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## The Promise of Unconventional Oil

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As escalating world demand for oil continues to outpace supply, and oil prices rise to record levels, the time is ripe for increased development of unconventional oil resources.

Unlike past efforts that were stifled by a combination of low market prices and high extraction costs, this time the market outlook for developers is positive. The driving force behind higher oil prices over the past eight years has been lasting economic development in places such as China, India, and southeast Asia, rather than temporary supply shocks from conflict, embargo, or natural disasters as was common in the past. The persistent higher prices have created strong R&D incentives and a push to bring relatively more difficult and costly unconventional oil to market.

The question is not whether unconventional oil sources will take over a significant portion of demand from conventional oil, but when, and in which order. Currently, three sources of unconventional oil are particularly promising: 1) oil sands, 2) extra heavy oil, and 3) oil shale.

Oil sands are in wide production now, given current oil prices and expectations of sustained high prices. The largest known reservoir is the Athabasca Oil Sands of Alberta, Canada, with proven reserves about equal to the proven conventional oil reserves of Saudi Arabia. Total reserves in the Oil Sands are estimated at 1.5 - 2 trillion barrels, greater than the proven conventional reserves of the entire world.

Canada currently supplies 20% of U.S. imports and, with rapidly increasing Oil Sands development and infrastructure investments like the TransCanada XL pipeline, the importance of Oil Sands will continue to grow. Production costs vary by field but have fallen considerably with learning-by-doing and are often in the \$20-\$40 range. It is estimated that production will triple or quadruple over the next ten years if oil prices do not decline. Athabasca Oil Sands is projected to produce over 3 million barrels a day by 2020.

There are also significant oil sand reserves in Utah and Alaska, which exceed the size of the conventional oil reserves of the entire U.S. Partly due to water restrictions and other hurdles, they have not yet been commercially developed.

Extra heavy oil is, all else equal, easier to extract than oil sands and an obvious source of unconventional oil that is feasible to extract now. The main constraint to its development has been political uncertainty. Most extra heavy oil is located in the Orinoco oil belt in Venezuela and largely controlled by President Chavez and the Venezuelan government. The resource itself is very large - of similar size to the Alberta Oil Sands in proven and total reserves - and large scale development has just recently begun. Absent future political troubles, the Orinoco belt is expected to produce over 2 million barrels a day by 2020.

The other promising source of unconventional oil on the horizon is oil shale. The largest known reservoir of oil shale in the world lies in the Green River Formation, which spreads across Wyoming and surrounding U.S. states. It is estimated to contain 1.5 trillion barrels of oil, equal in size to each of the Athabasca Oil Sands and Orinoco Oil Belt deposits, and containing half of the known 3 trillion barrels of oil shale worldwide.

Historically, the higher cost of recovering oil from oil shale and the relatively low price of oil has prevented its widespread development. However, sustained high oil prices and large R&D investments by firms in in situ extraction have brought oil shale to the edge of profitability. A RAND estimate of production cost by surface mining is \$70-\$95 a barrel to start and falling to \$30 with experience and learning. A Shell estimate of production cost by its experimental in situ extraction technique is \$30. If current oil prices persist, and environmental hurdles are resolved, oil shale is poised to grow to be as important as the Oil Sands are now.

These figures make clear the world is not getting low on oil, only on light and inexpensive oil. At a time when conventional oil resources are shrinking and energy demand is at all time highs, the economics is right for increased development of these more difficult and costly sources of oil. It is promising as well that two of the most plentiful sources of unconventional oil lie in stable North American countries, one in the U.S. and one in a nation friendly to the U.S, Canada.

Arguments downplaying the importance of unconventional oil have been raised. Opponents have stated that developing any one of these resources would only add a few million barrels a day to production so, with worldwide consumption at 86 million barrels a day, its effect on oil prices will be small. Others add that even a trillion extra barrels does not postpone the end of oil for long, so its value is limited. These arguments fall flat.

Ensuring affordable energy supplies in the future requires responsible development of new sources today. No single unconventional source is intended to replace conventional oil, nor should it. In fact, as world demand outgrows supply and prices rise, it is necessary to develop multiple sources of unconventional oil, as well as other non-petroleum and green energy sources, to meet the challenges of growing demand for energy. Current high oil prices signal the need for new supply, and to do nothing now will create a more significant energy crisis later. Taken together, development of these new sources of energy act as natural brakes on the escalation of oil prices.

Further, a trillion extra barrels of oil is significant given historic reserve-to-production ratios, and would postpone the end of oil another 30 years. The final draw is likely to be much higher still - 5 to 10 trillion barrels is not unreasonable - as learning-by-doing improves

extraction technologies and recovery rates in the long run. Thus, these sources have the potential to provide centuries of additional supply. Just as offshore drilling in the Gulf was considered unconventional 60 years ago, but now accounts for 30% of U.S. production, Oil Sands are becoming conventional today and oil shale may be considered conventional 60 years from now.

The home-grown sources of unconventional oil are a blessing in volume, but also carry a curse. Unconventional oil is unconventional because it is more expensive to produce, more land intensive, less energy efficient, and has a higher CO<sub>2</sub> and impurity content than conventional oil. As a result, its development will have a higher environmental impact at home and developers must expect significant environmental challenges in developing them.

For example, the vast Green River Formation of oil shale lies largely under federally protected land. Like oil reserves under the Arctic National Wildlife Refuge, its development would come with controversy. As another example, construction of the Keystone XL pipeline extension that would carry additional Oil Sands oil from Alberta to markets in the United States met with significant opposition on environmental grounds. In fact, the greatest challenge to develop sources of unconventional oil in North America in the end may well come from environmental concerns rather than technology hurdles.

Oil sands, extra heavy oil and oil shale is not as clean or as easy as conventional oil sources, but as nations demand more energy and conventional sources dry up, they are the most promising next things. With oil prices unlikely to return to past levels and stay there, the time for time is ripe for developing these resources now. Only by combining unconventional oil development, green technology investments, and energy efficiency improvements together, will the U.S. be well positioned to tackle the difficult energy challenges of the future.

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