

ly less than 85 MMbbl/d, he said a 2.5 percent annual decline rate would lower the net gain 10 MMbbl/d by the end of this decade.

"If we decline in mature fields—and more and more of the world base is mature—at 5 percent, we lose 19 MMbbl/d in that same half decade," Petrie surmised. "It has been attributed to one of the large service companies that the decline rate in the existing base is more like 8 percent. I am not sure that is true . . . but if it is somewhere between 8 and 5 percent, the loss of production is somewhere between 28 MMbbl/d and 19 MMbbl/d. That would suggest we are a lot nearer peak oil than some people acknowledge."

### Price Hypotheses

Of course the bottom line for independent oil and gas producers is the bottom line. Today's tighter balance between supply and demand, and the outlook for a supply-constrained future suggest higher price expectations, Petrie said.

Displaying histograms showing the dis-

tribution of average West Texas Intermediate crude oil prices and Henry Hub natural gas prices for 1995-2004, Petrie recognized a \$10 a barrel shift to the right in the time-weighted center of gravity for oil prices—from \$18-\$20 to \$28-\$30—and a \$2.50 shift to the right for gas prices—from \$2.00-\$2.50 an Mcf to \$4.50-\$5.00—from the second half of the 1990s to the first half of the 2000s.

Saying he no longer made price predictions, only hypotheses, Petrie offered, "My price hypothesis is that we are probably going to have an environment where the distribution is no longer normal; it is going to be skewed to the right. The time-weighted center of gravity—until we get forces that tell me otherwise—is somewhere around \$50, plus or minus \$2 a barrel.

"In the next few years, I think we will spend more time on the right side of the curve than on the left," Petrie ventured. "The best way for us to get any kind of serious test of \$30 is probably by way of \$80 plus."

Turning to natural gas, Petrie impart-

ed, "I have a \$6 number with a similarly skewed distribution. I think we have to visit \$9 or \$10 an Mcf to test below \$4."

If anything, EIA's short-term outlook is even more bullish. Rodekohr displayed a WTI base-case price projection through 2006 that stayed consistently in the upper \$50s, while his 95 percent-confidence interval ranged between the upper-\$40s on the low side and the upper \$60s on the high side. A similar natural gas spot price graph stayed between \$7.50 and \$8.00 an Mcf for the base case and presented a 95 percent confidence interval that ran from a little more than \$5 an Mcf on the low side to nearly \$12 on the high side.

"We expect oil prices to remain relatively high for the next 18 months," Rodekohr confirmed. "We don't think anything is going to bring prices down to the \$20 world."

For natural gas, he added, "We think there is tremendous upside . . . approaching \$12 an Mcf in certain winter peak conditions. There is more upside risk than downside risk." □

## Alternatives Offer Promise, Not Solution

DENVER—One way to satisfy future demand for natural gas is by drilling more wells. Other means are to substitute other fuels or to lower demand. Speakers at the Rocky Mountain Natural Gas Strategy Conference offered perspectives on these options in a variety of panel pre-

sentations Aug. 1-3 in Denver.

The U.S. Energy Information Administration projects U.S. gas demand will exceed 30 trillion cubic feet annually by 2025, Energy Markets & Contingency Information Director Mark E. Rodekohr told attendees in the conference's open-

ing session. Nevertheless, sustained high gas prices are having an impact on consumers, asserted American Gas Association President and Chief Executive Officer David N. Parker.

"You should know that between 1999 and 2004, the average retail price of natural gas to residential consumers rose 60 percent, from \$6.69 (an Mcf) to \$10.74 delivered," Parker recounted.

Energy-intensive industries—those that use gas as a feedstock as well as for power, such as chemicals, metals and forest products—have been the hardest hit, he advised. "They have lost 240,000 American jobs in the past seven years," Parker said, adding: "The National Association of Manufacturers believes we will lose another 700,000 jobs in the next decade if energy supply is not expanded."

But high energy prices affect small businesses just as much, Parker continued. For example, he estimated dry cleaning costs had risen 25-30 percent in the past five years. "The National Restaurant Association tells us that it is seeing a decline in the use of family-oriented restaurants in large part because people don't have the money to spend," he added.

Parker reported that the average Midwest homeowner paid \$991 to heat his home last winter, an increase of 71 percent



Among panelists who discussed energy supply, quantities and qualities during the opening day of the Rocky Mountain Natural Gas Strategy Conference were, from left, Eugene Kim, a senior analyst with Wood Mackenzie; Ronald L. Lehr with the American Wind Energy Association; moderator Patricia Nelson Limerick; Michael Campbell, M.D. Campbell & Associates; and Stuart Wagner, a principal in Petrie Parkman & Co.



over the past six years. He pointed out that amounted to 2.5 percent of the median gross household income of \$40,000 a year in the upper Midwest. "This was during a period when we had warmer winters for the past four years," Parker mused.

### Energy Alternatives

High prices drive renewed interest in conservation and efficiency. Jim Martin, executive director of Western Resource Advocates, revealed that his organization assimilated a number of reports prepared by a variety of institutions that detailed conservation and efficiency measures by which "we could reduce demand by several trillion cubic feet annually."

"These are all (efficiency) investments that are not only technologically achievable, but can be achieved at costs far less than the net benefits to be derived from them," Martin maintained. "They begin saving money and come online quickly as well."

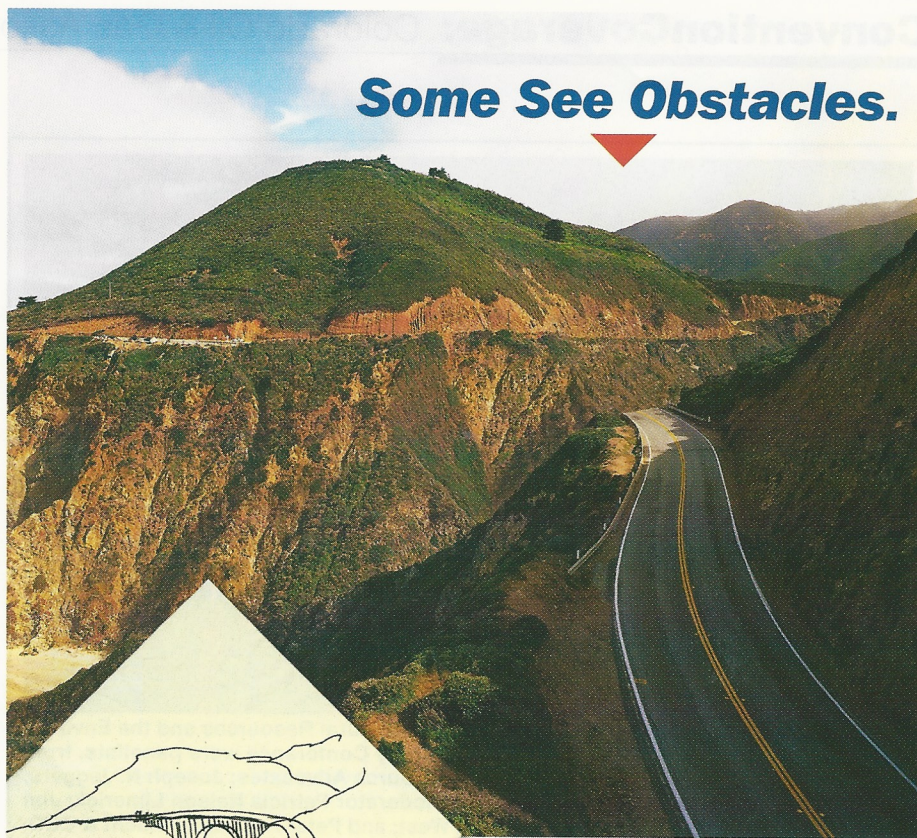
High prices also spur interest in alternative energy sources. While natural gas may have been the fuel of choice for new electric generating facilities in the 1980s and '90s, Stuart A. Sanderson, president of the Colorado Mining Association, reported projections for more than 50 gigawatts of new coal-fired generation in the 2000s and '10s.

"Some of those will happen; some of them won't, but 42 percent are in the permitting stage right now," he said, noting that America had 507 billion tons of demonstrated coal reserves, a 250-year supply at current consumption rates.

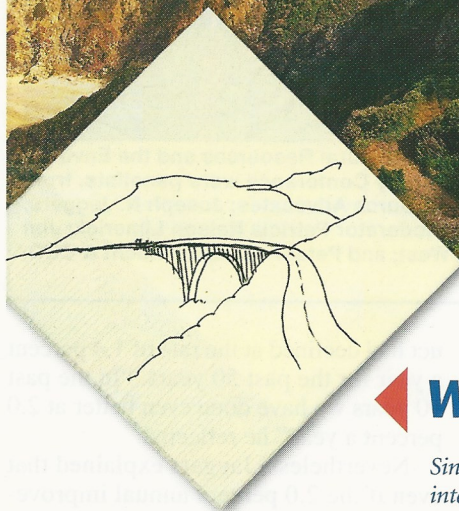
The wind industry is experiencing its own boom. Western Representative Ronald L. Lehr said the American Wind Energy Association projected that installed wind-generating capacity would grow from 6,374 megawatts at the end of 2003 to 20,000 mW in 2010 and 100,000 mW in 2020. That would account for 6 percent of U.S. electricity needs in 2020 and could replace 1 billion cubic feet of gas a day, Lehr said.

He said improvements in blade design, turbine technology and electronics drove down the costs of wind installations from \$12,600 a kilowatt in 1981 to \$790 a kW in 2000, and reduced wind power costs from \$80 a megawatt-hour to \$35-\$45 an mWh today. Lehr graphed improvements in wind energy technology at 5 percent a year and predicted, "As this line goes forward, I think you can expect some continued declines in the cost of wind energy."

Although there has not been a nuclear power plant built in the United States since 1978, Michael D. Campbell, managing partner in M.D. Campbell & Associates and chairman of the American Association of Petroleum Geologists



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Offering perspectives in a session titled "Energy, Natural Resources and the Environment" at the Rocky Mountain Natural Gas Strategy Conference were panelists, from left, Jim Martin, executive director, Western Resource Advocates; Joseph N. Jagggers, vice president E&P Denver region, Williams; moderator Patricia Nelson Limerick; Jim Sims, executive director, Partnership for the West; and Peter A. Dea, president & CEO, Western Gas Resources.

Uranium Committee, noted that electrical output had continued to climb thanks to increased efficiency and utilization.

"To produce the 768 million kilowatt-hours (of electricity) produced by nuclear energy from wind would require the whole area of Minnesota," Campbell mused. "For solar cells, it would require an area equal to West Virginia."

The primary barriers to expanding nuclear energy have been public fear and disposing of radioactive waste. But Campbell countered, "The industry has spent 25 years improving nuclear power reactor encasements. Three large airplanes full of fuel could not make it through them; they are designed that way."

He also cited the nuclear industry's "outstanding safety record, improved technology and operations, and construction management" as reasons why he said he believed that in the future "nuclear energy . . . (is) going to be a much stronger contributor to generating electricity in the United States and around the world."

## Limitations

However, there is only so much to be gained through efficiency and conservation, and alternative power sources have their limitations, other conference speakers reminded.

Joseph N. Jagggers, Williams vice president for exploration and production, Denver region, noted that energy input per dollar of U.S. gross domestic prod-

uct had declined at the rate of 1.4 percent a year for the past 50 years. "In the past 10 years we have done even better at 2.0 percent a year," he reflected.

Nevertheless, Jagggers explained that even if the 2.0 percent annual improvement in energy efficiency could be maintained and one projected 3.5 percent annual GDP growth, it would require an additional 685,000 barrels of oil-equivalent each year to meet demand.

Nor do higher oil and gas prices appear to be choking the U.S. economy, offered Questar Corp. Chairman, President and CEO Keith O. Rattie. "Despite nearly three straight years of high energy prices, U.S. GDP grew at a very healthy 3.4 percent in the second quarter," he observed. "That is the ninth straight quarter that the U.S. economy posted greater than 3.0 percent growth. The evidence today is that \$60 oil and \$7 natural gas are not going to wreck the U.S. economy."

Rattie also exposed what he termed a number of energy myths that had grown around the debate over federal energy policy. Among them, he said, despite three decades of taxpayer subsidies, solar and wind provided only 1 percent of America's primary energy needs in 2004.

"The truth is, the wind doesn't blow everywhere," he reminded. "And yes, sunshine is free, but solar power on any scale is hugely expensive."

Rattie also cautioned folks to be skeptical of President Bush's call for a hydro-

gen economy. "This is not a matter of political will, of which the president is certainly not lacking; it is thermodynamics and engineering," Rattie advised.

"The only way to produce hydrogen that is even remotely economic is by cracking natural gas or coal, which brings you right back to dependency on fossil fuels," he explained. "The alternative—electrolysis—is hugely expensive and requires cheap, abundant electricity, which is an oxymoron."

Even if hydrogen could be produced cost effectively, Rattie said it presented a transportation problem. "Hydrogen molecules are so small they leak when transported under pressure in existing pipelines, so we would need a whole new distribution network," he intoned.

Finally, Rattie noted that the energy density of hydrogen was only 1/4th that of gasoline and only one-fourth that of natural gas. "So a tank of hydrogen won't take you very far."

## Natural Gas Challenge

Even assuming the best from renewables and efficiency still leaves a daunting task for natural gas producers, suggested Peter A. Dea, president and CEO of Western Gas Resources.

He corroborated Lehr's projections for wind energy with a study from the Union of Concerned Scientists that renewables could supply 6 percent of U.S. power needs by 2020, theoretically replacing an equivalent amount of natural gas. He also cited advocacy group estimates that improved efficiency could cut gas demand another 13 percent.

"If you combine renewables and efficiency from those studies, we can possibly dampen demand for natural gas by 19-20 percent by 2020, which would be a yeoman's job," he concluded.

But even allowing for that, based on EIA's projection of 29 Tcf of gas demand by 2020, and factoring in 31 percent annual decline in gas production, the challenge for gas producers remains, Dea said, "Essentially from 2007 forward, we need to drill 25,000 new gas wells a year, even with these efficiencies and renewables materializing."

On the positive side, he observed that the Baker-Hughes rig count for gas directed drilling had increased two-thirds since the valley of 2002-03. Yet he warned, "We have still seen a 1-2 percent decline in U.S. gas production over the past two years.

"So overall, there is no one single solution," Dea determined. "We truly do need a balanced approach." □