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Specializing in environmental and natural resource issues

**TESTIMONY OF W. THOMAS GOEROLD, PH.D.
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SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES
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I am Dr. Thomas Goerold, Resource Economist and Owner of Lookout Mountain Analysis in Golden, Colorado. My firm specializes in analyzing many different policy alternatives to domestic and foreign energy and mineral issues.

I appreciate the opportunity to testify today regarding the impacts of different oil and gas resource estimates and their potential impacts on energy policy and energy security. My testimony will not concentrate so much on examining the different number estimates that may be drawn from these different assessment methodologies, but instead will look more broadly at how to best use this nation's energy policy tools to achieve energy security. My testimony examines the implications on energy policy of recognizing the increasingly finite supply of oil and gas remaining in the U.S.

The first section examines attempts by the U.S. Geological Survey (USGS) to estimate the amount of oil remaining in the U.S. and the world. After examining the distribution of U.S. and world oil and gas resources, the remainder of this testimony analyzes some of the most effective U.S. energy policies.

I would like to introduce into the record two reports that I have prepared that are particularly relevant to energy resource assessment methodologies and results; (1) ***Examination and Critique of ARI Report: Undiscovered Natural Gas and Petroleum Resources Beneath Inventoried Roadless and Special Designated Areas on Forest Service Lands Analysis and Results, with Additional Discussion of U.S. Geological Survey and National Petroleum Council Reports***; and (2) ***A Brief Examination of the Adequacy of Future U.S. Natural Gas Infrastructure and Resources and The Role of Public Lands in U.S. Natural Gas Production***.

USGS World and U.S. Oil and Gas Assessment

The USGS 2000 World Oil and Gas Assessment projected that (excluding the U.S.) the world's undiscovered conventionally recoverable oil, natural gas liquids (NGL), and natural gas is about 1,634 billion barrels of oil, expressed as barrels-of-oil equivalent (BOE). This estimate is about 5 percent higher than the USGS 1994 estimate of 1,556 billion BOE. (USGS, 2000). The USGS 2000 estimate includes a 20 increase in undiscovered oil, a 130 percent rise in NGL, and a 14 percent decrease in undiscovered natural gas. The large volumes of oil, gas, and NGL from reserve growth were not previously assessed by the USGS. Including U.S. resources, the 2000 USGS estimate shows a 9.5 increase overall in billion BOE, with oil up 24 percent, NGL up 104 percent and gas down 10 percent (USGS, 2000).

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Compared with their previous estimate, the 2000 USGS study shows (1) more oil and gas in the Middle East and North Africa, (2) more oil and gas in eastern South America, (3) generally less oil and gas in Mexico and China, and (4) much less gas in the Former Soviet Union (especially in the Arctic). Other Arctic areas of some basins in China, and the Alberta Basin of Canada are now expected to produce smaller amounts of gas than in previous USGS studies.

Areas with the greatest volumes of undiscovered conventional oil include the Middle East, northeast Greenland Shelf, the West Siberian and Caspian areas of the former Soviet Union, and the Niger and Congo delta areas of Africa. Newly identified areas of oil potential with no previous production history include northeast Greenland and offshore Suriname.

Areas with the greatest volumes of undiscovered conventional gas are the West Siberia Basin, Barents and Kara Seas shelves of the former Soviet Union, the Middle East, and offshore Norwegian Sea. Promising areas without current development are located in East Siberia and the Northwest Shelf of Australia.

As shown in Table 1 below, not including the U.S., the average volumes of undiscovered world resources are 649 billion barrels of oil, 4,669 Tcf of gas, and 207 billion barrels of NGL. In addition, the estimated mean additions to reserves from discovered fields are 612 billion barrels of oil, 3,305 Tcf of gas, and 42 billion barrels of NGL. About 75 percent of the world's grown conventional oil endowment and 66 percent of the world's grown gas endowment have already been discovered in the areas assessed (outside of the U.S.). Also, for these areas, 20 percent of the world's grown conventional oil and 7 percent of the world's grown conventional gas had been produced by the end of 1995.

Table 1. World level summary of petroleum estimates for undiscovered conventional petroleum and reserve growth for oil, gas, and natural gas liquids (NGL).

[BBOE, billions of barrels of oil equivalent. Six thousand cubic feet of gas equals one barrel of oil equivalent. F95 represents a 95 percent chance of at least the amount tabulated. Other fractiles are defined similarly. Production and reserves normalized to 1/1/96. Shading indicates not applicable]

	Oil				Gas					NGL			
	Billion Barrels				Trillion Cubic Feet				BBOE	Billion Barrels			
	F95	F50	F5	Mean	F95	F50	F5	Mean	Mean	F95	F50	F5	Mean
World (excluding United States)													
Undiscovered conventional	334	607	1,107	649	2,299	4,333	8,174	4,669	778	95	189	378	207
Reserve growth (conventional)	192	612	1,031	612	1,049	3,305	5,543	3,305	551	13	42	71	42
Remaining reserves*				859				4,621	770				68
Cumulative production*				539				898	150				7
Total				2,659				13,493	2,249				324
United States													
Undiscovered conventional**	66		104	83	393		698	527	88	Combined with oil			
Reserve growth (conventional)**				76				355	59	Combined with oil			
Remaining reserves				32				172	29	Combined with oil			
Cumulative production				171				854	142	Combined with oil			
Total				362				1,908	318				
World Total (including United States)				3,021				15,401	2,567				

*World reserve and cumulative production data reflect only those parts of the world actually assessed and are from Petroconsultants (1996) and NRG Associates (1995).

**U.S. data from Gautier, D.L., Dolton, G.L., Takahashi, K.I., and Varnes, K.L., eds. 1996, 1995 National assessment of United States oil and gas resources--Results, methodology, and supporting data: U.S. Geological Survey Digital Data Series DDS-30, release 2, one CD-ROM, and from Minerals Management Service, 1996, An assessment of the undiscovered hydrocarbon potential of the Nation's outer continental shelf: Minerals Management Service OCS Report, MMS 96-0034, 40 pages.

Source: USGS, 2000, World Petroleum Assessment 2000, Description and Results.

As of January 1, 1996, average U.S. estimates of undiscovered conventional oil are about 83 billion barrels, with reserve growth from existing fields contributing another 76 billion barrels, and known and identified reserves standing at approximately 32 billion barrels. Cumulative production to 1995 was about 171 billion barrels.

In summary, the U.S. could be expected to produce about 191 billion barrels of additional petroleum from domestic supplies. At current rates of consumption, if one assumes that all domestic consumption could be supplied by domestic oil sources it would take about 29 years to exhaust the 191 billion barrels of additional domestic oil sources. By contrast, assuming that current rates of domestic production are maintained and that oil imports will grow to satisfy increasing demand (about 2.6 billion barrels of annual oil production), it would take about 73 years to consume the 191 billion barrels of identified domestic oil. These two scenarios bracket the likely maximum amount of time that this country has before the costs of using oil exceed the benefits of consuming it.

Other studies, including at least one by the Rand Corporation, concentrate on quantifying the amount of domestic oil resources that may be economically producible. As such, these studies impart valuable information about the distribution and amounts of oil left in this country. But, the basic conclusion is nevertheless the same—the U.S. does not have enough oil and gas resources left in the ground that it can (or should) produce every barrel that it consumes. And, oil and gas imports are expected to become increasingly cheaper to consume than domestically produced energy. The larger question thus becomes, given these geological facts on the domestic energy supply, what is the best course of long-term U.S. energy policy.

U.S. Energy Policy Options

When estimating a country's remaining energy resources it is generally assumed that the least expensive and most abundant oil and gas resources are found and consumed first. And, as a country consumes more and more domestic energy, progressively more expensive oil resources are found and consumed. But, there is another option to consuming all domestically produced energy—foreign oil imports can be substituted for domestic production.

In fact, most countries' oil consumers seek to find the least costly sources of oil, regardless of whether they are derived from domestic or foreign sources. If imported oil is cheaper and more readily available to consumers, foreign oil will be preferentially consumed.

A. Energy Security

Much has been written about the security of U.S. supplies of oil—whether it is from domestic production or from imports. A particularly strong argument about energy security is that security of energy supplies increases as diversity of sources increases. This is the same concept that investment advisors counsel their clients—security comes from not placing all of your eggs in one basket. Thus, a mix of domestic production and imports from a multitude of foreign sources actually represents most countries' best source of energy security. Currently, the U.S. imports as much oil from non-OPEC as OPEC sources. The four largest sources of U.S. oil imports include not only Saudi Arabia, but also Canada, Mexico, and Venezuela. In many ways this reliance on disparate geographical sources of oil imports decreases U.S. dependence on domestic sources of oil and thus increases our energy security.

This presumption seems to fly in the face of the common implicit assumption that domestic oil production is preferred to imports. But, there are at least two disadvantages to exclusively

consuming domestic oil; (1) a barrel of domestic oil consumed now means that there is one less barrel of oil in the ground for future consumption—thereby decreasing future policy options and increasing the effect that any potential future foreign oil import interruption may have on this country.

And, (2) U.S. domestic oil production tends to be more expensive to produce than imported oil—the costs of lifting, transported, and marketing U.S. domestic oil tend to exceed similar imported oil costs. The reason for this is that U.S. oil is produced from the world's most mature energy province. Most of the cheapest and most abundant oil has already been produced in the U.S. Meanwhile there are many foreign sources of oil—including non-OPEC, OPEC, Western and Eastern Hemisphere sources that are not as intensively explored and therefore the costs of bringing this oil to U.S. markets is much lower than domestic production.

Yet another potential disadvantage of using only U.S.-produced oil is that it comes from a huge number of sites throughout the U.S. Domestic oil and gas is shipped by pipeline, tanker-truck, and other sources. The terrorists of 9/11 showed that America's huge geographical breadth is not immune from attackers. The vast pipeline network, domestic oil refineries and petrochemical complexes represent a tempting target for future terrorists. One might argue that these large spider-webs of oil refining and shipping might at least as vulnerable as the large supertankers that ship U.S. oil imports from many different points of the globe.

B. U.S. Domestic Oil and Gas Endowment

Virtually all studies have shown that, if every acre of U.S. land was opened up to drilling—including all parks, wilderness areas, and every offshore acre out as far as the 200-mile limit, the U.S. can never realistically expect to be able to produce all of its own energy. Not now, and not in the future. And, even if this country were able to produce every barrel of oil that it consumes, it may not be a desirable U.S. policy to maximize domestic energy production.

C. U.S. Supply-Side and Demand-Side Energy Policy Options

Nature has endowed this country with a finite amount of petroleum that cannot be changed by any government's policies. It can be argued that supply-side actions, such as subsidizing the production of ever-decreasing amounts of domestic oil at progressively greater costs is ultimately wasteful and counter-productive if one is pursuing energy security.

One might say that this country could learn from the fundamental changes in international energy markets that started in the 1970s. Instead of encouraging more production of more expensive domestic oil and gas, this country could be concentrating on managing more productive energy policies. That is, this country could look not at supply-side policies, but instead could try to manage the demand-side of the energy equation.

That is not to say that no supply-side actions might be appropriate—subject to the other potential uses of the land. There are strong arguments that this nation could support research into more efficient extraction of domestic energy resources. Of special interest are those policies that support research into wringing out more barrels of oil and gas from existing oil- and gas-fields. Currently producing fields typically do not produce as much as one-half of the identified oil-in-place. Productive energy policies could include advances in better visualizing the underground reservoirs and increasing the proportion of oil-in-place that is actually produced. These enhanced oil recovery (EOR) technologies tend to be expensive, but can be applied to known fields that

already have the entire energy production infrastructures in place. In addition, existing energy production regions, such as the Gulf Coast onshore and offshore also tend to already have a well-trained, experienced workforce in a region that is currently set up to produce oil and gas efficiently. Another significant benefit of these EOR policies would be that fewer or no new pristine and un-roaded areas need to be disturbed for energy production.

Drawing on this nation's recent history, there are some proven and very effective demand-side energy strategies. These effective policies that have been used before concentrated on (1) using oil and gas more efficiently, and (2) researching energy alternatives to conventional oil and gas. Collectively, these two broad strategies have had the effect of decreasing the amount of oil and gas needed by the country and thereby have increased the energy security of this nation. Also, recent U.S. history has shown that pursuing greater energy-use efficiencies and alternative energy sources does not mean that consumers must degrade their standard of living and make do with less. Instead, these two strategies can lead to an ever-increasing standard of living at a lower overall cost.

For example, as we have seen in the last 20 years, Detroit has not raised the fuel efficiency of automobiles and light trucks. The average miles-per-gallon of these vehicles has actually decreased since the mid-1980s. But, in the 1970s and early 1980s Congress passed a binding set of standards that mandated higher fuel efficiency from these vehicles. Average fuel efficiency increased by 50 percent and more from earlier levels. The effect of this legislation was that consumers in the late 1980s drove cars and light trucks that were (1) more fuel efficient, (2) produced much less air pollution, (3) employed many more safety standards, and (4) actually produced greater power than vehicles of the 1970s. Instead of degrading the standard of living in this country the Corporate Average Fuel Efficiency (CAFE) standards actually led to improvements in every aspect of driving—including significant reductions in pollution and greenhouse gases. Both consumers and the automotive industry thrived.

And, the impact of CAFE standards was not just isolated to a small portion of the energy sector. About two-thirds of all oil used in this country is used in the transportation sector. Congressional actions to improve fuel efficiency had a very significant impact on increasing this nation's overall energy security, resulting in a large reduction in U.S. oil demand.

However, since the mid-1980s the U.S. has not moved to raise CAFE standards. In fact the standards have actually declined slightly since that time. Instead of building on past triumphs, the U.S. has been content to rest on its laurels. In the absence of a mandate from Congress, Detroit has not moved on its own to raise the mileage of cars and light trucks. As a result, the country's appetite for oil has been growing faster than it would have with more efficient cars and trucks. Another impact of this policy is that the production of airborne pollutants from cars and trucks has also not been controlled.

The Bush Administration has proposed that energy incentives should be differentially applied to the supply-side of the energy sector. These incentives would largely have the effect of producing an ever-greater proportion of this nation's finite supply of oil. At the same time, the Administration is not concentrating on effectively using the demand-side incentives to use our oil and gas more efficiently. Pursuing this course of action will likely lead the U.S. to use up our domestic oil and gas at increasing rates, and allow less-efficient energy technologies to produce more pollution.

The most-effective and least-intrusive energy policies that this country could pursue might be three-fold. (1) Get the most energy out of currently producing oil and gas fields using enhanced

oil recovery (EOR). (2) Concentrate on making this nation's stock of energy-using technologies more efficient, so that every barrel of oil and every Mcf of gas could produce greater benefits to the users. And (3) develop new technologies that would give this country alternatives to conventional oil and gas—and substitute renewable energy sources such as solar, wind power, and biomass for conventional energy sources.

References

U.S. Geological Survey, 2000, World Petroleum Assessment 2000, Description and Results.