

From Perceived Shortage to Energy Abundance

Consumers in North America, particularly the United States, are enjoying an energy renaissance that has transformed the supply outlook. The results include far greater supply security, more affordably priced energy, and new oil and natural gas development that has created millions of jobs. These benefits have stemmed from key advancements in capability to produce oil and natural gas from unconventional reservoirs—shale rock, deep offshore waters and oil sands.

Abundance from Shale

Shale has staying power. Production is increasing from established trends and new areas are still emerging. In North America, vast, regional shale rock deposits span tens of thousands of square miles. These deposits can hold substantial amounts of natural gas, oil or both, resulting in roughly 20 drilling regions including:

- **The Eagle Ford**—the largest and fastest growing U.S. oil field
- **The Marcellus**—America's largest natural gas field
- **The Bakken**
- **The Permian Basin**
- **The Barnett**—the birthplace of shale development
- **The Montney** and **Duvernay** in western Canada

Natural Gas Production Soars

U.S. natural gas reserves are up 87 percent since 1994. Energy-intensive U.S. industries are reviving thanks to affordable natural gas. New shale production dramatically increased North America's natural gas supplies, more than making up for declining conventional production. Experts estimate that North America has a century's supply of natural gas.

U.S. and Canadian production together are growing so fast that substantial exports of natural gas in the form of liquefied natural gas (LNG) are now possible. Producers in the U.S. and Canada proposed dozens of LNG export terminals, which are undergoing governmental permitting. Studies indicate that though LNG exports will not significantly influence consumer prices, they will benefit trade

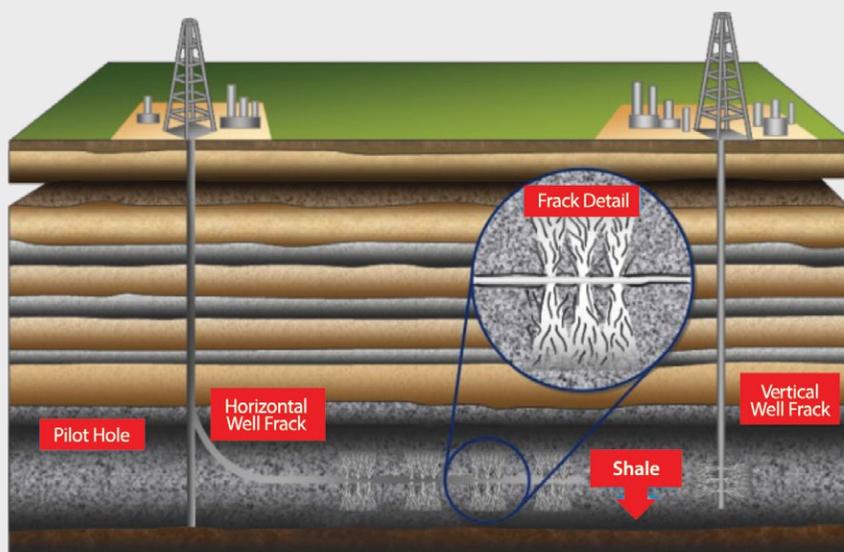
balance while creating jobs and providing economic stimulus.

U.S. Oil Production Approaches a New Record

The U.S. now ranks as the world's third largest oil producer. During the late 2000s the North American industry intensified its focus on shale formations known to contain oil and natural gas liquids. The results were transformational, as a surge in production of "tight oil" from shale quickly halted a 30-year-long decline in U.S. liquids production. Total U.S. liquids output increased to more than 10 million barrels per day—up more than 40 percent in just five years. The Department of Energy forecasts that output will climb another 20 percent by 2020. And North America could become a net oil exporter later this decade.

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A COMBINATION OF TECHNOLOGIES UNLOCKED SHALE'S POTENTIAL



Shale rock often contains oil and natural gas. Indeed, it is the source rock for the oil and gas in the conventional reservoirs. However, its exceptionally low permeability does not allow for commercial production rates with conventional completion techniques. Ongoing research and development allowed for the synergistic combination of two key technologies:

- **Hydraulic fracturing**—injecting water under high pressure to create tiny fractures in the rock; and
- **Horizontal drilling**—drilling wells that curve out laterally, thus gaining exposure to more potentially productive rock.

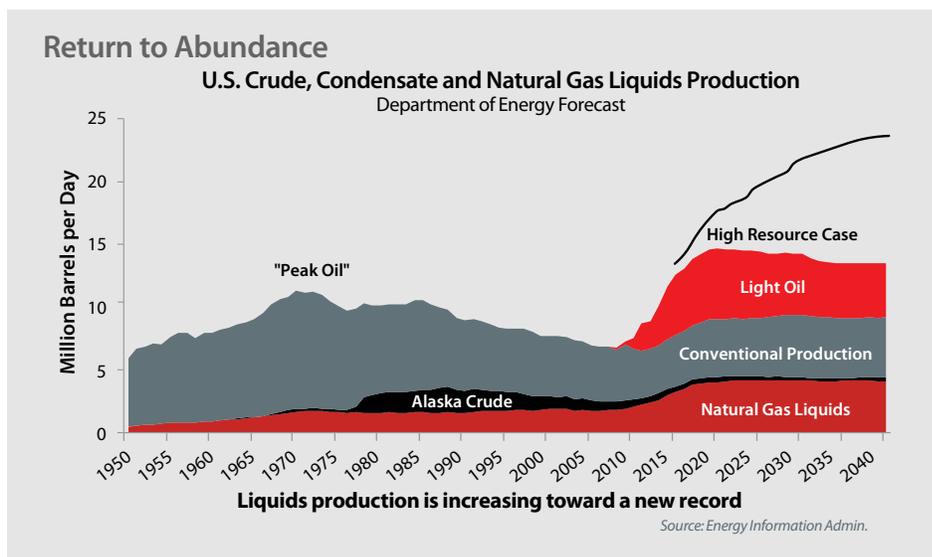
Fracturing and horizontal drilling were first combined in shale wells in the late 1990s. Together they enabled commercial production, and the rest is history.

Deepwater Production

Technology innovations now make drilling in waters up to 12,000 feet deep possible. The deepwater trend in the Gulf of Mexico is also contributing to rising liquids production. Approximately 1.3 million barrels of oil per day come from waters deeper than 1,000 feet. This production doubled in the 1990s, then flattened. Scheduled startups of new producing facilities are expected to increase production in the years ahead. Longer term, production of large existing discoveries in new areas will begin as new facilities are completed—a process that can take a number of years.

Conventional Production

Older oilfields can still have substantial resources in place; new technology can make it possible to identify and develop bypassed pockets of oil. Even as rising oil and natural gas production from shale formations and deepwater development drives overall U.S. production upward, volumes from conventional reservoirs remain essential. The country's thousands of conventional oil and natural gas fields, spanning 32 states, contribute more than half of total U.S. liquids production, as well as more than 40 percent of natural gas production. Although total volumes from conventional fields have been declining, those declines should flatten and even reverse due to several contributing factors. Among them are the use of hydraulic fracturing and horizontal drilling—techniques that made the shale revolution possible—to improve resource recovery from older fields.



Alaska still holds one-tenth of total U.S. oil reserves, with production of 550,000 barrels per day—down 75 percent from its peak. Local awareness of the need for continued industry investment has led to new state tax policies intended to encourage new exploration and development, which could mitigate this decline.

Canadian Oil Sands Production

Northern Alberta's oil sands are one of the largest known hydrocarbon deposits in the world—third behind those in Saudi Arabia and Venezuela. An additional key factor in North America's energy abundance is increased production from the Canadian oil sands. The oil sands currently yield approximately 2.5 million barrels per day. The United States is a logical

market for this oil due to geographic proximity, close trading and political relationships with Canada. Furthermore, the oil sands contain bitumen, a heavy oil—the type many U.S. refineries are specifically designed to process. Mexico and Venezuela traditionally supplied heavy oil, but production is falling from these sources. Canada's oil sands represent a stable replacement source.

Sources and Further Information

On the U.S. Energy Information Administration website www.eia.gov see:

- "What is Shale Gas and Why is it Important?" at http://energy.gov/sites/prod/files/2013/04/f0/why_is_shale_gas_important.pdf
- "Annual Energy Outlook 2014" at <http://www.eia.gov/forecasts/aeo/>
- "Recent Improvements in Petroleum Trade Balance Mitigate U.S. Trade Deficit" at <http://www.eia.gov/todayinenergy/detail.cfm?id=17191#>
- "U.S. Crude Oil and Natural Gas Proved Reserves" at <http://www.eia.gov/naturalgas/crudeoilreserves/?src=Petroleum-f11>

On the American Petroleum Institute website www.api.org see:

- "Hydraulic Fracturing Primer: Unlocking America's Natural Gas Resources" at <http://www.api.org/policy-and-issues/policy-items/hf/hydraulic-fracturing-primer>
- "10 Facts Everyone Should Know About Shale Energy" at <http://www.api.org/policy-and-issues/policy-items/hf/10-facts-everyone-should-know-about-shale-energy>
- "Get the Facts on Oil Sands" at <http://www.api.org/policy-and-issues/policy-items/oil%20sands/get-the-facts-on-oil-sands>
- "Facts About Pipeline Safety and Canadian Crude" at <http://www.api.org/policy-and-issues/policy-items/oil%20sands/facts-about-pipeline-safety-canadian-crude>
- See "World Factbook Rankings" at <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2241rank.html>

For information on the Canadian oil sands:

- See Canadian Association of Petroleum Producers website at www.capp.ca
- See Oil Sands Today website at <http://oilsandstoday.ca/Pages/default.aspx>
- See "Facts and Statistics" at <http://www.energy.alberta.ca/OilSands/791.asp>

For more information: www.powerincooperation.com