilities that produce both electricity and thermal energy, such as steam or hot water, in a single onsite integrated system. The IWG analysis indicates that some industrial activities, such as paper production and cement production, would increase natural gas usage, as gas is substituted for petroleum or coal. However, on net, industrial sector gas consumption would go down under the advanced scenario.

D. National Levels of Achievable Savings in the Residential, Commercial, and Industrial Sectors

Building on the studies described above, here we estimate the natural gas savings which could be attained nationally if aggressive but achievable efficiency programs are implemented in the residential, commercial, and industrial sectors over a period of 15 years.[27] We used the Energy Information Administration Annual Energy Outlook 2005 reference case forecast of gas contsumption for 2020 by sector as our business-as-usual level of consumption. To represent an energy efficient scenario, we applied the average of the percentage savings from Figure 8 by sector to the business-as-usual consumption by sector to estimate the magnitude of savings that could be achieved with aggressive efficiency programs. Since the studies shown in Figure 8 differ in methodology, assumptions and geographic area, the average of the savings in Figure 8 should be interpreted as an approximation of national achievable efficiency savings.

Figure 9 compares business-as-usual natural gas consumption in 2020 in the residential, commercial, and industrial sectors in the U.S. (including associated plant and lease fuel and pipeline fuel usage) with an estimate of what consumption in these would be under an aggressive efficiency scenario. It shows that in 2020, **gas consumption in the residential, commercial, and industrial sectors (excluding CHP) could be cut by more than 2 trillion cubic feet annually through energy efficiency — an 11 percent savings — from the business-as-usual scenario. That is, demand by the residential, commercial, and industrial sectors would, in aggregate, be reduced from about 19 trillion cubic feet per year under the business-as-usual scenario to about 17 trillion cubic feet per year in 2020 due to energy efficiency investments.**

Fig. 9. Residential, Commercial, and Industrial Gas Consumption Could Be Reduced 11% in 2020 with Energy Efficiency



E. Reducing Natural Gas Consumption in the Electric Power Sector

Beyond savings in the residential, commercial, and industrial sectors, there is also a potential for reducing natural gas consumption in the electric power sector. As Figures 2 and 5 show, electricity generation is an important and growing use of natural gas. In 2003, electricity generation comprised about 22 percent of all natural gas consumption.[28]

Generation of electricity from gas- and coal-fired power plants can be greatly reduced by a combination of energy efficiency for electric end users (you and me) plus an increased investment in renewable energy. In Western

27. It is assumed that it would take about 15 years to fully implement efficiency programs so as to reach the achievable potential.

Resource Advocates' 2004 report, *A Balanced Energy Plan for the Interior West*, we examined the benefits, feasibility, and impacts of deploying more efficiency measures and more renewable resources to meet growing energy demands, and compared that scenario to business-as-usual.[29] The study found that, in 2020, under the *Balanced Energy Plan*:

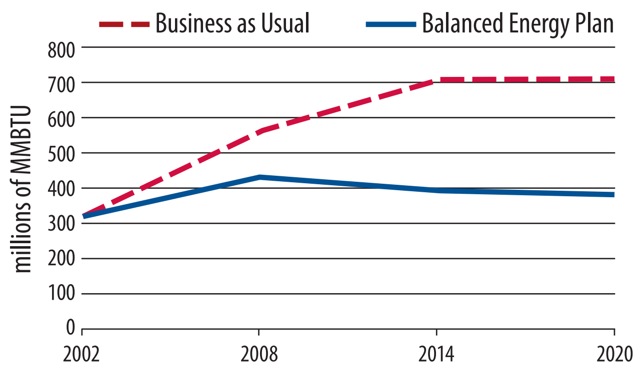
- Electricity consumption just in the Interior West could be **decreased by roughly 30 percent** compared to a business-as-usual scenario.

- Non-hydro renewable resources could supply approximately 20 percent of the Interior West's electric generation.

- Natural gas consumption for generation of electricity **would decline from 710 million MMBtu under the business-as-usual scenario in 2020 to 379 million MMBtu in 2020 in the Interior West.**[30] Thus these electric power sector savings could substantially reduce natural gas use. See Figure 10, from *A Balanced Energy Plan*.

- Electric energy service costs in the Interior West would be about **$2 billion less in 2020** than under business-as-usual (in year 2000 dollars).

Fig. 10. Natural Gas Consumption by the Electric Power Industry in the Interior West



- The Interior West would be better positioned to withstand risks such as high natural gas prices, costs of compliance with possible future carbon dioxide emission regulations, or the effects of prolonged drought on hydropower production.

Other studies have concluded that natural gas usage by the electric energy industry could decline significantly. The Interlaboratory Working Group study forecast that natural gas use in the electric sector nationwide would decrease by 1,600 million MMBtu in 2020 under the advanced scenario compared to business-as-usual.[31] This represents an 18 percent reduction relative to business-as-usual.[32]

28. Natural gas is chosen for electric generation for a variety of reasons: capital costs of gas fired power plants are relatively low, the efficiency (heat rate) of new gas-fired power plants is improving, and gas-fired power plants can serve peak, intermediate, or base loads of electric utilities.
29. Western Resource Advocates, *A Balanced Energy Plan for the Interior West*, Boulder, CO: 2004. Available at www.westernresourceadvocates.org. The Interior West consists of Arizona, New Mexico, Colorado, Nevada, Utah, Wyoming, and Montana.
30. In the *Balanced Energy Plan*, 3,240 MW of old, less efficient gas plants are retired between 2003 and 2020 while only 1,960 MW of old gas plants are retired under business-as-usual. The addition of new gas plants between 2003 and 2020 under business-as-usual is 16,075 MW, but is only 7,815 MW under the *Balanced Energy Plan*.
31. Interlaboratory Working Group, *op. cit.*, Chapter 7. The forecast excludes the effects of combined heat and power projects.
32. Under the advanced scenario, energy efficiency investments would reduce electricity generation in 2020 by about 22 percent relative to business-as-usual. This study also calculated that about 9 percent of the electricity generated in the U.S. in 2020 could be derived from wind, biomass, geothermal, and other non-hydro renewable energy resources

IV. What Are the Benefits of More Efficient Natural Gas Use?

Investing in efficiency (and renewable energy in the case of the electric energy industry) would yield significant benefits for the nation and the Rocky Mountain Region. A sound strategy will:

- Reduce gas consumption,
- Save consumers money,
- Lower gas prices, and
- Decrease pressure to extract more gas from sensitive lands in the Rocky Mountain Region.

A. Lower Costs of Natural Gas Services

In 2020, the gas costs avoided by making investments in residential, commercial, and industrial energy efficiency would be $11 billion in constant 2004 dollars if the wellhead price of gas in 2020 were the same as it was in 2004 ($5.49 per MCF).[33] The cost of achieving these gas savings is the incremental cost of the energy efficiency measures and programs, including program administrative costs. The cost of employing gas energy efficiency measures has been estimated in several studies and we assumed an average value of the cost of saved energy of between $1.74 per MCF and $2.00 per MCF in year 2004 dollars. Thus, the annualized costs of implementing achievable, cost-effective energy efficiency programs in 2020 would be about $3.4 to $3.9 billion in 2004 dollars.[34] **The net benefits of energy efficiency in 2020 would therefore be $7.1 to $7.6 billion in year 2004 dollars.** Even if natural gas costs are significantly lower than assumed or the cost of saved energy is significantly more expensive than assumed, net benefits would still be positive. The results reported above pertain to a single year. Individual studies of potential energy savings reported in Appendix B found positive net benefits over long periods as well.

In sum, taking into account the net benefits of energy efficiency, the nation will pay less to heat buildings, cook food, and manufacture products like fertilizer with the energy efficient measures in place than under business-as-usual.

as opposed to less than 3 percent under business-as-usual. Electricity generated using natural gas as a fuel (excluding combined heat and power generation) would decline by about 10 percent under the advanced scenario in 2020, relative to business-as-usual. The advanced scenario assumes a rapid increase in the average efficiency of gas fired generation because of deployment of new, efficient combined cycle power plants, retirement of some inefficient gas fired steam generating capacity, and less frequent use of remaining less efficient gas plants.

33. Wellhead price from Energy Information Administration, Short-Term Energy Outlook, March 2005, Table 4.

34. Ecotope: *Natural Gas Efficiency and Conservation Measure Resource Assessment for the Residential and Commercial Sectors*, Prepared for the Energy Trust of Oregon, 2003, Tables 1.5 and 1.9. Interlaboratory Working Group, *Scenarios for a Clean Energy Future*, Oak Ridge National Laboratory, Lawrence Berkeley National Laboratory, and National Renewable Energy Laboratory, 2000: ORNL/CON-476, LBNL-44029, NREL/TP-620-29379, Table 4.5. R. Neal Elliott, Anna Monis Shipley, Steven Nadel, and Elizabeth Brown, *Natural Gas Price Effects of Energy Efficiency and Renewable Energy Practices and Policies*, American Council for an Energy-Efficient Economy, Washington, DC, 2003, Report No. E032, pp. 56-58. Costs were inflated to 2004 dollars using the Gross Domestic Product Implicit Price Deflator. The lower value of the cost of saved energy is the average reported in the studies. The upper value is the maximum reported in the studies. The assumed average value of the cost of saved energy is weighted by the relative savings in the residential, commercial, and industrial sectors.

B. Lower Natural Gas Prices

Significant reductions in the demand for natural gas due to aggressive investments in energy efficiency programs and policies may lead to significant decreases in the price of natural gas. As demand shifts downward, it becomes unprofitable to use the most expensive gas resources, and adequate gas can be supplied from lower cost resources. Consequently, the price of gas is expected to fall as demand falls, holding all other factors constant.

It is important to understand that the supply of natural gas appears to be price inelastic[35] — or in a lay person's terms, high prices do not appear to be stimulating large new supplies to come on the market. This is due to the industry's characteristics. The National Petroleum Council[36] points out that there are very few options for increasing gas supplies in the short run since there are limited actions that can be taken to increase gas supply in the absence of developing new technologies for finding and recovering gas and discovering new gas resources. In the long run, when investments in new supplies, such as LNG production, liquefaction, shipping, and terminals, can be made, supply may become more elastic.

Predicting how much efficiency investments would reduce gas prices is difficult as the track record of price forecasts obtained from gas industry models is relatively weak. The Energy Information Administration[37] has noted that "Natural gas generally has been the fuel with the least accurate forecasts in consumption, production, and prices..." With this caveat in mind, we reviewed several studies which estimate the magnitude of price decreases that would result from decreased gas demand.

A study conducted by the American Council for an Energy Efficient Economy (ACEEE)[38] found that recent volatility in natural gas prices could be attributed to a tight supply situation. Thus, small declines in demand could result in large decreases in price. In particular, by 2008, combined electric and natural gas energy efficiency and renewable energy measures could reduce gas consumption by 5.5 percent according to ACEEE, with the largest savings in the electric power generation sector. (Industrial use of gas would increase as a result of lower prices.) **ACEEE forecasted that, with a policy to promote energy efficiency and renewable energy, wholesale natural gas prices at Henry Hub, a major wholesale pricing point located in Louisiana, would be reduced by 22 percent in 2008 relative to a base case.**

35. Price elasticity refers to the percentage change in quantity associated with a given percentage change in price. The supply function is price inelastic if an x percent increase in price elicits an increase in supply of less than x percent. There is, unfortunately, very little in the way of publicly reported statistical analyses of supply elasticities of natural gas. Most of the studies reviewed by Dahl and Duggan date from periods during which gas prices were regulated. Carol A. Dahl and Thomas Duggan , "Survey of Price Elasticities from Economic Exploration Models of US Oil and Gas Supply," *Journal of Energy Finance and Development*, Vol. 3 (1998), pp. 129-169. These studies measured the quantity of natural gas in several ways — wells drilled, success rate, discovery size, or total reserves. Some of the studies reviewed by Dahl and Duggan found no statistically significant relationship between the quantity of gas supplied and the price of gas, but some found inelastic supply functions for wells drilled, success rate, or discovery size.

36. National Petroleum Council, *Balancing Natural Gas Policy*, Volume II, pp. 289-290.

37. Esmeralda Sanchez, "Annual Energy Outlook Forecast Evaluation", Energy Information Administration, November 19, 2003.

38. R. Neal Elliott et al., *op. cit.*. The analysis used a model developed by Energy and Environmental Analysis, Inc.

A Lawrence Berkeley Laboratory review[39] of other studies concluded that:

- Increased use of renewable energy and energy efficiency could help ease the threat of high natural gas prices in both the short-term and the long-term; and

- Roughly speaking, each 1 percent reduction in natural gas demand nationally is likely to lead to a long-term average reduction in wellhead gas prices of between 0.8 and 2 percent. As wellhead prices decline, it is reasonable to expect that gas prices paid by consumers would also decline.

In conclusion, large-scale energy efficiency programs **will likely lead to a decrease in gas prices**. Again, some caution about the magnitude of price decreases is advisable because of the modest statistical and modeling foundation of our current knowledge.

C. Reduced Environmental Impacts in the West

By embarking on a path of cost-effective energy efficiency, the market forces to rapidly develop gas resources in environmentally sensitive areas are diminished. To some extent, other gas resources could economically supply the needed gas. At a minimum, reduced aggregate demand for gas will moderate the pressure to develop gas resources at environmentally sensitive sites and give federal government agencies and the gas industry more time to evaluate and address the environmental impacts of gas exploration, drilling, and production at specific locations. It will soften what otherwise will become a boom-and-bust cycle in parts of the West. And it will allow further development of new technologies that reduce the impacts of natural gas development.

39. Ryan Wiser, Mark Bolinger, and Matt St. Clair, *Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency*, Berkeley, CA: Lawrence Berkeley National Laboratory, January 2005, LBNL-56756. The studies reviewed were prepared by the Energy Information Administration, the Union of Concerned Scientists, the Tellus Institute, and ACEEE. Except for the ACEEE study, cited above, all used the Energy Information Administration's National Energy Modeling System.

V. Implementing End-Use Natural Gas Efficiency

Energy efficiency investments do not "just happen." Putting these investments in place requires, among other things, state and federal policies to reduce natural gas demand. Fortunately, the United States, and especially states like California, have decades of experience in this area. For example:

- Federal and state governments have set efficiency standards for common appliances like air conditioners, refrigerators and washing machines and dryers;
- Building codes can be updated regularly to incorporate recent advances that promote a higher quality of life with lower energy bills;
- The federal government, many states, and electric utilities have programs to help economically disadvantaged people weatherize their homes; and
- Companies across the country make energy efficiency investments for large consumers and earn a profit from a share of the reduced energy bills that result.

Utility programs are one of the most important means of advancing energy efficiency.[40] These programs are directed toward several markets such as existing homes, new residential construction, existing commercial and industrial customers, new commercial construction, and low-income residential customers. The box on the next page describes what one utility program (Vermont Gas Systems) has been able to achieve.

State and federal appliances standards have made a major contribution to reduced energy usage.[41] For example, the 1992 standards for annual fuel utilization efficiency of gas furnaces eliminated a large number of inefficient models from the market by 1995.[42] New standards could reduce natural gas consumption in residential, commercial, and industrial applications, often with simple fixes such as low flow pre-rinse spray valves used in restaurants to pre-wash dishes and flatware before they are put in a dishwasher.[43]

Opportunities for energy savings at manufacturing and mining establishments are often site specific, depending on industrial processes. The U.S. Department of Energy conducts an Industrial Technologies Program that contributes to the cost of conducting energy efficiency assessments at individual plants. Assessments are conducted by third parties such as universities and outside technology and engineering firms.

40. KeySpan Energy Delivery New England, *Demand-Side Management and Market Transformation Plan, 2002-2007*, Report to Massachusetts Department of Telecommunications and Energy, April 11, 2003. Martin Kushler, Dan York, and Patti Witte, *Responding to the Natural Gas Crisis: America's Best Natural Gas Energy Efficiency Programs*, American Council for an Energy-Efficient Economy, Report No. U035, December 2003.
41. Steven Nadel, Andrew deLaski, Jim Kleisch, and Toru Kubo, *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*, Washington, D.C. and Boston, MA: American Council for an Energy-Efficient Economy and Appliance Standards Awareness Project, Report No. ASAP-5/ACEEE-A051, 2005.
42. Stephen Meyers, "Efficiency of Appliance Models on the Market Before and After DOE Standards," Lawrence Berkeley National Laboratory, LBNL-55509, June 2004.
43. Steven Nadel, Andrew deLaski, Jim Kleisch, and Toru Kubo, *op. cit.*.

Vermont Gas Systems (VGS) Comprehensive Program Portfolio

VGS serves about 35,000 customers

Demand side management programs initiated in 1993

Programs address residential, low-income, commercial, and industrial customers

Programs address new construction, retrofit of existing buildings, and equipment replacement

VGS provides:

- Energy audits
- Technical review and recommendations for new construction
- Engineering analyses of gas saving measures
- Information about equipment manufacturers and suppliers
- Assistance with code and permit requirements
- Inspections of work in progress and verification of measures
- Rebates to reduce consumers' up-front costs

Program participation:

- 7,284 efficiency measures installed by residential customers through 2002
- 476 efficiency measures installed at commercial and industrial sites through 2002

Impact:

- Measures installed through 2002 save about 4.7% of 2002 system throughput
- Benefit/cost ratio = 3.97 (excluding environmental benefits)
- Customers will save $22.5 million at current rates over next 15 years on measures installed through 2002

Budget: About $1 million per year (2001-2003)

Cost recovery is through rates; costs are deferred and collected in rates over an amortization period determined in rate cases.

Source: Martin Kushler, Dan York, and Patti Witte, Responding to the Natural Gas Crisis: America's Best Natural Gas Energy Efficiency Programs, American Council for an Energy-Efficient Economy, Report No. U035, December 2003.

One organization's experience in Nevada provides a model for what can be done nationwide. The Southwest Energy Efficiency Project (SWEEP) evaluated 14 policy options for Nevada to increase that state's energy efficiency.[44] SWEEP recommended that several of the proposed policies be given the highest priority by policymakers. Table 4 shows the high-priority policies applicable to natural gas and SWEEP's target level of savings for 2020.

Table 4. SWEEP's High-Priority Natural Gas Energy Efficiency Strategies for Nevada

High-Priority Policy	Nevada savings targets in 2020 billion cubic feet per year
Stimulate natural gas utility energy efficiency programs	10.6
Upgrade building energy codes	4.0
Adopt appliance efficiency standards	0.8
Increase funding for low-income home weatherization	0.6
Increase support for energy efficiency upgrades in K-12 schools	0.3

44. Howard Geller, Cynthia Mitchell, and Jeff Schlegel, *Nevada Energy Efficiency Strategy*, Boulder, CO: Southwest Energy Efficiency Project, January 2005.

VI. Conclusions

Natural gas is a relatively clean-burning fuel that is used to heat homes and businesses, cook food, generate electricity, and produce heat and steam for industrial processes in factories across the nation. It is an important part of the total energy portfolio upon which the United States depends. Without a shift in public and private sector decision making, the role of natural gas in residential, commercial, and industrial uses and in electric power plants will continue to grow slowly.

Nationally, gas wells have exhibited sharp declines in productivity. The gas industry will have to work hard to keep domestic production at recent levels and will turn to more expensive sources of supply in the future. As a result, gas prices likely will continue to increase and will be highly volatile.

The intense pace of gas resource development on the West's public lands threatens to forever change large areas of previously undeveloped ranch lands and wilderness-quality lands in places like the HD Mountains of Southwest Colorado, Otero Mesa of far southern New Mexico, and the Roan Plateau of central Colorado.

We do not suggest that it would be wise, or even desirable, to halt the exploration for natural gas on federal lands in the American West. However, the search for natural gas is industrializing parts of our West; the Jonah Basin in Wyoming shows one extreme of what natural gas development can mean for previously open spaces. In the future, unchecked exploration for natural gas supplies threatens places like the Rocky Mountain Front of Montana, Otero Mesa in New Mexico, and the Roan Plateau and the HD Mountains of Colorado.

This report shows that an alternative exists. A combination of investments in energy efficiency and renewable energy could:

- Significantly reduce the demand for natural gas and lower gas prices relative to what they otherwise would have been;
- Reduce costs for homeowners and businesses;
- Moderate the need for additional gas production; and
- Reduce pollution.

Cost-effective, practical end use efficiency measures are less costly than production and delivery of natural gas. They can be implemented quickly without significant lag times, and begin yielding energy savings immediately.

Such energy efficiency measures could diminish consumption of natural gas in the residential, commercial, and industrial sectors combined by about 11 percent by 2020. Gas consumption by the electric power sector could be reduced through electric energy efficiency programs and through greater reliance on renewable energy resources such as wind, biomass, solar, and geothermal energy.

An efficiency initiative would provide public lands managers and the energy industry with the breathing room needed to ensure that the domestic development of natural gas resources is done in an environmentally responsible manner. Few issues could be more important to the American West.

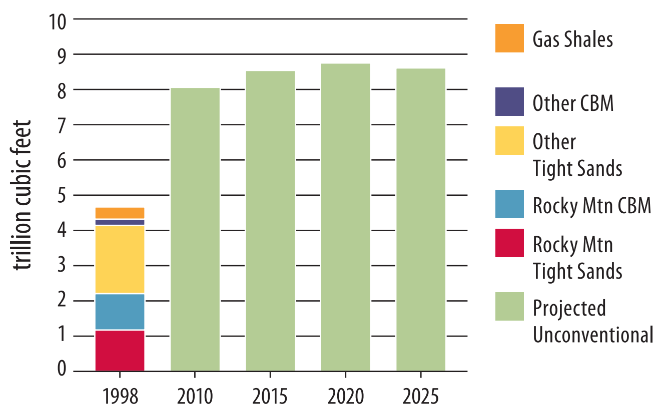
Appendix A: The Growing Role of Unconventional Gas

While many of the conventional oil and gas-producing basins in the lower forty-eight states are mature and in decline, significant unconventional gas reserves remain available in the Interior West. This Appendix describes unconventional gas production and resources (tight sands, coalbed methane (CBM), and gas shales). Figure A provides an overview of the role of unconventional gas production.[45] In 1998 unconventional gas comprised about one quarter of all U.S. gas production. By 2025, it is forecast to comprise about 39 percent of U.S. gas production.

Tight sands accounted for about two thirds of unconventional gas production in 1998. The Rocky Mountain region was the leading producer of unconventional gas in 1998, its tight sands and coalbed methane accounting for about half of the production of unconventional gas nationwide.

It is expected that unconventional gas production will be well above 1998 levels by 2010, but that unconventional gas production will level off between 8 and 9 trillion cubic feet per year between 2010 and 2025. Much of the future production of unconventional gas is likely to come from the Rocky Mountain region. Proved reserves of tight sands are greatest in that region[46] and about four-fifths of coalbed methane proved reserves are located in that region.[47]

Fig. A. Unconventional Gas Production Will Grow and Level Off



45. The 1998 data are from Ted McCallister, "Impact of Unconventional Gas Technology in the Annual Energy Outlook 2000," Energy Information Administration, *Issues in Midterm Analysis and Forecasting 2000*. Forecasts are from Energy Information Administration, *Annual Energy Outlook 2005*, Table A14 and pertain to onshore unconventional resources in the lower 48 states.
46. McCallister, *op. cit,*. p. 3. The Energy Information Administration defines proved reserves as the quantities of gas that geologic and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.
47. Energy Information Administration, "Coalbed Methane in the US: Panel 2 of 2."

Appendix B: Description of Efficiency Studies Reviewed

In this report, we relied upon several other studies[48] that have been completed on both a regional and national scale to assess the potential savings available from investments in natural gas end-use efficiency. The material in this Appendix provides background on those analyses.

Washington

This study covers the Puget Sound Energy service area. It addresses achievable potential by 2023. The study looks at the "portion of the potential that is likely to be available over the planning horizon under prevailing market barriers and administrative constraints that hamper delivery or implementation." The study added 15 percent to costs to account for program administration and delivery costs. Penetration rates were based on experience, ability to ramp up programs, and customer willingness to adopt measures assuming incentives cover all incremental costs. Measures were included if the cost of saved energy was less than or equal to $1 per therm. About 75 percent of the portfolio of measures comprising the achievable potential cost less than $0.65 per therm.

California

These studies looked at major investor owned gas utilities in California and present estimates of maximum achievable potential by 2012. Measures eligible for inclusion in the maximum achievable potential are cost-effective. The studies apply only to construction existing in 2000 (residential) or 2002 (commercial) and do not include new construction. Implementation of programs to reach the maximum achievable potential savings would require an increase in program funding to a level about 4 times that of the current program funding level. Benefit-cost ratios using the total resource cost test for the maximum achievable potential are:

- 1.36 for the commercial sector, and
- 1.34 for the residential sector.

Oregon

The Oregon study estimated economic potential but did not provide sufficient information to determine baseline consumption for future years. We therefore included only results for the annual savings for the commercial sector for which the study provided 2002 baseline consumption. All measures whose cost of saved energy is less than or equal to $0.50 per therm are included.

48. Ecotope: *Natural Gas Efficiency and Conservation Measure Resource Assessment for the Residential and Commercial Sectors*, Prepared for the Energy Trust of Oregon, 2003. Puget Sound Energy, Least Cost Plan Update August 2003, Chapter IV. GDS Associates, *The Maximum Achievable Cost Effective Potential Gas DSM for Questar Gas*, March 22, 2004. Fred Coito and Mike Rufo, KEMA-Xenergy, Inc., *California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study*, 2003. Fred Coito and Mike Rufo, KEMA-Xenergy, Inc., California Statewide Residential Sector Energy Efficiency Potential Study, 2003. Interlaboratory Working Group, *Scenarios for a Clean Energy Future*, Oak Ridge National Laboratory, Lawrence Berkeley National Laboratory, and National Renewable Energy Laboratory, 2000: ORNL/CON-476, LBNL-44029, NREL/TP-620-29379.

Utah

This study examined maximum achievable cost-effective potential by 2013. It looked at the "potential for maximum penetration of energy efficient measures that are cost-effective according to the Total Resource Cost test and that would be adopted given unlimited funding, and by determining the maximum market penetration that can be achieved with a concerted, sustained campaign involving highly aggressive programs and market interventions." Benefit-cost ratios using the total resource cost test for the maximum achievable cost-effective portfolio are:

- 2.25 for the commercial sector, and
- 1.72 for the residential sector.

East Fork Falls, Parachute Creek, Roan Plateau, Colorado.
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United States

The Interlaboratory Working Group study did not estimate potential savings, per se. Instead it constructed two scenarios of future energy consumption — a moderate scenario and an advanced scenario. We used the results from the advanced scenario for 2020. Features of the advanced scenario include:

- A set of policies consistent with a sense of urgency in meeting energy and environmental goals;
- Policies include voluntary labeling and deployment programs, building codes, energy efficiency standards, and tax credits;
- Policies may be controversial today;
- Policies may impose significant costs on one or more regions or sizable groups;
- Policies may correct market imperfections;
- Policies involve a maximum increase of 100 percent in mature federal deployment program budgets and federal research and development budgets;
- A domestic carbon dioxide trading system will be established; and
- A carbon cap is set so that the value of a carbon trading permit is about $50 per metric ton of carbon in 2010.

WESTERN RESOURCE
ADVOCATES

2260 Baseline Road, Suite 200
Boulder, CO 80302
303.444.1188

www.westernresourceadvocates.org