WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE
For sustainable energy.

FACT SHEET – OIL SHALE

Definition

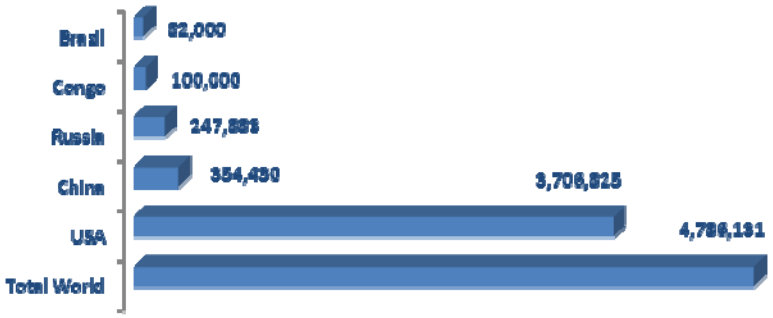
Oil shales are fine-grained sedimentary rocks containing relatively large quantities of organic matter (known as 'kerogen') from which significant volumes of shale oil and combustible gas can be produced by destructive distillation. The use of oil shale can be traced back to ancient times. Common products made from oil shale were kerosene/lamp oil, paraffin wax, fuel oil, lubricating oil and grease, naphtha, illuminating gas, and the fertiliser chemical, ammonium sulphate. With the introduction of the mass production of automobiles and trucks in the early 1900s, the feared shortage of gasoline led to the exploitation of oil shale deposits for transportation fuels.

Oil shale can be used in various ways: to generate electricity via direct combustion or produce a vast variety of petrochemical products, including shale oil and other liquid fuel. Shale oil can also be used as a direct substitute for conventional crude oil, therefore it can be assumed that in the coming years the fast growing demand and potentially higher prices for oil will result in a rise in the demand for shale oil. Some forecasts indicate that oil shale can account for more than a third of the growth in use of unconventional oil by 2030.

Resource

Although information about many oil shale deposits around the world is rudimentary at best, the potential resources of oil shale in the world are enormous. Total world resources of shale oil currently are conservatively estimated at 4.8 trillion barrels. This is almost 4 times more than the crude oil resources which stand at 1.3 trillion barrels. However, economically recoverable oil shale reserves are much lower.

Shale Oil Resources (million barrels) – Top Countries at end-2008



Source: WEC Survey of Energy Resources, 2010

Oil shale resources are well distributed around the world. Some 40 countries have registered about 300 deposits, with the USA accounting for 77 % of world resources, Russia for 9% and China for 7%. Other countries with significant resources include Brazil, Italy, Congo (Dem. R.) and Israel. The largest of the deposits is the Eocene Green River Formation in North Western Colorado, North Eastern Utah and South Western Wyoming.

China undertook its first national oil shale evaluation in 2004-2006. It confirmed that there is a vast and widespread resource across 47 basins and 80 deposits with the total estimated in-place shale oil resource of 354 billion barrels. Nearly 70% of the deposits are located in Eastern and Middle China. There are more than 80 oil shale deposits identified in Russia with a total estimated quantity of 247,883 million barrels.

Sizeable deposits of oil shale have been discovered in various parts of Israel and current estimates of the theoretical reserves total some 300 billion tonnes, but those considered open-pit mineable resources are estimated at 550 million tonnes only. Generally speaking, Israeli oil shales are relatively low in heating value and oil yield, and high in moisture, carbonate, and sulphur content.

WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE
For sustainable energy.

Technologies

The shale oil can be extracted by surface and in situ of retorting and depending upon the methods of mining and processing used, as much as one-third or more of this resource might be recoverable. The amount of shale oil that can be economically recovered from a given deposit depends upon many factors, including geothermal heating, mine depth and surface land uses. There are several technologies which make it possible to produce shale oil at current market conditions. At the moment only Enefit, PetroSix, ATP, Kiviter and Fushun technologies are used industrially to produce shale oil. However, there are many other technologies under development (in situ, etc.). Economies of scale are needed to lower unit production costs of these technologies and units would have to become bigger.

Production

Currently the oil shale industry is concentrated in Brazil, China, Estonia, Germany, Israel, Russia and the United Kingdom. These countries together used to produce over 30 million tonnes of shale oil per year between 1963 and 1992. From the peak in 1981, the annual production dropped to about 15 million tonnes.

Economics

Petroleum-based crude oil is cheaper to produce today than shale oil because of the additional costs of mining and extracting. Only a few deposits are currently being exploited: in Brazil, China, Estonia, Germany and Israel. Production costs of oil from oil shale rock is dependent upon a number of input factors: technology used, properties of oil shale, location of the resource, regulatory and fiscal regimes and final products. On average, the production cost is estimated between 70 and US$100 per barrel. At current crude oil prices (around US$95 a barrel) shale oil can compete with conventional oil.

The use of conventional oil and natural gas is growing rapidly, and there are mounting concerns about the supply of oil and gas to meet the growing demand. Since the 1970s, the reserves-to-production ratio (R/P) for oil and gas has consistently remained at around 40 years for oil and 50-60 years for gas. Proven oil reserves have seven increased during 1987-2007 by 17% and proven gas reserves by 38%.

The limited competitiveness of oil shale during the last decades has prompted initiatives to reduce its cost through improved or innovative technologies and management practices covering the entire shale oil production chain.

Environmental considerations

As most industrial processes, production of shale oil faces a number of environmental challenges. In-situ technologies can be harmful to groundwater and other oil shale processing technologies require large amounts of water. The environmental impacts of above ground retorting are much more technology-specific. For example, technologies using gaseous heat carriers have a problem with solid waste containing organic residue. Most solid heat carrier technologies struggle with high CO_2 emissions. One of the most environmentally friendly technologies of producing shale oil is Enefit, which does not generate organic waste nor use excessive amounts of water.

Generally, new generation technologies such as fluidized bed combustion, could reduce CO_2 emissions from oil shale-based power plants. Expectations in the 1970's, that the vast resources of oil shale could raise world oil shale production to 150 to 200 Mt by 2000, have not materialised. New oil shale processing technologies should be technically feasible, environmentally acceptable and economically viable. Today this seems to be the main challenge for shale oil.

For more information, visit http://www.worldenergy.org/publications/