Oil Shale - Background

1) What is oil shale and in what parts of the world is oil extracted from it?

Oil shale, also referred to as bituminous rock, consists of sedimentary rock rich in organic matter (mainly kerogen). These rocks can produce energy when mined and burned in a special oven, and liquid fuel can likewise be obtained from the quarried rock. It is also possible to make use of the shale deposit *in situ*, without mining, by heating it underground. The fuel thus produced has qualities similar to those of the refined products of crude oil, with the percentage of sulfur present being determined by its percentage in the soil layer.

The worldwide potential oil production from oil shale is around 13 trillion barrels, as compared to around one trillion from oil that can be produced from crude fuel. In other words, this natural resource is found in abundance. But, despite its enormous global production potential, in 2010 shale oil extraction on an industrial scale was underway only in Estonia, China, Australia and Brazil, all of which use opencast mining techniques. Both Professor Flexer and the representatives of IEI, including Dr. Bartov, stressed that at present there is not a single site in the world where shale oil is extracted commercially by heating the layers of shale *in situ*.

In the USA, shale oil deposits are found in a number of regions. Over the past 25 years, most extraction attempts have taken place in Colorado[1] and Wyoming, where pilot sites for *in situ* technology were established; most closed down because of their failure to prove economically viable or as a result of environmental pollution.[2]

This paucity of global production is likewise influenced by international oil prices and by the fact that this source of energy has a comparatively poor output ratio: independent research has estimated that the net energy output ratio (i.e., the relationship between the amount of energy invested and the amount procured as a result of that investment) in Shell pilots in Colorado may be as low as 1.2-1.5, depending on the quality of the organic material and the type of heating technology used *in situ*.[3] Estonia is the only country in the world in which oil shale constitutes the main source of energy, and it is used there because it allows the country to remain independent of external energy sources. Estonia, however, has paid a high environmental and social price for this independence.[4]

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[1] Fowler, T.D. and Vinegar, H.J., 2009. Oil shale ICP – Colorado field pilots. SPE 121164.
[2] EPA, The Class V Underground Injection Control Study: In-Situ Fossil Fuel Recovery Wells, Vol 13. (Sep. 1999).
[3] A. R. Brandt, (2008), "Converting Oil Shale to Liquid Fuels: Energy Inputs and Greenhouse Gas Emissions of the Shell In-Situ Conversion Process," Environ. Sci. Technol., 42, 7489.
[4] EASAC, (2007) A study on the EU oil shale industry viewed in the light of the Estonian experience. A report by EASAC to the Committee on Industry, Research and Energy of the European Parliament. Available at: http://www.easac.eu/fileadmin/PDF_s/reports_statements/Study.pdf

2) The extent of known deposits in Israel

Israel possesses around 20 oil shale deposits in a number of different locations, and these, according to Geological Institute estimates, can be expected to produce a total of over 219 billion barrels of oil. The most significant of these deposits covers an area of some 1,400 square kilometers in the Judean Plain, which is where the 238.1 kilometers licensed to IEI are located. The production potential of the entire Judean Plain deposit is estimated at around 195 billion barrels,[5] and, on the basis of the Geological Institute's calculations, the production potential of the licensed area can be claimed to be roughly 33.15 billion barrels.

Additional significant deposits are to be found in the Negev, where the Rotem Plain possesses a potential of some 1.4 billion barrels and the Yamin Plain has a potential yield of 2.1 billion barrels. In addition, according to the Institute of Geology, there are another three areas suitable for *in situ* extraction. These include the deposits of the Zin Valley, which has an extraction potential of around 1.62 billion barrels, of Sde Boker with an extraction potential of 1.08 billion barrels, and Nevatim, which has an extraction potential of around 600 million barrels or more).[6]

In the Rotem Plain and the Yamin Plain, most of the oil shale layers are situated at a depth of between 30 and 100 meters below the surface (at Yamin Plain the depth is slightly greater), and the shale layer itself is between 30 and fifty meters thick, with an organic material content of between 15% and 18%.[7] In the Rotem Plain area, oil shale extraction by means of opencast mining and controlled combustion was begun as early as twenty years ago, for purposes of electricity and steam production. These activities were originally conducted by the Israeli government's energy resources development company, but in the past decade both mining operations and management of the power station have been carried out by Rotem Empert. It should be noted that the oil shale mine at the site has suffered spontaneous combustion, and a fire has been burning there for a long time now.

As stated above, at Sde Boker, the Zin Valley and Nevatim, the geological findings indicate possible suitability for the use of *in situ* technology. The production potential for these three deposits alone will probably be sufficient to satisfy Israel's oil needs for around forty years.[8]

In the Judean Plain area the oil shale deposit lies at a greater depth than some of the Negev deposits. This deposit is some 200 meters below the surface; it is 200 meters thick and has an organic content of approximately 20%.[9] The depth of the Judean Plain oil shale deposit is thus unsuitable for mining, and the only possible means of extraction is by heating of the shale layer *in situ.*

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[5] Tzvi Minster, Israel Geological Survey, 2009.
[6] Tzvi Minster, Israel Geological Survey, 2009.
[7] Moshe Shirav, ibid.
[8] This calculation is based upon the fact that the combined production potential of Sde Boker, Nevatim and the Zin Valley is around 3.3 billion. This number has to be divided by 87.7 million, which represents Israel's annual oil consumption, reckoned by barrel.
[9] Ibid.