

VAST AMOUNTS OF OIL HIDDEN IN EGYPT'S KERAGEN ROCK

Besides conventional and shale oil, Egypt has a large amount of another hydrocarbon called oil shale. The country has conducted studies on this kerogen rich resource for decades, but its economical exploitability remains in question.

By Laura Raus

What is Oil Shale? – Not Shale Oil

Although the terms “oil shale” and “shale oil” are sometimes used interchangeably, there is a difference between them. Oil shale is in fact not shale and does not contain oil as such. According to the International Energy Agency (IEA), it is a sedimentary rock that contains organic matter rich in hydrogen, kerogen, which can be converted into shale oil by heating it to at least 300 C. Besides converting to oil, oil shale is used as fuel for thermal power plants and for chemicals production. Cement can be obtained as a by-product of oil shale heat retorting, informs the World Energy Council.

Reserves Comparable to Crude Oil

IEA estimated in 2010 that global oil shale resources are equivalent to over 5 trillion barrels of oil in place. However, they often lay kilometers underground and are almost impossible to extract. Over 1 trillion barrels of oil shale is technically recoverable, but it is not known how much can be extracted economically. The ratio of energy outputs to inputs is only up to 3 to 1 for oil shale, whereas it is around 20 to 1 for crude, writes the Christian Science Monitor. EIA said in 2010 that commercial oil shale exploitation is possible at crude prices of USD 60 per barrel.

Besides costs, oil shale development is inhibited by its environmental impact. Its transformation into shale oil as well as its direct combustion emits more CO₂ than any other primary fuel. Oil shale mining creates the risk of groundwater contamination, according to the US Government Accountability Office. Oil shale processing also requires vast amounts of water. One needs two barrels of water to obtain one barrel of oil from oil shale, informs IEA.

Volatile Industry

For those reasons, oil shale has never become very popular, although it has been used for centuries because its high-quality deposits easily burn without processing and it has been at times hailed as a true alternative to crude. In the 1800s, oil shale industries were set up in several countries including Germany, Canada and Australia, which yielded products such as lamp oil, naphtha and paraffin wax. In the 1970s, interest in oil shale grew considerably in the US due to high crude prices, but cheaper crude of the 1980s led to the shutdown of almost all oil shale projects there, informs Environmentally Conscious Consumers

for Oil Shale. When Exxon closed its Colorado oil shale project in 1982, 2,000 people lost jobs, writes the Daily Sentinel. By 1986, the federal government had ended its support for the oil shale industry. The industry has also vanished in several other countries. Only China, Brazil and Estonia have sustained commercial oil shale exploitation for decades, writes the journal Oil Shale.

Players in the Oil Shale Scramble

About two-thirds of oil shale deposits lie in the US, but China, Israel, Russia, Brazil, Jordan and Australia also have sizable reserves. There are significant reserves in the MENA region as well.

Estonia: Almost All Electricity from Oil Shale

Most oil shale mining takes place in Estonia. According to the national energy company Enefit, Estonia's oil shale power capacity is 10 TWh a year, enough even for exports. The country uses oil shale also for chemicals and fuel production. By 2020, it aims to produce up to 20,000 bpd of diesel from oil shale, significantly more than its domestic demand currently, reports Platts.

Estonia has mined oil shale for over hundred years, although there is some opposition to that on environmental grounds. For example Valdur Lahtvee of the Stockholm Environment Institute told CNN: “Oil shale industry contributes approximately 4% of Estonia's GDP, but at the same time accounts for 90% of its hazardous waste, 80% of major air emissions and 70-80% of water usage.”

However, Estonia is developing a cleaner oil shale industry, informs IEA. In 2012, Enefit launched a technology that utilizes 100% of mined oil shale, yielding shale oil, electricity and retort gas. The only by-product is ash, which can be used for making construction materials. Excess heat and retort gas is used to produce additional electricity and almost no water is needed in the whole process.

Jordan: First Steps in Oil Shale Production

Jordan, whose oil shale can yield 34 billion bbls of shale oil according to AP, has signed several memorandums of understanding since 2006 for the development of the resource, which it hopes to give 14% of the country's energy by 2020. The developers include Shell, Petrobras, Total as well as Chinese, Russian and Gulf companies, informs the annual report 2011 of Jordan's

Ministry of Energy and Mineral Resources.

Together with its partners, Enefit expects to establish Jordan's first oil shale power plant, with a capacity of 500 MW and cost of USD 1.5 billion, by 2017. The government has committed to buying the plant's electricity for 30 years. By 2020s, Enefit also aims to set up an oil plant. However, full financing for both projects is yet to be found. The Saudi Arabian Corporation for Oil Shale hopes to start producing oil from Jordan's oil shale in five years by utilizing a Russian technology and to produce 30,000 barrels by 2025, but feasibility study for the project has not yet been done, reports Zawya.

“The people have long requested the successive governments of Jordan to start with oil shale business knowing that 97% of Jordan's energy is imported,” said Awni al-Otoom, Professor at Jordan University of Science and Technology, who considers oil shale an excellent option for the country. Oil shale can decrease Jordan's energy dependence, but not necessarily costs. According to al-Otoom, oil shale electricity costs as much as that of heavy oil and twice as much as that of gas. Besides, technology for large-scale oil shale extraction has not yet been well developed. Another obstacle is the fact that Jordan is among the top five poorest countries in terms of water supply.

Israel to Risk with a New Technology

In 2009, Israel discovered huge oil shale deposits that could yield almost as much oil as Saudi Arabia has in proven reserves. Israel already has experience with small-scale oil shale mining and now IEI, a subsidiary of New York traded Genie Energy, plans to try an innovative technology, in-situ retorting, for exploiting this resource, reports Business Insider.

This technology has been tested by several companies for decades, but has not yet proven commercially viable. In case of in-situ retorting, oil shale is heated for several months while it is still underground until it produces liquid, which is pumped to the surface. While this process could access vast deposits of oil shale that lay very deep underground, some experts say that it could also cause groundwater contamination. Israel's environmentalists sued the government for its plans to exploit oil shale by in-situ retorting. However, the highest court of the country in December 2012 rejected their claims, informs Business Wire.

In the US, ExxonMobil is experimenting with in-situ retorting and Shell plans to try it in Jordan. Nevertheless, experts think that commer-

cial utilization of this technology is still several years underway.

The US and Australia Are Hesitant

Other countries that own significant oil shale reserves have been less determined to exploit them. In Queensland, Australia, a 20-year moratorium was imposed to a large oil shale project in 2008 due to opposition from environmentalists. In February 2013, the local government announced that it would allow oil shale development under strict environmental conditions, but the moratorium would remain in place, reports ABC News.

In the US, interest in oil shale revived in the 2000s due to high oil prices, informs the Congressional Research Service. However, in February 2012 the government cut down the land set aside for oil shale and tar sands development in Colorado, Utah, and Wyoming by two-thirds, to the disappointment of Shell, Total, ExxonMobil, and Enefit that were eyeing opportunities there. "Because there are still many unanswered questions about the technology, water use, and impacts of potential commercial-scale oil shale development, we are proposing a prudent and orderly approach," explained Bob Abbey, the Director of the Bureau of Land Management, according to Northern Colorado Business Report.

In the same month, Chevron pulled out of its oil shale research project in Colorado. In September 2013, Shell announced it would shut down its oil shale pilot project in Colorado after 31 years of experimentation, saying that it has more profitable opportunities elsewhere, reports FuelFix. The US Energy Information Agency does not foresee major oil shale production until 2035 due to cheaper alternatives.

Can Egypt Benefit from Oil Shale?

Oil shale was discovered in Egypt in the 1940s, according to Shale Oil Processes, a book by J. Speight, and several studies have been conducted on it since.

The 1984 survey conducted by Egyptian Mineral Resources Authority (EMRA) with University of Berlin determined that oil shale could yield 4.5 bbl of oil in the Safaga-Qusier area, and 1.2 bbl in Abu Tartur where it could be obtained as a byproduct when mining phosphates. The 2006 study EMRA conducted with the Canadian consortium Centorion, later bought by Dana Gas, estimated total reserves of the Abu Tatur plateau and the

Red Sea province, at 8.11 bbl. EMRA considers the figure of the 1984 study more realistic, but also points out that large areas such as the Nile Valley and Sinai are believed to contain large deposits of oil shale, and should be pursued for oil shale exploration as well.

Most studies suggest that the best use of oil shale in Egypt would be direct combustion for electricity generation but the exploitation of this resource only makes sense if the cost of alternative fuels is high. Al-Otoom believes that oil shale development would be reasonable in Egypt at present. "The worst thing to do is to generate electricity with the depleting conventional oil and gas, particularly for a country with fast population growth such as Egypt," he noted. "Conventional fuels should be saved for transportation purposes."

Ingo Valdma, Head of the Department of Mining at Tallinn University of Technology, on the other hand thinks that oil production would be a better way to utilize Egypt's oil shale because this is a generally a more profitable use of this resource. But since the oil content of Egypt's oil shale is low, the professor thinks that oil shale utilization would probably not make sense in Egypt.

According to University of Oxford energy expert Justin Dargin, oil prices should be at least around USD 120 pbb to even consider investment in oil shale with currently available technology. However, in-situ conversion could reduce costs to about USD 30-40 pbb. "If this process is scalable, then perhaps large scale production in Egypt could take place in the long term," thinks

Dargin.

At least in 2010, Egypt's government seemed to believe in the viability of oil shale industry. In that year, it signed an agreement with Jordan, Syria, Turkey, Morocco and several companies for the establishment of an oil shale development center. However, the establishment was stalled due to the Arab Spring.

Conclusion

IEA predicted in 2010 that under existing-policies scenario, 0.5 million bpd of oil would be produced from oil shale by 2035, whereas the production in 2010 was just 15,000 bpd. However, oil shale would continue to comprise just a fraction of oil supply. No oil shale revolution is expected unless in-situ retorting proves commercially viable.

If the latter happens, Egypt may obtain benefits from its oil shale. However, this could not happen under current policies. "Egypt's existing contracting frameworks for conventional oil and gas projects are unlikely to be attractive for shale development given even conventional oil and gas producers find it difficult to generate sufficient margins under current arrangements," said Laura El-Katiri, Research Fellow at Oxford Institute for Energy Studies. Unless there will be thorough reforms in Egypt's energy sector, the country is unlikely to see significant production of oil shale as well as other unconventional resources even if technologies evolve.

Table: Reserves of conventional versus unconventional oil (billions of barrels oil-in-place)

	Proven conventional oil	Technically recoverable shale/tight oil	Technically recoverable oil shale
Egypt	4.4 (2013)	4.6 (2013)	5.7 (1984)
World	1,526 (2012)	345 (2013 estimate of 41 countries)	over 1,000 (2010)

* There are more types of unconventional oil – bitumen (mostly in Canada's tar sands, which can yield 169 billion bbls of oil), extra heavy oil other than bitumen, and oil from coal, biomass and gas conversion, but total size of such reserves is unknown.

Sources: EIA, IEA, EMRA, CAP

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