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Before the House Committee on Science, Space and Technology

April 17, 2012

Mr. Chairman, Mr. Ranking Member, distinguished committee members; thank you for the opportunity to be here today to talk about America's unconventional oil resources and the potential for their development. I am here today in my capacity as a contributor to the recent National Petroleum Council Study, "Prudent Development - Realizing the Potential of North America's Abundant Natural Gas and Oil Resources". For this study I was the chairman of the Resources and Supply Task Group which focused on hydrocarbon resources and development potential in the U.S. and Canada. I also work for Shell where I focus on analyzing North American natural gas and crude oil markets.

The National Petroleum Council (NPC) Study was undertaken in response to a request from Secretary of Energy Dr. Chu to assess North American resources of natural gas and oil; describe their development potential; describe the key technologies which will be used in this development; set out how development can be achieved while ensuring high standards of environmental performance and management of community impacts; and analyze the contribution which greater use of natural gas can make in reducing CO2 and other air emissions, while achieving objectives of environmental protection, economic growth, and energy security. The study was commissioned in September 2009 and the final report was delivered in September 2011. The study report, 55 supporting topic papers, and other study materials are publically available on the NPC's website (www.npc.org).

The NPC is a Federally chartered, self-funded Advisory Committee with the sole purpose of providing advice to the Secretary of Energy and Executive Branch by conducting studies at their request. It is not an advocacy group and does not lobby. NPC study participants represent diverse interests and expertise relating to the topic being addressed. There were over 400 participants involved in the study that produced the NPC's "Prudent Development" Report, the majority of which were from organizations outside of the oil and gas industry.

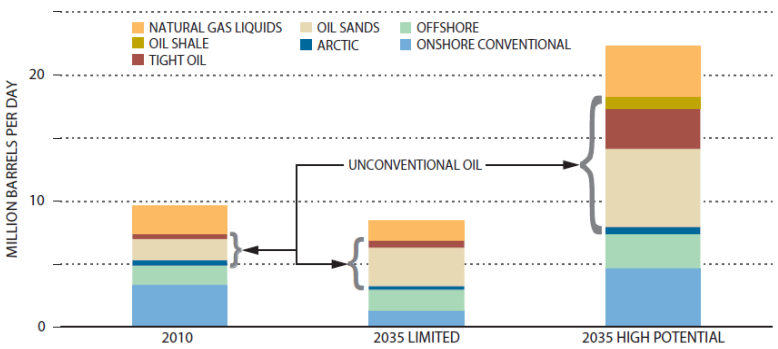
The Task Group which I chaired was composed of almost 100 experienced industry professionals, academics and experts from government agencies, and set out to describe the natural gas and oil resources available for development in the U.S. and Canada; potential pathways for development and production over the next two to four decades, laying out the enabling conditions which could favour a pathway to higher production and the challenges or barriers which could constrain production growth; and the key technologies, current and future, which will need to be developed and deployed.

The Task Group undertook a comprehensive review of the following hydrocarbon resource types: offshore oil and natural gas; Arctic oil and natural gas; onshore conventional oil and enhanced oil recovery; unconventional oil; and onshore natural gas. We also studied crude oil and natural gas infrastructure needs; hydrocarbon resource assessments; and we reviewed and analyzed a wide range of publicly available studies on these topics as well as undertaking a survey of proprietary outlooks from oil and gas companies and consulting firms.

Since the focus of this hearing is on unconventional oil, I propose to concentrate my remarks in this area, although I would also be pleased and willing to answer questions about other segments of North American hydrocarbon supply potential.

We define unconventional oil as oil resources which require non-traditional production techniques and technologies to be developed and produced; in contrast to conventional oil which is usually produced from a defined reservoir through a vertical wellbore using natural or induced pressure. In the case of unconventional oil, non-conventional production techniques include mining or in-situ thermal recovery of heavy oil, bitumens and kerogen. We include heavy oil, very heavy, oil shale and oil sands in this category of unconventional oil. Unconventional oil can also include such resources as tight oil, which is usually light and sweet, but which is extracted from source rock using horizontal drilling and multi-stage hydraulic fracturing techniques similar to those deployed in shale gas plays.

Figure 1-5. More Resource Access and Technology Innovation Could Substantially Increase North American Oil Production



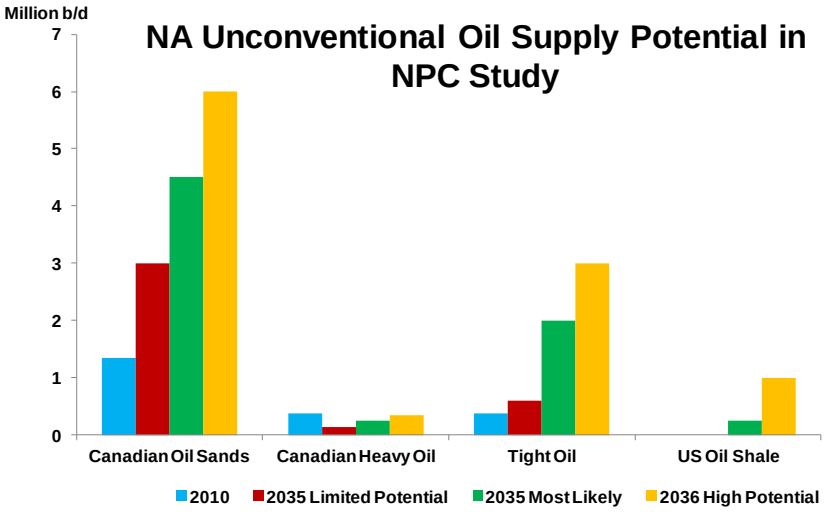
Note: The oil supply bars for 2035 represent the range of potential supply from each of the individual supply sources and types considered in this study. The specific factors that may constrain or enable development and production can be different for each supply type, but include such factors as whether access is enabled, infrastructure is developed, appropriate technology research and development is sustained, an appropriate regulatory framework is in place, and environmental performance is maintained.

Source: Historical data from Energy Information Administration and National Energy Board of Canada.

The study team found that the ultimate potential of North American unconventional oil is huge. Oil in place is estimated at over 3.5 trillion barrels, with recoverable resources using known technology standing at over 177 billion barrels. This compares with about 185 billion barrels of technically recoverable conventional oil resources in the U.S. And with future technological developments, we may ultimately be able to recover over 1 trillion barrels of all these resources with sustained advances in appropriate technologies and operating practices. Moving towards ultimate potential will take decades, not years, but requires sustained activity in developing appraisal, drilling and recovery technologies and operating practices; and recognition from policy-makers and regulators that regulatory, fiscal and leasing frameworks need to take into account the specific complexities of these resources.

The NPC study took an in-depth look at how the resources identified could be developed into production over the next couple of decades (as well as the conventional oil resources in North America). Figure 1.5

from the Executive Summary of the report shows the range of potential production and highlights how unconventional crude oil might be developed compared to conventional oil. It included production from both the U.S. and Canada, as we considered the two countries to represent essentially one large market for oil supply. The chart shows that, out of 2010 total production of just under 10 million b/d, approximately 2 million barrels per day came from what we would consider unconventional plays, predominantly the Alberta oil sands; and a further 3 million barrels per day or so came from natural gas liquids, much of which was associated with unconventional natural gas production.



The two other bars on the chart represent the potential range of North American oil production by 2035.

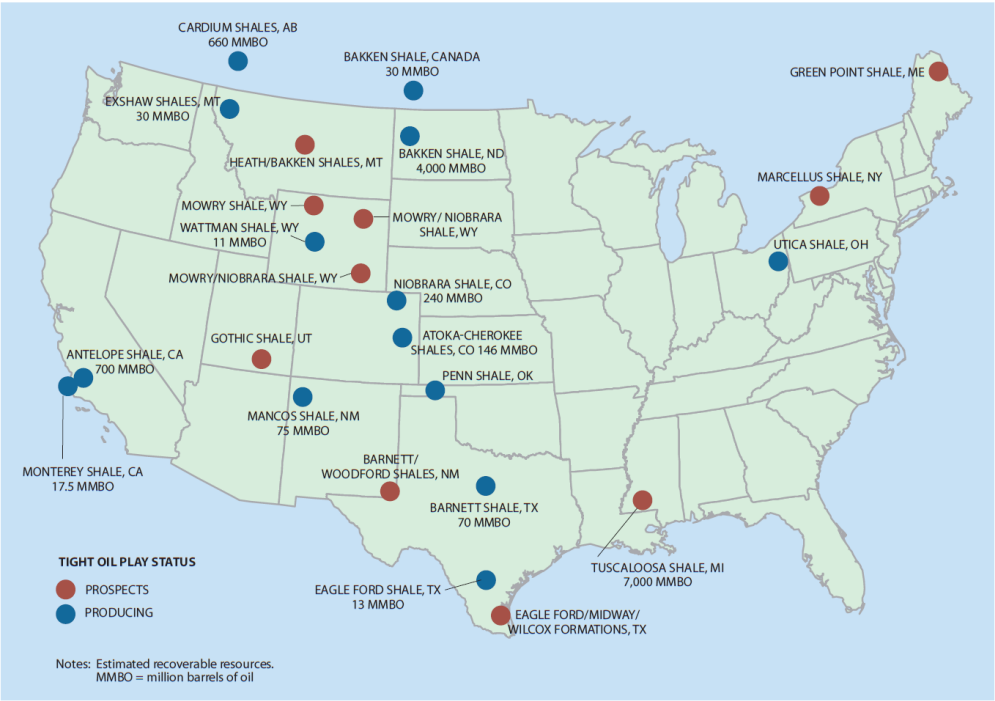
The Limited outlook assumes that development of new plays and expansion of existing plays proceed quite slowly, inhibited by restrictions on access, restrictive leasing frameworks, a lower capacity to develop appropriate technologies and a lower pace of infrastructure development. Even in this more limited outlook, however, there could be an expanded role for unconventional oil, growing to over 3.5 million b/d, with growth from the Alberta oil sands and from U.S. tight oil. Indeed, in this more restricted oil development scenario, unconventional oil would represent a growing share of the total as the more conventional sources decline as a result of the lack of new development, combined with continuing depletion of existing mature reservoirs.

In the High Potential scenario, shown on the right of this chart, the study team assessed that total North American oil production could rise to over 22 million b/d by 2035, if more favorable development conditions are assured by governments, regulators and oil and companies alike. Of this 22 million b/d, the study team estimated that about 7 million b/d could come from unconventional sources with a further 5-6 million b/d coming from natural gas liquids, again much of which should be expected to be associated with unconventional natural gas production.

The following chart breaks out the individual components of unconventional oil included in the overall ranges of production. We can see that the highest scope for increases is still expected to come from the Alberta oil sands, with their vast resources of identified hydrocarbons. But US tight oil could also become a significant contributor over this time period, reaching at least 3 million b/d by 2035. In fact, over the course of the NPC study and in the time since it has been completed our understanding of tight

oil resources and their potential to grow production increased substantially. And it is quite conceivable that even the high potential case shown here understates the scope of production which may be achievable.

The following map shows the principal areas of current and potential development of tight oil, as known today. It is, of course, quite possible, that, as with shale gas, more prospective areas are identified as more knowledge and experience is acquired. (The map makes an estimate of recoverable resources for some tight oil plays using published literature, reports from states and government agencies, and industry press releases. These estimates could be low - many of the tight oil plays are in early stages of development and resources may be significantly greater than currently reported).



It is worth clarifying at this point that US oil shale, although it represents a massive hydrocarbon resource, even in the most favourable scenario for development, should not be expected to have as much impact as oil sands and tight oil in this time frame. However, in order to be available for ramp-up to significant volumes in subsequent decades, a sustained effort in leasing, research and technology development will be needed in the near-term. Since unconventional resources will mostly require unique new techniques to extract the oil, learning from the Canadian oil sands example, the yardstick

for measuring the successful development and deployment of new technologies is decades – not years. Other factors to support growth include -- fiscal measures to spur growth and reduce risk, and long term land access agreements so that operators have time to develop and deploy new extraction ideas.

Now let me turn to the key technologies which can influence these potential outcomes and which will be needed if the higher potential production profiles are to be achieved. For unconventional oil, new technologies include both methods to extract the oil economically, and, since unconventional oil generally has a higher environmental footprint than conventional oil, ways to reduce environmental impacts from production.

First let me address tight oil. In this case, the successes over the past five years in unconventional and shale natural gas development really opened the path for the subsequent take-off of tight oil development. The impact of new technology application has been to revitalize areas which have in the past seen significant oil and natural gas development, but which had mostly been perceived as largely "played out" such as in the Williston Basin of North Dakota and Montana, home of the Bakken play.

The key to opening up the new tight oil resources has been the application of new extraction methods - horizontal drilling, combined with multi-stage hydraulic fracturing. At this level, the technology is similar to that used to open up shale gas plays. However, specific use of technology is conditioned by the specific geologic conditions encountered in each location. Rock permeability and porosity conditions vary as do depth and pressure. The design of drilling and completion strategies in each basin needs to be tailored to local conditions. Technology improvements as these developments go forward will be around better identification of oil location within the formations, optimum placement of fractures and flow monitoring systems which can track the performance of individual fractures. And , on the environmental technologies and operating practices side, operators need to develop new techniques that both reduce overall water use and manage the water flows as an integrated cycle from water acquisition to water disposal. Recycling of water will be increasingly necessary as the volume of activity increases. In addition to the above technologies, a multitude of other technological advances have continued to improve the identification of resources, reduce costs, and/or increase recoveries of tight oil and other resources.

In the North American context, the development of the Alberta oil sands is also a key component of expanded oil supply. For the first 20 years, the oil sands industry has been focused on developing technology that could extract the oil economically. Over the next 20 years, the focuses will be on the environmental technologies. a clearer understanding of the technologies used and how environmental impacts are managed for the region as whole is an important for consideration for Canadian policy makers and regulators. As supply grows, methods to reduce the environmental footprint of extraction, and to ensure that the growth stays within the regional environmental limits is a key focus.. There are two broad categories of oil sands extraction – 1) surface mining, in which shallow deposits of bitumen are removed using truck and shovel techniques and then treated to remove bitumen from the other mined materials; and 2) in-situ extraction, used in deeper deposits, hot steam injection is used to increase bitumen viscosity so it can flow to the surface. There are various in-situ technologies available

and operators are continuously testing new approaches to increase efficiency, environmental impacts, and recovery rates and/or to lower operating costs. These approaches are discussed in more detail in the "Unconventional Oil" topic paper of the recent NPC study, and it is worth stressing here that, with the opportunity to develop these resources, the industry has been extremely proactive in developing improvements in technology, operating practices and environmental performance in all its aspects, to enable continued expansion of the production . For example, the industry has lowered its GHG emissions intensity per barrel by 39 percent from 1990 to 2008[1].

In fact, the Alberta oil sands development could, in many respects, serve as a template for unconventional oil development in many other areas of the U.S. and Canada. Industry, provincial and federal governments and regulatory agencies have consistently worked together to develop appropriate access, leasing frameworks, regulations and environmental standards which have together enabled steady expansion of capacity over many years, allowing the economic and energy security benefits of these resources to be achieved, whilst also driving continued improvement in environmental management. A constructive learning from the Canadian oil sands, which could be applied to other unconventional resources, is to undertake a full assessment of the environmental and social impacts early to allow for long term planning, and integration of mitigation strategies early in the resources development.

The Alberta oil sands has reached its current position as a world-class oil province, both in terms of current production and future growth, after decades of patient, sustained effort by all involved to assemble an operating and regulatory framework which works well for all participants, allowing substantial benefits to be realized. In the U.S. we can see a possible parallel in the development of oil shale in the Rocky Mountain states. Again, here various attempts have been made over the past 40 years or so to build large-scale production, commensurate with the immense size of the available resource. However, as yet, cost-effective and environmentally appropriate development and producing technologies have not yet emerged to move into sustainable high-volume production, and this process might take several more decades and enormous capital commitments from the oil and gas companies. To enable these development pathways to proceed with confidence, broad and consistent government engagement is required to provide some degree of long-term regulatory certainty. On the technology front, a broad partnership of industry, academia and government research facilities would be desirable to allow a range of concepts to be developed and tested. If these regulatory frameworks and technology development efforts are not put in place and sustained, then we may not be ready to tap into these vast resources when there is a clear need in the market, later this century. We should not let our current and near-term successes in such resources as tight oil distract us from preparing for the long-term when new sources of oil will surely be required.

[1] National Inventory Report 1990---2008: Greenhouse Gas Sources and Sinks in Canada" Environment Canada (2010) Available athttp://www.ec.gc.ca/Publications/default.asp?lang=En&xml=492D914C---2EAB47AB---AO45---c62B2CDACC29 Part I, Page 69

There are other types of unconventional oil which we have identified, such as heavy and extra-heavy oil, and US oil sands. Others may emerge in the coming years and decades. Together with the vast, world-class producing and prospective basins in North America for conventional oil, such in the offshore, around all the coastlines of the lower-48 states (not just the Gulf of Mexico); in the Arctic regions of the U.S. and Canada; and in the application of new drilling techniques and enhanced oil recovery methods to fields which may have previously been considered as mature, North America has the prospect of maintaining and building on its position as one of the major oil producers of the world for many years to come. Although there are significant uncertainties about the future size of the North American oil market (and these will be addressed in the forthcoming NPC study on the future of Transportation Fuels), the opportunity to produce a much larger share of domestic consumption from North American sources is real and demonstrated. Unconventional oil has added a new dimension to what was already a rich portfolio of oil development options. In considering current and future energy policy, we urge policy makers to take all necessary steps to keep these options on the table, allowing capital to be deployed, technology to be developed and significant energy security and economic benefits to be achieved. There are challenges to many of these prospects. But industry can overcome these challenges by being allowed to proceed with development and technological advances. The continuous history of this industry has been one of ever-increasing productivity and technological intensity, allied with ever-improving environmental performance and engagement with the communities where we operate. Government and policy-makers have an important role to play in setting out a framework for activity which recognizes the contribution of the resource potential, while addressing the needs of wider groups of stakeholders.