# U.S. HOUSE OF REPRESENTATIVES
# COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

# HEARING CHARTER

## *Supporting American Jobs and the Economy Through Expanded Energy Production: Challenges and Opportunities of Unconventional Resources Technology*

Thursday, May 10, 2012
9:30 a.m. -12:00 p.m.
2318 Rayburn House Office Building

## PURPOSE

On Thursday, May 10, 2012, at 9:30 a.m. in Room 2318 of the Rayburn House Office Building, the Subcommittee on Energy and the Environment of the Committee on Science, Space, and Technology will hold a hearing titled, *"Supporting American Jobs and the Economy Through Expanded Energy Production: Challenges and Opportunities of Unconventional Resources Technology*." The purpose of the hearing is to examine challenges and opportunities associated with expanding development and use of unconventional oil and gas production technologies.

## WITNESS LIST

### Panel One

- **The Honorable Charles McConnell,** Assistant Secretary for Fossil Energy, U.S. Department of Energy
- **Ms. Anu Mittal,** Director, Natural Resources and Environment, U.S. Government Accountability Office

### Panel Two

- **Ms. Samantha Mary Julian,** Director, Office of Energy Development, State of Utah
- **Mr. Jim Andersen,** Chief Executive Officer and President, U.S. Seismic Systems, Inc.
- **Mr. Cameron Todd,** Chief Executive Officer, U.S. Oil Sands, Inc
- **Mr. Tony Dammer**, Member, Board of Directors, National Oil Shale Association

## KEY ISSUES FOR COMMITTEE CONSIDERATION

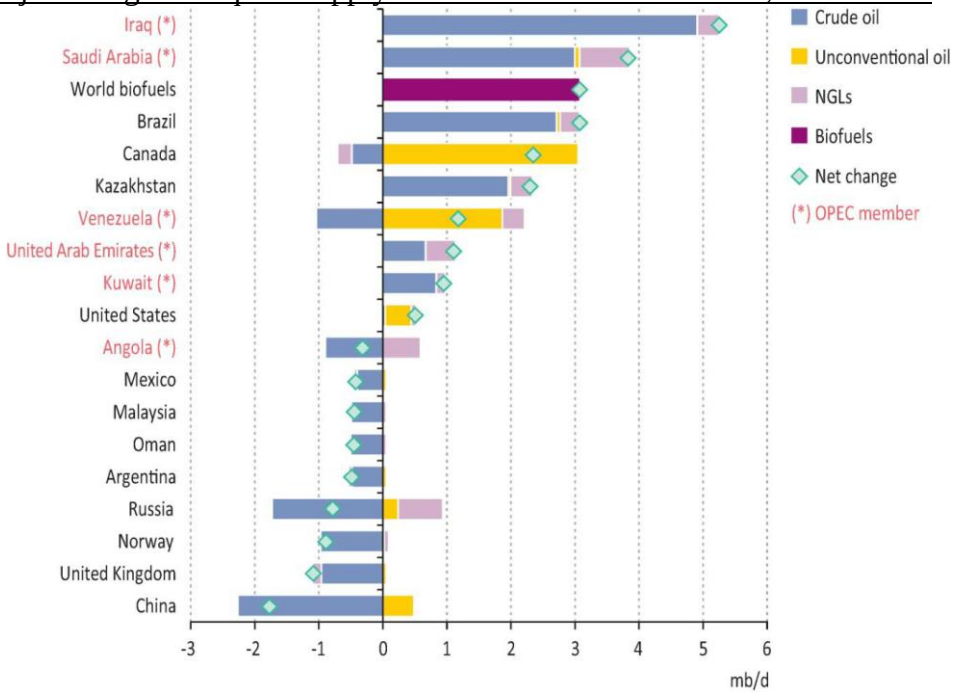
While unconventional energy resources are increasingly developed, key issues must be considered. Specifically:

- How can the environmental impacts associated with resource development be minimized, including water management and use?
- What targeted and appropriate research and development activities could be supported by the Federal government?
- What are policy barriers may impede unconventional oil and gas R&D?
- How can all stakeholders involved in the process cooperate on overarching strategies to expand unconventional resource production?

## BACKGROUND

The world currently consumes approximately 87 million barrels of oil per day (MMbd), which is projected to increase to 99 MMbd in 2035, primarily driven by growth from non-OECD countries.[1] Currently, conventional oil production is the primary source of oil supply; however, the International Energy Agency (IEA) projects conventional crude oil production to decline to 68 MMbd in 2035. In order to meet projected demand, IEA projects production of unconventional oil, natural gas liquids (NGLs), biofuels, and other substitutes is anticipated to increase to 47 MMbd by 2035. (Figure 1)

Figure 1: Major changes in liquids supply in the New Policies Scenario, 2010-2035[2]




[1] International Energy Agency, "World Energy Outlook 2011," November 9, 2011. Executive Summary available at: http://www.worldenergyoutlook.org/media/weowebsite/2011/executive_summary.pdf

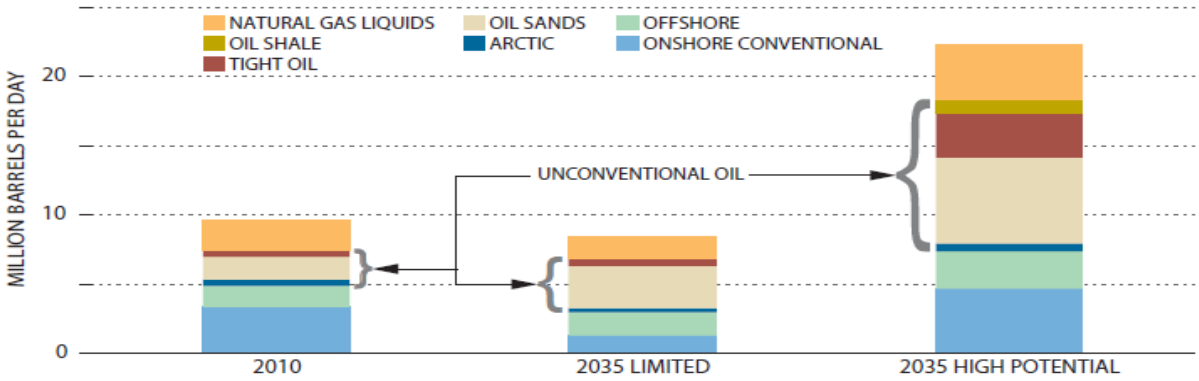
[2] International Energy Agency, "World Energy Outlook 2011: Key Graphs," November 2011. Accessible at: http://www.worldenergyoutlook.org/media/weowebsite/2011/key_graphs.pdf

In September 2011, the National Petroleum Council (NPC), a federally chartered advisory committee to advise the Secretary of Energy on matters relating to oil and natural gas, issued a report titled *"Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources.*"[3] The report is a "comprehensive study to reassess the character and potential of North American natural gas and oil resources…"[4] The study identifies crude oil and natural gas resources and supplies and considers the prospects for North American oil development in light of the various challenges associated with different resource bases, including offshore, Arctic, onshore oil, unconventional oil, and pipeline infrastructure issues. (Figure 2) Within the various resource basis, the NPC estimates:[5]

- Currently technically recoverable in the Continental U.S. at nearly 60 billion barrels of oil;
- Arctic contains an estimated 100 billion barrels of recoverable oil;
- Alberta oil sands with a recoverable oil potential of more than 300 billion barrels;
- Onshore conventional oil estimated at 80 billion barrels,
- "Tight oil"[6] could produce an additional 34 billion barrels;
- Oil shale could yield resources estimated at 800 billion barrels.

Figure 2: National Petroleum Council Resource Estimated Potential Production.

**Figure ES-6.** More Resource Access and Technology Innovation Could Substantially Increase North American Oil Production




Notes: 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.

Note that in 2010, oil demand for the U.S. and Canada combined was 22.45 million barrels per day. Thus, even in the high potential scenario, 2035 supply is lower than 2010 demand, implying a continued need for oil imports and participation in global trade.

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

[3] National Petroleum Council, *"Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources,*" September 15, 2011. Executive Summary accessible at: http://www.npc.org/reports/NARD-ExecSummVol.pdf

[4] National Petroleum Council, *"Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources,*" September 15, 2011. p. 46. Full Report accessible at: http://www.npc.org/Prudent_Development.html

[5] NPC "Prudent Development, p. 46.

[6] "Tight oil" is oil contained in traditional deposits, but could not flow through the tight formation rock, thus was traditionally inaccessible.

## Resource Characterization and Potential Supply

The United States currently ranks first in the world in natural gas production and third in oil production.[7] This position as a leading global oil and gas producer can be credited in part to advances and breakthroughs in technology to facilitate the development of America's unconventional oil and gas resources. Given the variety, size, and scope of the unconventional deposits, advances in technology have increased recovery and output significantly increased U.S. resource estimates and future production potential.

Historically, conventional deposits have provided most of the oil and natural gas produced in the U.S. [8] Conventional resources are generally those resources that are recovered from a reservoir in which oil, natural gas, and water accumulate in a layered arrangement. Thus, unconventional resources can be defined as what they are not; they are those resources that cannot be produced, transported, or refined using traditional techniques. An unconventional deposit is one in which the distribution of oil and gas is throughout a geologic formation over a wide area, rather than within a discrete deposit. This category encompasses heavy oil, tight oil, oil shale, and oil sands, as well as shale gas and methane hydrates.

## Types of Unconventional Oil and Gas Resources

*"Heavy Oil"*

Heavy oil, also referred to as bitumen, has a viscosity[9] and specific gravity[10] that is much higher than that of light crude. This resource typically contains high concentrations of sulfur and metals such as nickel and vanadium. In North America, this resource is most prevalent in a Canadian region termed the "heavy oil belt," and is similar to the production of oil sands in the area. Oil in place in this region is estimated at over 35 billion barrels, and in 2009, production was at 382,000 barrels per day (bpd).[11] Estimates of U.S. heavy oil resource in place are between 60-100 billion barrels, 2 billion barrels of which are proven reserves and another 20 billion may ultimately be recoverable. Most heavy oil resources in the United States are located in California and Alaska.[12]

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[7] CIA World Factbook. Accessible at: https://www.cia.gov/library/publications/the-world-factbook/rankorder/2173rank.html

[8] Whitney, Gene; Behrens, Carl E.; Glover, Carol. Congressional Research Service, "Us Fossil Fuel Resources: Terminology, Reporting, and Summary." November 30, 2010. Accessible at: Accessible at: http://budget.house.gov/UploadedFiles/CRS_NOVEMBER2010.pdf

[9] "Viscosity" is a property of fluids and slurries that indicates their resistance to flow, defined as the ratio of shear stress to shear weight.

[10] "Specific Gravity" is the dimensionless ratio of the weight of a material to that of the same volume of water.

[11] National Petroleum Council , Unconventional Oil Subgroup Working Paper: "Unconventional Oil". September 15, 2011. Accessible at: http://www.npc.org/Prudent_Development-Topic_Papers/1-6_Unconventional_Oil_Paper.pdf

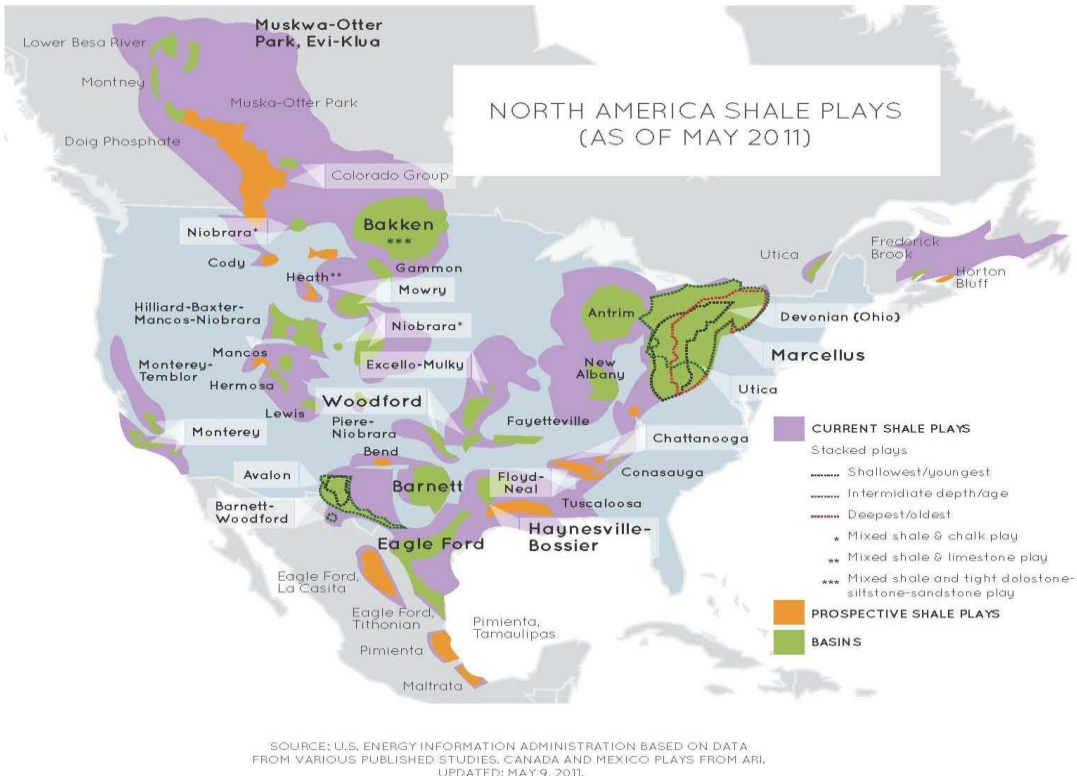
[12] Task Force on Strategic Unconventional Fuels, "Development of America's Strategic Unconventional Fuel Resources". Initial Report to Congress, September 2006. Accessible at: http://www.unconventionalfuels.org/publications/reports/sec369h_report_epact.pdf

*"Tight Oil"*

Tight oil, also referred to as shale oil, is produced using a combination of horizontal wells and fracturing to unlock hydrocarbons locked in low permeability and porosity siltstones, sandstones, and carbonates, or shale plays. Notable tight oil plays include the Bakken formation in North Dakota, Montana, and Saskatchewan; the Eagle Ford in southern Texas; the Cardium in Alberta; and the Miocene in California. Recent technological advancements have turned tight oil resources into one of the "most actively explored and produced targets in North America."[13]

Estimates of tight oil potential are significant. The NPC estimated a range of total resources from 5.6-10 billion barrels, with a potential high side estimate of 34 billion barrels. The Bakken field alone contains estimated recoverable resources ranging from 3.65 billion barrels to 4.3 billion barrels; the US Geological Survey (USGS) identified the Bakken as the largest continuous oil accumulation ever assessed by the agency.[14] Additionally, the report notes that these estimates may be conservative, as some plays are still in the nascent stages of discovery and the size of the resource may not be fully known. (Figure 3) There is also significant potential for technology and efficiency improvements to enhance and expand the amount of recoverable resources.

Figure 3: North American Shale Plays[15]




[13] NPC Unconventional Oil Resources Pg 84

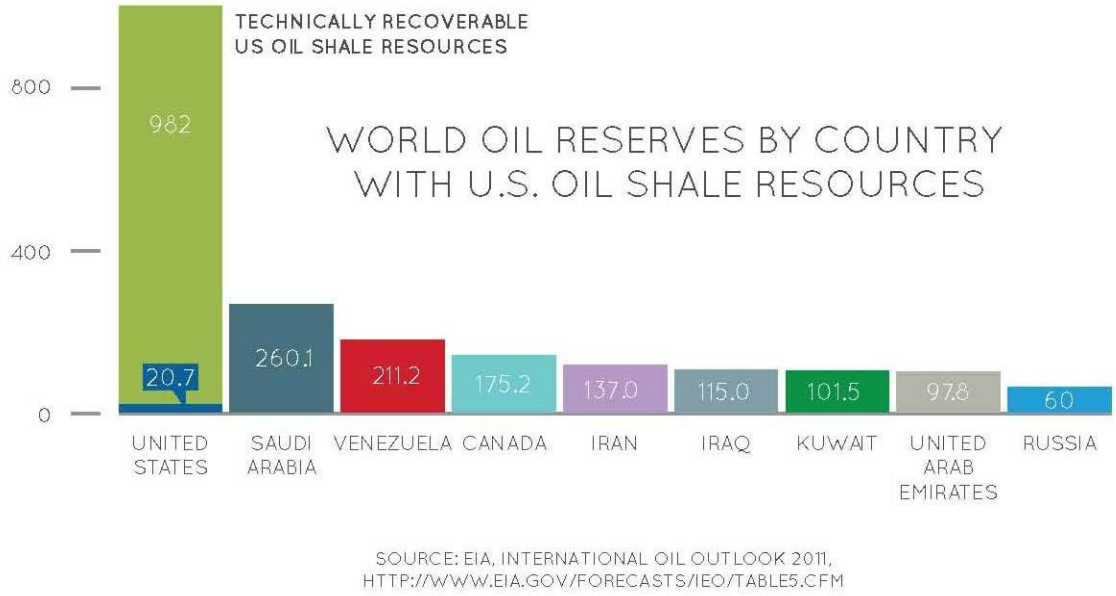
[14] The group based these estimates on published literature, reports from state and Federal government agencies, and industry information. References also include USGS reports, and a NETL/DOE report.

[15] Institute for Energy Research, *"Hard Facts: An Energy Primer,"* 2012, pp. 27. Accessible at: http://www.instituteforenergyresearch.org/hardfacts-uploads/NJI_IER_HardFacts_ALLpages_20120423_v8.pdf

*"Oil Shale"*

Oil shale refers to deposits in which the petroleum component, kerogen, has not been fully transformed into oil or gas; kerogen must be heated to transform it into an upgraded hydrocarbon. The geologic state of the resource does not permit it being pumped directly from the ground, and must either be processed above ground or in place (ex situ or in situ). The potential for oil shale production in the U.S. is sizeable at 6 trillion barrels of oil in place, mostly concentrated in the Green River Formation in Colorado, Utah, and Wyoming. However, only a fraction of the oil in place will be suitable for recovery. Nearly 80% of oil shale resources, including the richest, most-concentrated deposits, are located on Federal lands.[16] The remaining resources are owned by states, individuals, private companies, and tribes. Privately owned lease holdings are concentrated near the southern margin of the Piceance basin in Colorado, and could support commercial operations up to 400,000 bpd. In contrast, federally owned land could easily support a number of large projects with each lease supporting up to 300,000 bpd.[17] Oil shale has a limited production history in the U.S., and currently there is no commercial scale production of oil shale. (Figure 4)

Figure 4: World Oil Reserves[18]




[16] INTEK, Inc. prepared for the US Department of Energy, Office of Petroleum Reserves, "*Secure Fuels from Domestic Resources: Profiles of Companies Engaged in Domestic Oil Shale and Tar Sands Resource and Technology Development*". Fifth Edition, September 2011. Accessible at: http://www.unconventionalfuels.org/publications/reports/SecureFuelsReport2011.pdf

[17] Strategic Unconventional Fuels Task Force, "*Task Force's Strategy and Program Plan, 2007*," September 2007. Accessible at: http://www.unconventionalfuels.org/publications.html

[18] IER, Hard Facts, pp. 28.

*"Oil Sands"*

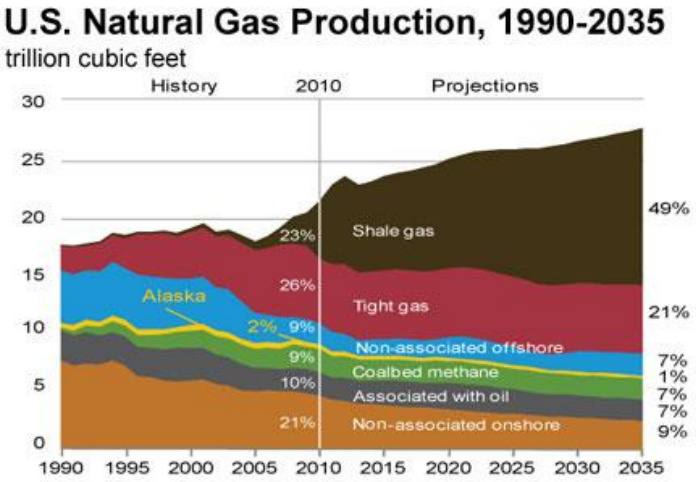
Oil sands are a mixture of sand and other rock materials that contain crude bitumen, thick viscous crude that can be in a near solid state at reservoir temperature. These resources are generally composed of "approximately 80-85 percent sand, clay or other mineral matter, 5-10 weight percent water, and anywhere from 1-18 percent weight percent crude bitumen."[19] Production of this bitumen, which is carbon rich, extra heavy, and contains contaminants such as sulfur, oxygen, nitrogen, and heavy metals, requires removing these contaminants and improving the value of the crude in order to meet pipeline density and viscosity requirements. Production technologies vary as to the location and characteristics of various deposits, and include mining and extraction technologies as well as in situ processes such as steam assisted gravity drainage, cyclic steam stimulation, and solvent injection, among others.

In North America, oil sands deposits have been identified in both Canada and the United States. In Canada, oil in place estimates for oil sands have been pegged at 1.8 trillion barrels, vaulting Canada into second place behind Saudi Arabia for total oil reserves.

The oil sands resources located in the United States differ in geological composition, continuity, and deposition from Canada's resources. Canada's oil sands are generally water wet and consolidated, while U.S. oil sands are generally hydrocarbon wet and unconsolidated. Currently, there is no commercial scale production from U.S. oil sands, though there are a handful of pilot scale projects. Despite the current lack of commercial production, estimates of U.S. oil sands in place are approximately 54 to 62.9 billion barrels spread across ten states, and about 11 billion barrels may ultimately be recoverable. The largest of these deposits are found in Utah, which contains approximately one-third of the domestic resource, estimated at 12 to 19 billion barrels located mostly on public land, both state and federal.[20] Large deposits also exist in Alaska, and the remainder of the resource is spread across Alabama, Texas, California, Kentucky, and other states.

*"Shale Gas"*

The Department of Energy's (DOE) Energy Information Administration's Annual Energy Outlook 2012, estimates that the U.S. possesses 2,214 trillion cubic feet (tcf) of technically recoverable natural gas resources. Of this total, natural gas from proven and unproven shale resources account for 542 tcf .[21]




Source: U.S. Energy Information Administration, AEO2012 Early Release Overview, January 23, 2012.

[19] NPC "Prudent Development," p. 34.

[20] INTEK, Inc. prepared for the US Department of Energy, Office of Petroleum Reserves, "*Secure Fuels from Domestic Resources: Profiles of Companies Engaged in Domestic Oil Shale and Tar Sands Resource and Technology Development*". Fifth Edition, September 2011. Accessible at: http://www.unconventionalfuels.org/publications/reports/SecureFuelsReport2011.pdf

[21] EIA Energy in Brief "What is shale gas and why is it important?". April 11, 2012. Accessible at: http://www.eia.gov/energy_in_brief/about_shale_gas.cfm

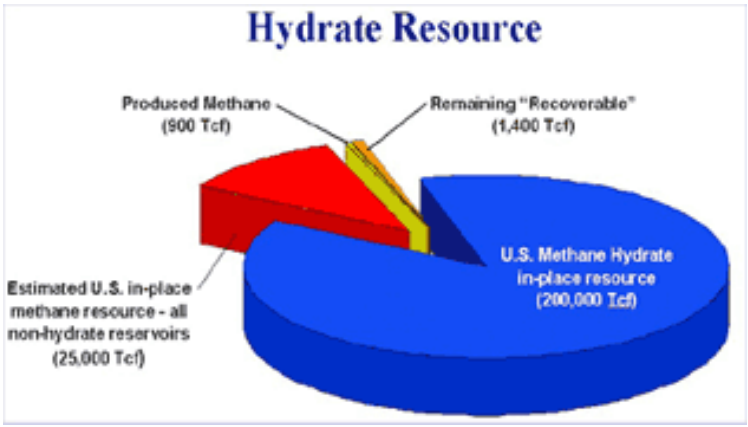
Shale gas refers to natural gas trapped in fine grain sedimentary rock formations characterized by low permeability and porosity. These resources have become accessible over the last decade due to the combination of advances in horizontal drilling and hydraulic fracturing. Natural gas production from shale account for 23% of total U.S. production, up from less than 1% in 2000, and is projected to account for 49% of total production by 2035.

*"Methane Hydrates"*

Methane hydrates are another potential source of increased natural gas production that will require research and technology development to produce. Methane hydrate "is a cage-like lattice of ice inside of which are trapped molecules of methane, the chief constituent of natural gas."[22] By warming or depressurizing the resource, it can be processed to natural gas. It is estimated the global volume of naturally occurring methane hydrates far exceeds the current natural gas resource estimates.[23] (Figure 5)

Methane hydrates deposits in the U.S. can be found in Outer Continental Shelf and under the Alaskan permafrost, and much of the research has focused on developing resource estimates for the Gulf of Mexico and Alaska's North Slope. According to estimates by the then-Minerals Management Service (now Bureau Ocean Energy Management, Regulation, and Enforcement) the Gulf could contain 11,000 to 43,000 tcf of methane in place. The USGS assessment of the North Slope estimated approximately 85 tcf of technically recoverable methane.[24] Additionally, the USGS estimates total in place methane hydrates resources in the U.S. are about 320,000 tcf.[25]

Figure 5: Total Hydrate Resource[26]




[22] US Department of Energy, Office of Fossil Energy, "*Methane Hydrates-The Gas Resource of the Future*," accessible at: http://www.fossil.energy.gov/programs/oilgas/hydrates/index.html

[23] US Department of Energy, National Energy Technology Laboratory, National Methane Hydrates R&D Program, "*All About Hydrates-Estimates,*" accessible at: http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/about-hydrates/estimates.htm

[24] US Department of Energy, National Energy Technology Laboratory, "Energy Resources Potential of Methane Hydrates". February 2011. Accessible at: http://www.netl.doe.gov/technologies/oil-gas/publications/Hydrates/2011Reports/MH_Primer2011.pdf

[25] Collett, Timothy, USGS, "*Natural Gas Hydrates—Vast Resources, Uncertain Future*," March 2001. Accessible at: http://pubs.usgs.gov/fs/fs021-01/fs021-01.pdf

[26] DOE National Energy Technology Laboratory, *"All About Hydrates – Estimates.*" Accessible at: http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/about-hydrates/estimates.htm

## Department of Energy Unconventional Oil and Gas Programs

The United States has long recognized the potential of unconventional oil and gas resources. For example, President Taft created the Office of Naval Petroleum and Oil Shale Reserves (NPOSR) in 1912 to serve as a strategic resource in the event of war or national emergency for the U.S. Navy.[27] The office manages an oil field technology testing center that aims to address "technical and environmental issues associated with the production, distribution, and use of the nation's energy resources."[28]

DOE's Office of Fossil Energy (FE) manages research, development, and demonstration (RD&D) activities for oil and gas technologies. Specifically, FE's Office of Oil and Natural Gas "supports research and policy options to ensure environmentally sustainable domestic and global supplies of oil and natural gas."[29] The National Energy Technology Laboratory (NETL) serves as the lead FE RD&D facility and manages much of FE's oil and gas technology research.

Table 1 – Department of Energy Unconventional Oil and Gas Funding Levels (In Millions)

| Program | FY 2011 Current | FY 2012 Enacted | FY 2013 Request | FY 2013 House Energy & Water Appropriations Mark |
|---|---|---|---|---|
| Naval Petroleum and Oil Shale Reserves | $20.9 | $14.9 | $14.9 | $14.9 |
| Unconventional FE Technologies | $0 | $5.0 | $0 | $25.0* |
| Natural Gas Technologies | $0 | $5.0 | $12.0 | $10 |
| Gas Hydrates | $0 | $10.0 | $5.0 | $5.0 |

*House Appropriations Committee recommends $25 million "to be used to support both research to improve the economics of oil production from shale oil, as well as to reduce the health, safety, and environmental risks associated with shale oil extraction."[30]

### Federal Unconventional Oil Research and Development Activities

Efforts to economically produce various sources of unconventional oil and gas were underway through much of the last century.[31] For example, the U.S. Department of Interior (DOI)

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[27] US Department of Energy, Office of Fossil Energy, "*The Naval Petroleum and Oil Shale Reserves- 90 Years of Ensuring National Security*," accessible at: http://www.fe.doe.gov/programs/reserves/npr/npr-90years.html

[28] US Department of Energy, Office of Fossil Energy, U.S. Petroleum Reserves, "Naval Petroleum Reserves – Profile," Updated December 22, 2011. Accessible at: http://fossil.energy.gov/programs/reserves/npr/

[29] U.S. Department of Energy, Office of Oil & Natural Gas, updated May 7, 2012. Accessible at: http://www.fossil.energy.gov/programs/oilgas/index.html

[30] House Appropriations Committee Report, "Energy and Water Development Appropriations Committee Report, FY 2013." P. 97. Accessible at: http://appropriations.house.gov/UploadedFiles/EW-FY13-FULLCOMMITTEEREPORT.pdf

[31] INTEK, Inc., Prepared for the US Department of Energy, Office of Petroleum Reserves, "*Oil Shale Research in the United States: Profiles of Oil Shale Research and Development Activities in Universities, National Laboratories,*

conducted oil shale research activities during the 1940's. The oil crisis of the 1970's renewed calls for unconventional oil and gas research programs and the DOI instigated an oil shale leasing program to provide land for RD&D activities. When the oil crisis subsided, DOE reduced many of its unconventional oil and gas research programs.

Recently, significant technology advances and high crude oil prices have regenerated interest in unconventional fuels production. The development of horizontal drilling permitted the use of hydraulic fracturing to produce shale oil and gas. Shale oil production enabled the development of the Bakken fields in North Dakota. North Dakota is now the third largest oil producing state, producing over 550,000 bpd, up from 45,000 bpd in 2007. [32]

DOE currently conducts research and development activities to produce methane hydrate gas. On May 2, 2012, DOE, in partnership with ConocoPhillips and Japan Oil, Gas and Metals National Corporation, announced the completion of a successful field test of technology in Alaska to extract natural gas from methane hydrates.[33]

Energy Policy Act of 2005

Section 369 of the Energy Policy Act of 2005 (EPACT 05) contains provisions to facilitate the development of unconventional fuels.[34] The law states:

(1) "United States oil shale, tar sands, and other unconventional fuels are strategically important domestic resources that should be developed to reduce the growing dependence of the United States on politically and economically unstable sources of foreign oil imports;
(2) The development of oil shale, tar sands, and other strategic unconventional fuels, for research and commercial development, should be conducted in an environmentally sound manner, using practices that minimize impacts; and
(3) Development of those strategic unconventional fuels should occur, with an emphasis on sustainability, to benefit the United States while taking into account affected States and communities."[35]

EPACT 05 directed Bureau of Land Management (BLM) to begin leasing federal lands for the purpose of oil shale and tar sands research and development activities. The first round of research, development, and demonstration leases were awarded in 2006, and another round of leases were offered in 2009, but are yet to be awarded.

Strategic Unconventional Fuels Task Force

EPACT 05 also created a Strategic Unconventional Fuels Task Force composed of the U.S. Secretaries of Energy, Interior and Defense, the Governors of Colorado, Kentucky, Mississippi,

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*and Public Agencies*," Third Edition, September 2011. Accessible at: http://www.unconventionalfuels.org/publications/reports/Research_Project_Profiles_Book2011.pdf
[32] North Dakota Oil & Gas Industry "Facts and Figures," Updated April 12, 2012Accessible at: http://www.ndoil.org/image/cache/Facts_and_Figures_2012_4.12.pdf
[33] NETL Publications, Press Release, "*U.S. and Japan Complete Successful Field Trial of Methane Hydrate Production Technologies*," May2, 2012. Accessible at: http://www.netl.doe.gov/publications/press/2012/120502_us_and_japan.html
[34] P.L. 109-58
[35] Ibid.

Utah, and Wyoming, and three representatives of local governments in affected areas.[36] The Task Force was charged with making recommendations "regarding promoting the development of the strategic unconventional fuels resources within the United States."[37]

The task force submitted an initial report, as required, to the President and Congress in 2006, followed by a three volume strategy and program plan in 2007. Annual reports from 2008 and 2009 followed; however, despite the legislative requirement that annual reports be provided for each of the five years following the initial report, there were no annual reports for 2010 or 2011. According to its website, "The Task Force is presently considering what its future role should be." [38]

Resources addressed by the task force include oil shale, coal-derived liquids, heavy oil, tar sands, and enhanced oil recovery. The Task Force estimated the size and potential of these resources, and identified potential uncertainties or constraints to their development. Potential impediments identified were resource access, environmental and permitting timeline uncertainties, risky fiscal regimes, lack of demonstrated production technologies, and infrastructure constraints, among others. This report also provided initial recommendations on how to ameliorate uncertainties stemming from the identified constraints.

In the 2007 Strategy and Integrated Program Plan, these issues were examined by the Task Force in much more depth and detail. Major strategies were identified to accelerate the development of these resources and reap the public benefits associated with production while promoting environmental stewardship, mitigating adverse socio-economic impacts on states and localities, and maintaining governmental fiscal responsibility. This plan also included eight major recommendations, with associated steps and timelines for implementation.

1. Access to Resources on Public Lands: Provide an effective land tenure system;
2. Regulatory and Permitting: Provide an inclusive regulatory system and review process that encourages expeditious development;
3. Economic: Create a fiscal regime that attracts necessary private development capital;
4. Technology: Craft a fast track program to attract investment while maintaining fiscal responsibility;
5. Public Infrastructure: Create an integrated local and regional infrastructure plan to support efficient development and reduce duplicative investments;
6. Socio-Economic: Establish a program for development, planning, funding, and training that mitigates adverse local impacts and maximizes state and local employment and economic growth;
7. Government Organization: Ensure that appropriate organization structures exist at state local and federal levels that will promote and accelerate development in a reasoned, efficient way;

[36] Strategic Unconventional Fuel Task Force, Task Force Members, Accessible at: http://www.unconventionalfuels.org/members.html
[37] P.L. 109-58.
[38] Strategic Unconventional Fuels Task Force. http://www.unconventionalfuels.org/home.html

8. International Partnerships: Initiate partnerships that advance and accelerate understanding and development of unconventional resources and technologies. [39]

The Task Force found that, "if pursued aggressively by government and industry, domestic unconventional fuels could exceed 7 MMbd by 2035."

**State and International Unconventional Energy Initiatives**

The states with the highest concentration of oil shale and oil sands resources are Utah, Colorado, and Wyoming. In these states, a substantial amount of the resource exits on public lands, and thus fall within the purview of state and federal governments.

*Utah*

In Utah the federal government owns and manages approximately 60% of surface lands and even more of the mineral estate. In order to address this and other issues facing energy development, in 2010 Governor Herbert created the Utah Energy Initiative, a 10 year strategic energy plan designed to foster energy development while preserving quality of life[40]. A task force was appointed to develop this plan, which was completed in March 2011. Several key recommendations were aimed at encouraging development of the state's unconventional resources. Notably, the plan called for the creation of an effective strategy to encourage energy development on public land. Access to public lands for energy development was further recommended as a priority for the Governor's Public Lands Policy Coordination Office.

Additionally, the Governor's Energy Plan advocated strengthening the state's role in energy technology research and development, and created a new Energy Research Triangle Initiative amongst the state's three research universities, coordinated by the Governor's Energy Advisor. Other recommendations included coordination and transparency in the regulatory and licensing process through establishing a single point of contact for energy developers for information on state and local permit requirements, creation of a coordinating council of state agencies to collaborate on energy development, and process improvements in agencies that regulate the energy industry.

*Colorado*

In Colorado, the Governor's Energy Office recommended the development of an energy policy for the State, with a target completion plan to coincide with the 2013 legislative session. Additionally, in an effort to better coordinate and foster collaboration between state and local jurisdictions, Governor Hickenlooper established a task force to identify mechanisms to avoid duplication or conflicting regulations and help foster a climate that encourages responsible oil and gas development.[41]

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[39] Strategic and Unconventional Fuels Task Force, "*Strategy and Program Plan, Volume I: Preparation Strategy, Plan, and Recommendations,*" September, 2007. Page I-69. Accessible at: http://www.unconventionalfuels.org/publications/reports/Volume_I_IntegratedPlan%28Final%29.pdf

[40] "*Energy Initiatives & Imperatives: Utah's 10-Year Strategic Energy Plan*," March 2, 2011. Accessible at: http://www.energy.utah.gov/government/strategic_plan/govenergyplan.htm

[41] Governor John W. Hickenlooper, Office of the Governor, State of Colorado. Executive Order B 2012-002, "*Creating the Task Force on Cooperative Strategies Regarding State and Local Regulation of Oil and Gas Development,*" February 29, 2012.

*International Unconventional Oil and Gas Development*

The United States is not alone in possessing unconventional resources or pursuing their development. Both Russia and Argentina possess substantial tight oil reserves, oil sands can be found in over 70 countries[42], and oil shale resources are widely distributed as well. Though the United States possesses the largest deposits of oil shale, China, Russia, the Congo, Brazil, Italy, Morocco, Jordan, and Estonia all contain estimated in place oil shale.[43] Active commercial production is occurring in Estonia, Brazil, and China, with total global production at 20,000 bpd. Jordan, Morocco, and Israel are not currently producing but are projected to do so in the future.[44]

Shale gas can also be found in over 30 countries around the world, with significantly large deposits in China, Argentina, Mexico, and South Africa. Only China is estimated to have larger technically recoverable reserves than the United States, at an estimated 1,275 tcf.[45] Methane hydrates can be found in deposits in the Polar Regions and along the outer continental margins across the globe. While much has been made of the size and distribution of the resource, efforts are still very much in the research and demonstration phase.

## Unconventional Oil and Gas Technologies

A wide number of stakeholders are currently conducting various unconventional RD&D activities. As of September 2011, 34 companies[46] and 29 universities, national laboratories, and federal and state agencies were involved in oil shale and oil sands RD&D efforts.[47] The RD&D is focused on a number of areas such as:

- resource characterization;
- extraction methods, including in-situ processing;
- resource stimulation;
- environmental challenges, such as water consumption, groundwater protection and localized air quality.

DOE's Office of Petroleum Reserves publishes a thorough annual report profiling ongoing oil shale and oil sands research and technology projects.[48]

[42] While found in 70 countries, the bulk of the resource lies in Canada and Venezuela.
[43] NRG Expert Energy Intelligence, March 30, 2012. Accessible at: http://www.nrgexpert.com/expert-briefing-shale-oil-research/
[44] Boak, Jeremy, "*Oil Shales Making Cautious Progress*," August 2010. Accessible at: http://www.aapg.org/explorer/2010/08aug/emd0810.cfm
[45] U.S. EIA, "*World Shale Gas Resources: An Initial Assessment of Regions Outside the United States,"* April 2011. Full Report accessible at: http://www.eia.gov/analysis/studies/worldshalegas/pdf/fullreport.pdf
[46] Unconventional Fuels Task Force "Secure Fuels from Domestic Resources."
[47] Unconventional Fuels Task Force "Profiles of Oil Shale Research and Development Activities Universities, National Laboratories, and Public Agencies."
[48] For a full listing of research projects see the Strategic Unconventional Fuels Task Force Publication site at: http://www.unconventionalfuels.org/publications.html