

Resource Assessments as a Policy Tool: Balancing Society's Needs

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As a representative of the 30,000-member American Association of Petroleum Geologists (AAPG), I have been invited here today to testify as to the data, methods and technology on which hydrocarbon resource assessments for policy decisions should be conducted.

AAPG was honored to be invited last year by this Subcommittee to comment on the oil and gas resource estimates conducted by the United States Geological Survey (USGS) and Minerals Management Service (MMS). At that hearing we testified that these agencies have used available geological data, have applied sound scientific principles and have done a good job in assessing the undiscovered hydrocarbon resources in the United States. Although we did not take a public position on the 1999 National Petroleum Council's report entitled "*Natural Gas: Meeting the Challenges of the Nation's Growing Natural Gas Demand*", detailing the gas resources within the United States that are not accessible to meet the nation's needs, we agreed with its methods and conclusions. Today, I would like to repeat our appraisal of the methodologies used by USGS, MMS, and NPC and would also like to state in the very beginning that we are unable to say the same about some other methodologies being proposed, such as that proposed in the Rand Issue Paper.

Assessment of a resource is a time-dynamic process. Because this process involves estimating the location and magnitude of an inherently unknown quantity, the accuracy of an assessment may be considered to be limited by 1) the perception and understanding of the origin and occurrence of the resource, 2) the quality, distribution and accessibility of available data from which to project estimates, and 3) the methods employed to conduct the assessment. Whereas USGS, MMS, and NPC studies have addressed all of these issues, the RAND Issue Paper does not offer any insight into the above three points.

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

The American Association of Petroleum Geologists was founded in 1917. It is the largest professional geological society in the United States, and has members worldwide. The membership is dedicated to the geological study of the earth and its environment, and the exploration and development of hydrocarbon resources and other energy minerals. Because much of the membership is engaged, either directly or indirectly, in the search for hydrocarbons and the economic development of

hydrocarbon deposits, the AAPG is keenly interested in understanding the amount and geographic distribution of hydrocarbon reserves and resources. AAPG advocates a comprehensive national energy policy based on sound science and knowledge of the nation's resources and reserves.

COMMITTEE ON RESOURCE EVALUATION

In 1993, the AAPG Executive Committee chartered the Committee on Resource Evaluation (CORE) to "provide input and facilitate U. S. Government agencies in performing assessments of U. S. hydrocarbon resources." The charter was amended in 1997 to include international assessments so CORE would have a worldwide view of hydrocarbon resources. Since inception, CORE has reviewed the methodologies and scientific methods used for assessments by the U. S. Geological Survey (USGS) and the Minerals Management Service (MMS), and, in several instances, has made individual AAPG members with specific knowledge of certain geological provinces available to the agencies. To a lesser degree, CORE has offered opinions and technical information to the Energy Information Administration (EIA). For example, CORE supplied feedback to the EIA regarding its study of the economic impacts of the Kyoto Protocol on U. S. energy markets and made members with Deepwater Gulf of Mexico knowledge available to the EIA for consultation.

The Committee membership consists of domestic and international managers of major petroleum companies, independent geologists and environmental consultants, two current and former state geologists, three past AAPG Presidents, Director of the Potential Gas Committee (Colorado School of Mines), and scientists from the USGS and MMS. All the members have a great deal of expertise in the science and technology of reserve and resource estimation. At most of its meetings, CORE has invited guests from the USGS, MMS, EIA and industry and environmental experts who can contribute to our knowledge of the nature, amount, and geographic distribution of known, and yet to be discovered resources. CORE does not restrict its interest to conventional hydrocarbons, but includes basin-centered gas in continuous reservoirs, coal bed methane, shale gas, and to some level, gas hydrates.

Since its formation, CORE has consulted with the USGS on its 1995 National Assessment of United States Oil and Gas Resources, the 1999 Arctic National Wildlife Refuge 1002 Area assessment, and the 2000 World Petroleum Assessment, and the currently ongoing assessment of unconventional gas accumulations. For all of these, the Committee on Resource Evaluation has recommended to the AAPG Executive Committee that AAPG endorse the scientific methodologies and techniques used by the USGS, and the AAPG has publicly done so. AAPG has not endorsed specific resource numbers generated by the assessments, but has endorsed the sound scientific process used to generate the probability distributions that characterize these resources. As mentioned earlier, the then-Vice Chair and current Chair of the Committee on Resource Assessment, Dr. Naresh Kumar, testified in front of this Subcommittee on the scientific soundness of USGS and MMS assessment methods last year.

RESERVES AND RESOURCES

For the record, I would like to define certain terminology and define the part of the resource spectrum that is addressed by Resource Assessments. Figure 1 was developed jointly in 2000 by AAPG, the Society of Petroleum Engineers (SPE), and the World Petroleum Congress (WPC), and has been published by the SPE.

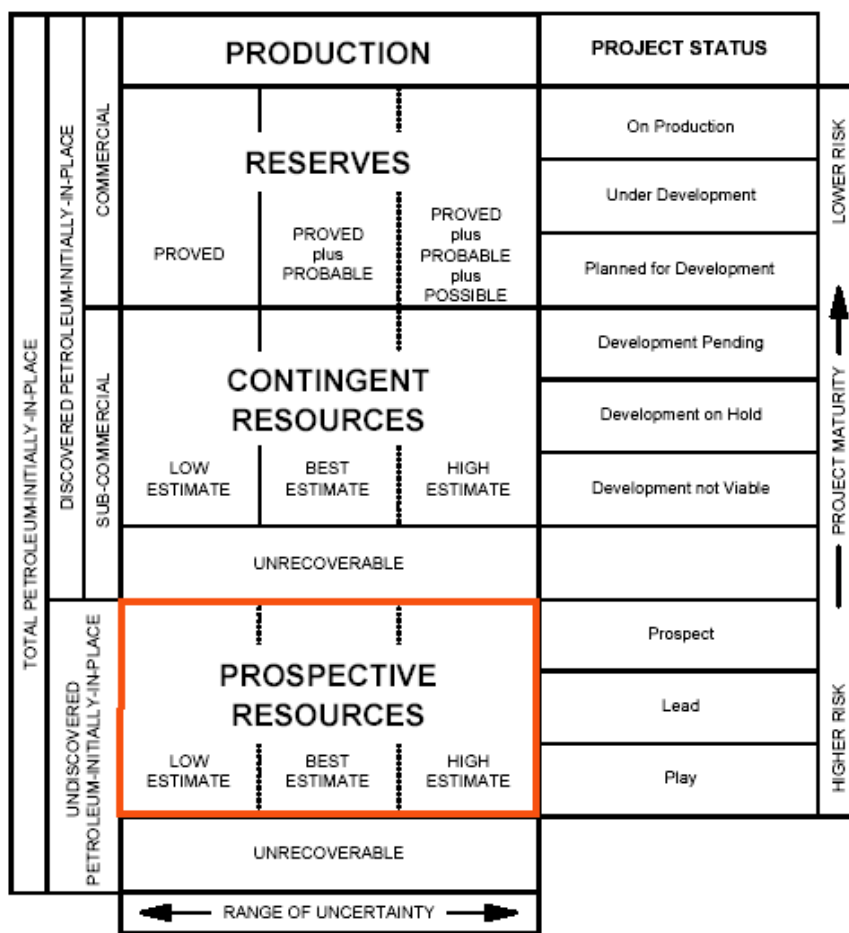
At the top of the figure, we define "reserves" as having been discovered and commercial in nature. We discuss them as being proved; proved plus probable; and proved plus probable plus possible; thus conveying a degree of certainty about the quantity.

Figure 1 shows the highlighted box that is the primary focus of today's testimony. Resources are potential, undiscovered, estimated volumes of hydrocarbons. The estimates are based on our current

state of geological knowledge and existing technology. Whether resources are ever converted to reserves is dependent on economic conditions, policy decisions, and incentives for companies to perform exploration activities. As exploration proceeds and more geological data is collected, our ability to make better estimates of resources increases. Also, as resources are converted to reserves, supply increases and the ability to meet demand improves. We discuss resources in terms of low estimate, best estimate, and high estimate. These levels of estimation are driven by our geological knowledge, available data, and the technology available to assess them.

Let me restate: in order for resources to be converted to reserves and ultimately to supply, exploration and development has to take place. The exploration process consists of leasing acreage, acquiring and interpreting seismic and subsurface data, and drilling.

FIGURE 1: RESOURCE CLASSIFICATION SYSTEM
(showing possible Project Status Categories)



Note: For illustrative purposes only. Not to scale.

U. S. ENERGY RESOURCES

AAPG believes the U. S. still has a large energy resource remaining to be tapped. We believe the techniques and scientific methods used by both the MMS and USGS are sound and provide a good basis for discussion of a national energy policy.

Studies by the USGS and NPC have concluded that the most prospective areas for major new discoveries, particularly natural gas, are on public lands in the Rocky Mountain sedimentary basins, offshore in the Gulf of Mexico, in the Eastern Gulf of Mexico, and on the Atlantic and Pacific Outer Continental Shelf. AAPG concurs with this assessment. Despite the huge potential of these areas, federal law presently prohibits exploration on the Atlantic and Pacific OCS and in the Eastern Gulf of Mexico. Access to much of the remaining resource potential of the Rocky Mountain basins is restricted or closed. The total estimated gas resource of these areas is 213 TCF (per NPC 1999 study). For comparison, the US currently produces approximately 19 TCF per year and imports another 3+ TCF/year from Canada. It is likely that with further exploration, these resource figures would increase significantly. Unfortunately, a significant amount of that resource is subject to restrictions as tabulated in Table 1 and shown in Figure 2. In the case of the Rocky Mountain Region, the resource subject to some restriction amounts to *two-thirds of the total estimated resource*.

Table 1: Amount of U.S. Oil and Gas Resources Subject to Restrictions

Area	Oil (Billions of Barrels)*	Gas (Trillions of Cubic Feet)*
ANWR	7.6	2.7
Atlantic OCS	2.1	31
Eastern Gulf of Mexico	3.6	24
Pacific OCS	10.7	21
Rocky Mountain Region	2.7**	137 ***
Total	26.7	215.7

* Figures are estimated to be Mean technically recoverable resources

** 0.6 Billion Barrels are closed for development, 2.1 Billion have some restrictions

*** 29 TCF are closed to development, 108 TCF have some restrictions

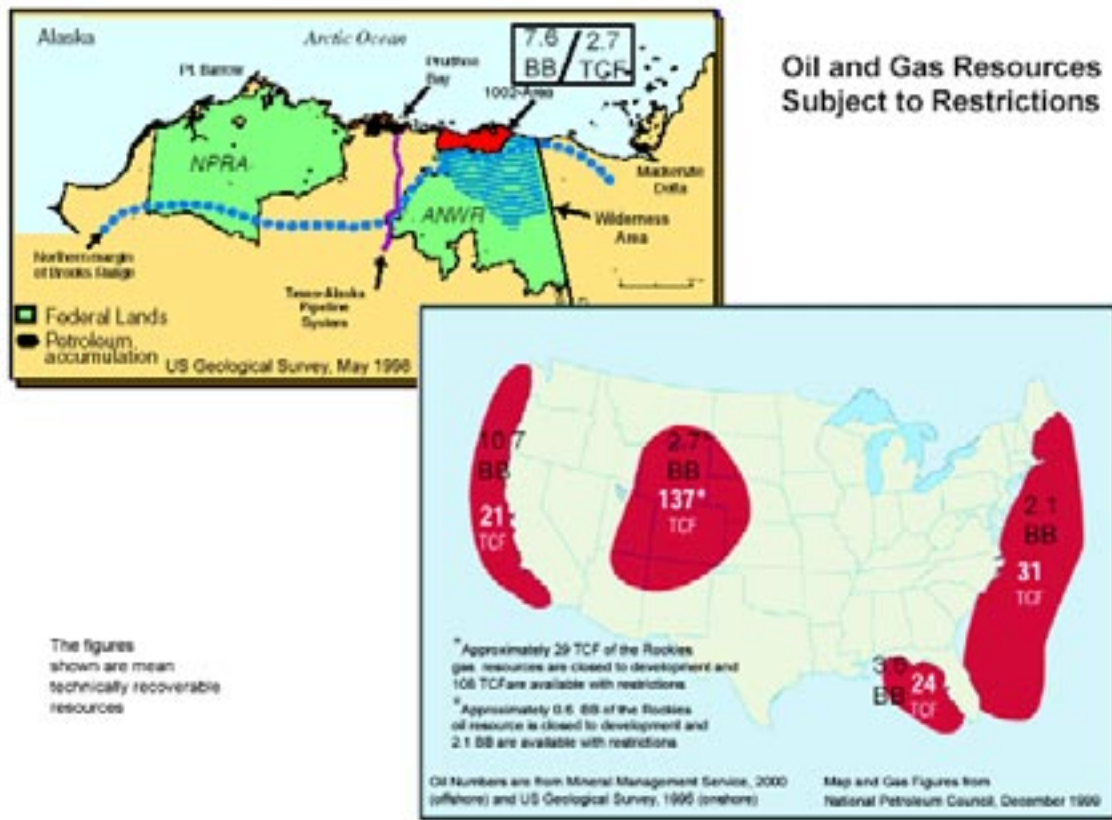


Figure 2

WHICH ESTIMATE TO USE FOR PUBLIC POLICY DECISIONS?

As this Subcommittee is well aware, under the reauthorization of the Energy Policy and Conservation Act in 2000, Congress asked the Department of the Interior to provide a scientific inventory of Federal Lands detailing the hydrocarbon resources estimated to be present on these lands and restrictions and impediments to development of these resources. This inventory would be used for management of land and energy resources and should form the basis for policy decisions required for balancing the nation's need for energy and the imperative for environmental conservation. As we understand it, these studies are still in progress.

Recently, questions have been raised criticizing the 1995 USGS National Oil and Gas Assessment, 1999 National Petroleum Council study and the 2001 Department of Energy's Greater Green River Federal Lands Analysis. The USGS, NPC, and DOE studies described the undiscovered oil and gas resources that may be present on the areas addressed by these reports. In addition to the "technically recoverable" resource, the USGS assessment and the NPC study *did* address the economically recoverable resource under various price and development scenarios.

The RAND Issue Paper proposes substituting viable resources for technically recoverable resources as the base that matters for policy decisions. The problem with this approach is that the viable resource is not a prerequisite for sound decisions, but is itself an outcome of many decisions, such as decisions on which technologies to develop and deploy, on what constitutes environmental "acceptability", and the like. The effect of land and access restrictions should be assessed in terms of both their short- and long-term effects on the *entire* nation's supply and security. The latter clearly

requires technically recoverable resources.

It is AAPG's firm belief that *technically recoverable resource* is the correct base to use when making policy decisions on competing use of federal lands. Although, further analysis of this resource base is perfectly justified depending upon policy issues to be addressed, only the total resource base can be used to balance against other competing social and environmental uses or preservation of these lands.

Although the economic analysis carried out by the USGS and NPC studies is valid and adequate, oil and gas companies considering exploration in any area perform their own economic analysis for their decisions. Each company has its own economic criteria and risk profile to determine whether they wish to explore in a basin. They will start with the technically available resource and assign their own criteria to make a decision. As Figure 3 shows, there are many factors that affect the conversion of Resources to Reserves and then Reserves into Supply. Legislation in the form of access or non-access, "standard lease terms" or "restricted access" or permanent or temporary moratoria are part of the equation. However, if the hydrocarbon resource base is to be weighed against all other competing interests in a given piece of land, the technically recoverable resource base is the logical starting point. That is also the only quantity that has the least chance of being manipulated for philosophical, political, and personal-interest reasons.

Assumptions of price, drilling costs, transportation costs, etc. are only good for the day they are made. As we have seen in the last ten years, a two- to three-fold change in oil and gas prices is not uncommon, nor is a similar change in the costs associated with exploration. In addition, a company that is already operating in a basin will have a different risk profile and economic criteria than a company that is new to that basin. The companies look at various plays on a long-term basis and understand there are economic risks and that a continuous reservoir or non-conventional play that may take hundreds of wells to develop is going to have a long lifespan and the project will see a lot of price fluctuations during its lifetime.

The whole objective of the studies being conducted under the EPCA reauthorization is to determine the balance between competing public interests. If the "cost" of environmental impact were used right in the beginning to diminish the volume of available resource in the Rockies, then according to some groups, no resources would exist.

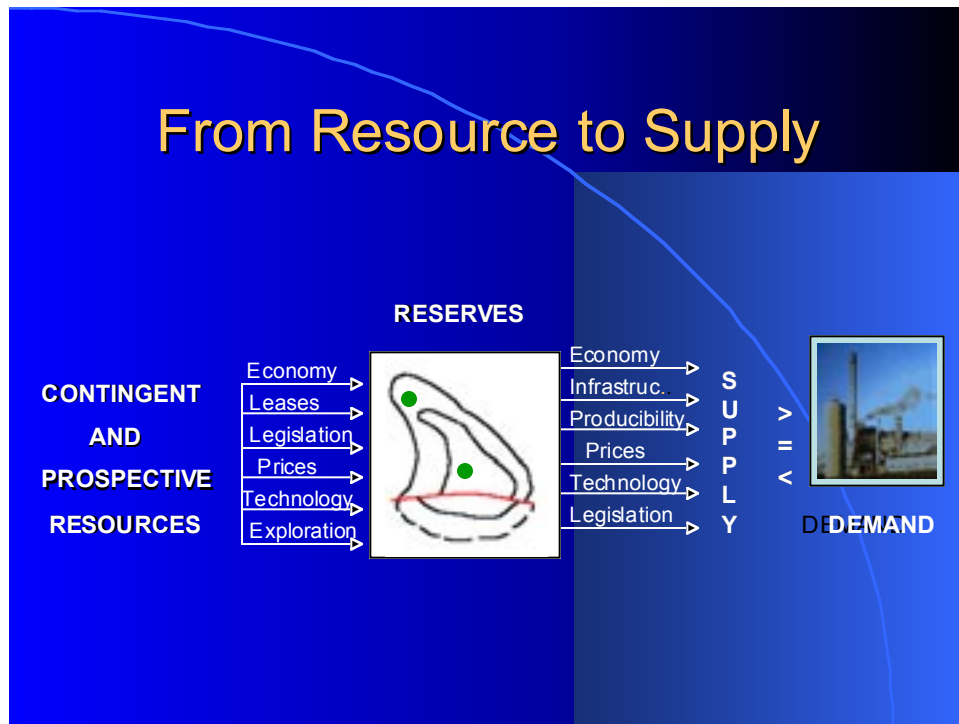


Figure 3

We have a very recent example of the impact of this approach. The MMS conducted OCS Sale 181 in December of last year in the Eastern Gulf of Mexico. By all accounts, it was a successful sale with seventeen companies participating. A total of \$459 million was bid at the sale, which offered 233 tracts. Successful bids on 95 blocks totaled \$340 million. However, prior to the scheduled sale, 800 blocks covering 3.4 million acres were deleted from the sale for political concerns, even though the blocks were as much as 100 miles offshore. Initially, these 800 blocks had passed the same environmental filter that the other 233 blocks had. The Federal government lost valuable revenues and future royalty payments, and the nation lost potentially valuable additions to the resource base.

I would directly address the question of "viable resources". Viability speaks directly to changes in costs, prices, accessibility and technology. After all, at one time none of the modern inventions that we take for granted, such as the telephone, or the computer, or the airplane were "viable". More specifically to the oil and gas industry, drilling and producing in 10,000 feet of water or multilateral drilling to access resources from a central point, or commercial production of coal-bed methane were not considered "viable" at one time. Thus we believe that viability hinges on market need. And market need drives technological innovation.

ISSUES SPECIFIC TO ROCKY MOUNTAIN BASINS

Although the purpose of our testimony is not to specifically counter the points raised in the RAND report, we would like to address some of the issues mentioned.

It has been suggested that any study of the basins should consider the restricted portion of only the economically viable resource. The NPC study did evaluate both technically recoverable and economic resources. In various scenarios evaluated in the study, NPC found that a high percentage of the assessed undiscovered resource base in the Rockies is either economic now or will become economic through the year 2015. This conclusion has been verified by the level of industry interest in the region and the region's growing gas production. The NPC study used economic viability of new prospects as

the primary determinant of future industry activity, reserve additions and production. The study showed that most of the assessed Rocky Mountain volumes are economic to develop, either now or in the future, and that a large volume of these resources is likely to be in areas where industry access is restricted. Gas production in the Rockies would be 800 BCF/year greater in 2015 with less access restrictions. This incremental Rockies production would satisfy approximately one-quarter of California gas demand in 2015.

The RAND report also questions various aspects of “access restrictions” that were tallied and considered in the NPC study. Through a detailed analysis of six calibration areas in the Rockies, the NPC Study arrived at three lease classifications and their percentages:

Lease Types Percentages

Off Limits	9%
Higher Costs Due to Access Issues	32%
Standard Lease Terms	59%

It should be pointed out that before any Federal Lands are available for leasing, they undergo Environmental Impact studies. The “Standard Lease Terms”, although “unrestrictive”, incorporate environmental objectives. Any economic study based on these terms already incorporates “environmental acceptability”. Thus, to reduce the resource base on the basis of “environmental acceptability” would amount to a double jeopardy against that resource base.

Those areas with higher costs were subject to increased drilling costs and drilling delays. The cost penalty was computed as a weighted average of the types of restrictions and mitigation measures that were expected to be encountered in the high cost areas. Some access restrictions are sometimes waived, but they almost always accompany costly mitigation measures. New access restrictions are placed on “standard lease terms” as new areas for drilling are reviewed. The net effect could well be a greater cost penalty than the values used in the NPC study. Additionally, restrictions on public lands many times impact access and costs of operation on non-Federal lands as well.

One of the important conclusions of the NPC study was that the Rocky Mountain region could supply a growing amount of the country’s natural gas needs. Therefore, policy makers should weigh the economic and environmental benefits of this potential gas supply against policies that might restrict access to the region’s natural gas resources.

AAPG has always stated that oil and gas exploration, development and production can and does co-exist with environmental preservation in every producing region of the country. Various state and federal regulations and lease stipulations and monitoring ensure that. However, each time the Congress reviews the nation’s need for growing oil and gas demand and attempts to find ways to secure additional domestic supplies, we hear calls for permanent closure of highly prospective areas.

ACCESS TO GAS RESOURCES ON FEDERAL LANDS

Even the environmental groups cite natural gas as a cleaner, environmentally more benign energy resource to fuel our economy. However, access to the huge gas potential of undeveloped public lands is limited, in the Western states and on the OCS. Additionally, the federal regulatory maze hinders domestic petroleum exploration operations and investment.

The U. S. cannot depend on gas imports from OPEC to meet rising demand. Natural gas is a North American commodity that is locked into a pipeline delivery system. Imports from Mexico will be minimal. The 1999 NPC study projected LNG imports of less than 1% of supply through 2015. That same study projected U. S. gas demand in 2010 to be 29 TCFG on an annual basis and projected U. S. production to be 25 TCFG/yr. The shortfall, according to the NPC, will be made up by 4 TCFG of

imports from Canada. What happens if the Canadian imports do not materialize? The United States must develop its own gas resources to meet future demand. This requires access to the public lands that are deemed most prospective for natural gas.

Conservation and renewable energy resources often are cited as the solution to our energy requirements. This is not a realistic expectation if one appreciates the actual tiny magnitude of current alternative energy, and that fossil fuels supply 88% of our primary energy. Energy conservation has been effective in certain areas, particularly in regard to increased miles per gallon for automotive engines. Those efforts obviously, must continue. But they will not be sufficient. For the maintenance of a *growing* economy additional hydrocarbon resources must be identified and brought into production for the foreseeable future.

Despite DOE expenditures of over \$9 billion since FY 1980 on solar and other renewable energy research, alternative energy resources provided only 0.3% of primary energy supply in 1999, exclusive of traditional hydroelectric power (3.8%). Obviously time and effort for research must continue on alternate energy resources, but we cannot count on these sources to meet our nation's needs in the short term.

AAPG does not advocate any reduction in alternative energy research. However, the fact is, that our economy will continue to depend on fossil fuels for the majority of the nation's primary energy requirements for at least another generation. On April 18, 2000 at the AAPG Annual Meeting in New Orleans, Jay E. Hakes, Energy Information Administrator, presented a paper entitled "Long Term World Oil Supply". One of the conclusions in that paper was that with an estimated mean ultimate recovery of 3.0 trillion barrels worldwide, and production growth rates of 0-3%, the estimated peak year of world oil production would range from 2030-2075. That is at least another one-half century of hydrocarbons being a significant part of our energy mix.

RESOURCE ASSESSMENTS

I would like to return to the issue of which assessment numbers should be used for public policy decisions. Organizations such as the USGS, MMS or the NPC have carried out assessment based on geological data, scientific knowledge, and proven tools available to them. At times the agencies have been "behind" industry's thinking, especially in the area of new or evolving exploration plays because they do not have access to all the data. For example, the latest information on economic production of natural gas from coal seams in the Powder River Basin of Wyoming is probably only known to the companies currently operating in that area. As a result, the assessments have sometimes been too conservative and have required subsequent revisions. Until emerging plays are proven and at least some of the data becomes public, the agencies assign limited resources to them, and rightly so. Once these kinds of "frontier" plays have been discovered and proven by the risk takers of industry, the total resource impact can be assessed.

One of the characteristics of assessments we have discovered is their tendency to grow in size over time. This is due to increased exploration and gathering of subsurface data, improvements in geological knowledge, and acquisition of additional seismic data. As our knowledge of a basin increases, so does our ability to estimate its resources; which generally results in an increase in the size of the resource. That also is why exploration is so competitive. Different interpreters can look at the same data set, and draw dramatically different conclusions about exploration prospects. For example, in the late 1960's M. King Hubbert estimated the ultimate gas resource for the United States (excluding Alaska) to be about 1,044 TCFG. In 2000, the estimate is almost twice that amount at 2,000 TCFG.

Tight sandstone reservoirs are very prominent in many basins of the Western U. S. In its 1995 study, the USGS assigned 200 TCFG of recoverable resource to this type of reservoir in the Rocky Mountain Basins. The USGS is currently embarking on a reassessment of resources in this type of

reservoir, because recent exploration has established new geological concepts and USGS has revised its own assessment methods for unconventional reservoirs. Given the nation's desire to switch to natural gas wherever economically feasible, this could be one of the most important assessments the USGS will perform. AAPG has evaluated the revised USGS methodology to assess such reservoirs and has endorsed this methodology.

SUMMARY

RAND corporation's own statement of research principles describes that any research should be well designed for the problem, that it should be based on sound information, that it should be balanced and independent and should be relevant to client's interest and needs. It also states that it should take into account the relevance of previous work. We believe that the clients, the citizens of the United States, deserve a sound energy policy that maximizes domestic production with utmost care for the environment. However, the clients' needs are ill served by insisting that we have ample sources of energy while putting restrictions on its supply, that we use more natural gas while shutting areas from where the gas might come, by insisting that we use alternative energy sources while having no viable alternative source in the near future, and by insisting that oil and gas development by definition spoils the environment while the facts are otherwise. The RAND Issue Paper essentially argues for "proving" that a given area contains technically recoverable, economically profitable, and environmentally suitable resource before access issues can be decided. However, without access to the area in the first place, its potential cannot be tested or realized.

AAPG firmly believes that the nation has a right to decide which type of lifestyle we should have. In order to evaluate competing interests in the use and nonuse of possible resources, the decision makers should know the total extent of possible resources just like they have the right to know the total extent of all other social, economic, and environmental concerns. Technically recoverable resource is the only number that addresses the full base of possible energy resource. All other concerns should be weighed against that number.

AAPG ENERGY POLICY RECOMMENDATIONS

The United States has abundant energy resources. However we are now faced with a real energy crisis, because the nation has not developed and implemented a comprehensive energy policy. In order to assure that our way of life is not dramatically impacted because of energy shortages, the AAPG recommends the following:

- The U. S. must develop a national energy policy that provides dependable, affordable, and uninterrupted energy for the public and commerce, and is based on a sound scientific assessment of the nation's resources and reserves.
- Energy policy must address the needs of all stakeholders, especially the consumers, and not over react to the demands of the shrillest interests with the most money for publicizing a particular position.
- Energy policy must be strategic and long-term, not "quick fixes" to short-term "crises".
- Energy policy must include a role for all energy sources, including coal and nuclear energy.
- Resource assessments are a vital planning tool for policymakers and industry. The agencies that perform these assessments and track oil and gas resources and reserves need continued support. They have done a good job to date.
- A major long-term and capital-intensive industry effort is required to explore for, develop, produce, and build the infrastructure necessary to deliver the energy supplies required to meet projected demand. Energy policy must facilitate processes that attract capital investment in energy

development without creating costly and time-consuming regulatory roadblocks.

- Industry access to public lands, which might contain hydrocarbon resources, should be a priority to encourage domestic energy sources. We cannot become further and more dangerously dependent on unreliable foreign energy imports.
- ***The public must be assured that energy resource development can be accomplished in an environmentally sensitive manner. The technology is available to do this and the petroleum industry already practices such environmental responsibility.***
- The impact of the Kyoto Protocol on the ability of the nation to supply the energy needed to fuel our economy without major disruptions must be carefully evaluated

On behalf of AAPG, I thank the Subcommittee for giving us this opportunity to testify.