Oil shale – the unconventional which will become conventional

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Before I explain to you how countries like the US (not to mention Brazil, Jordan, Morocco and others) will turn the tables of the energy world and become significant oil exporters, I want to make sure that one key term is clear – oil shale. Oil shale is important, much more important than most people realise and will become even more important in the future. There is a lot of confusion today about what exactly people mean when they talk about oil shale – is it in fact oil, a rock, or are we talking about the new boom in shale gas? Oil shale is a sedimentary rock that contains significant amounts of kerogen, (organic matter formed from fossilised plant matter). Oil shale can be used for energy production in various ways, but the most common are either to produce electricity, through direct combustion of the shale rock similar to coal based power, or to produce liquid fuels, the all-important oil, or in this case shale oil. Various technologies using heat and pressure have been and are continuing to be developed to extract shale oil from the rock – or as it is often described, squeeze oil from a stone. Together with this synthetic oil, an energy-rich gas is also produced, somewhat similar to natural gas. While this may sound somewhat bizarre, my own country of Estonia has been utilising this resource for almost 100 years. Estonians are quick to point out that they produce enough power to cover the domestic electricity demand as well as export to the neighbouring Baltic energy markets and Finland, all based on oil shale. Estonians have also been commercially producing shale oil dating back to 1924. China has had industrial production since 1930, with a reinvigoration in 1989 and the Brazilian company Petrobras has proven its shale oil technology since 1981.

With our long history of development, Enefit, known as Eesti Energia in Estonia, has been seeking out market proven solutions to improve efficiency and environmental performance. In 2008 we started cooperation with Outotec, a world-leading process and plant engineering company with unsurpassed experience in metals and minerals processing, and together we have developed a new generation of the Enefit technology. This advanced technology relies on Enefit's significant operations experience, while delivering the most efficient commercial shale oil production technology available today. We have already started building the first plant to implement this new technology, which will be commissioned in Estonia in 2012.

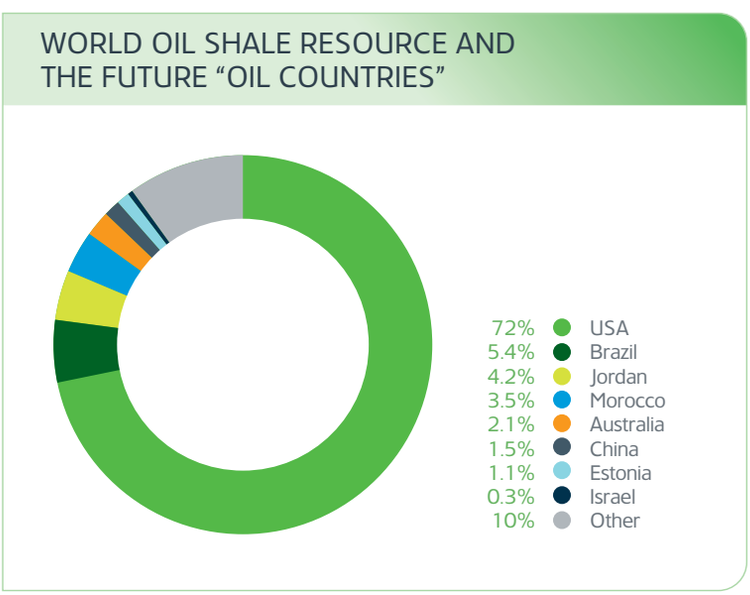

Figure 1. Extracting oil from rock isn't rocket science – there is still much room for improvement, but the 190 years of cumulative commercial production shared by Estonia, Brazil and China clearly demonstrates that the technology is proven

The world's next oil countries

Global proven conventional oil reserves total 1.2 trillion barrels[1]. Even larger is the world's supply of oil sands, in total estimated at 2 trillion barrels[2]. However, largest by far is oil shale; the US Geological Survey estimates the total world oil shale resources at 2.5-3 trillion barrels. So, why did I start by talking about the US? While the worldwide deposits of oil shale are huge, roughly 72 per cent of this is located in the US – primarily in Utah, Colorado and Wyoming. Based on their oil shale potential, other future 'oil countries', as shown in Figure 1, are likely to include Brazil (5.4 per cent), Jordan (4.2 per cent), Morocco (3.5 per cent) and Australia (2.1 per cent) not to mention of course China, Estonia, Israel, Russia and others[3]. As shown in Figure 2, although oil shale is hardly on the energy map today, it is expected to make up more than a third of the growth in unconventional oil by the year 2030, nearly as much as bitumen from oil sands. So, given the sheer size of the reserves and the 100-year track record, why haven't you heard more about oil shale and why isn't its projected growth a larger part of the future energy picture?

Historically, oil prices have been too volatile and conventional oil has been too readily available to support oil shale development in countries with other easier or cheaper energy alternatives. The key reason why oil shale has thrived and continued to be developed in Estonia, Brazil and China is its prioritisation at a government level as a strategic resource. Estonia, for example, has no other significant energy alternatives, yet has managed to secure its own energy independence in the power sector based only on oil shale. As demand continues to soar in India, China and other developing economies, and new conventional crude discoveries are in more extreme locations requiring significant investments and more technically challenging solutions, oil shale's role as a future energy solution will become more obvious.

How to measure energy independence

Energy independence is a hot topic today. When you take the US as an example, net import is roughly 13 million barrels per day[4]. If you consider an oil cost of US$65 per barrel, which is well below the year's average, the total cost to the US for importing oil was US$300 billion – this is roughly 50 per cent of the US trade deficit. Given that the US has at least three times more oil in its oil shale resources than all of the conventional oil remaining in Saudi Arabia, the importance of oil shale as a strategic resource cannot and must not be overlooked. In the near future, utilising all forms of domestic energy will become a priority and oil shale will become a key strategic resource for synthetic oil production for many more countries.

Technology development has lowered production costs, while increasing demand has driven up conventional oil costs. Studies show that developing new oil fields, including deep sea and oil sands are all more expensive alternatives[5] than industry estimates for oil shale. Future energy projections from reputable sources[6] show that even by 2030, the average oil price will more than support oil shale development. The figure varies by the specific deposit and technology, but Enefit is confident that its Enefit technology is a competitive alternative at an oil price of around $65/bbl, including a reasonable return on invested capital.

Why is oil shale different?

It is also important to address the unjustified stigma that oil shale suffers. Technology development has driven environmental improvements, yielding impacts that are very similar to other standard mining operations and industrial processes. This doesn't mean that the industry doesn't have work to do, but if mining for coal and other minerals is allowed and refineries and chemical production facilities are accepted, then there is absolutely no reason that oil shale should not also be an acceptable industry. A clean and efficient oil shale industry can and will be a responsible party in the global energy future. Air emissions, for example, can be reduced to acceptable levels. CO_2 emissions cannot be ignored, but face the same challenges and solutions as in other industries. The one key environmental difference with

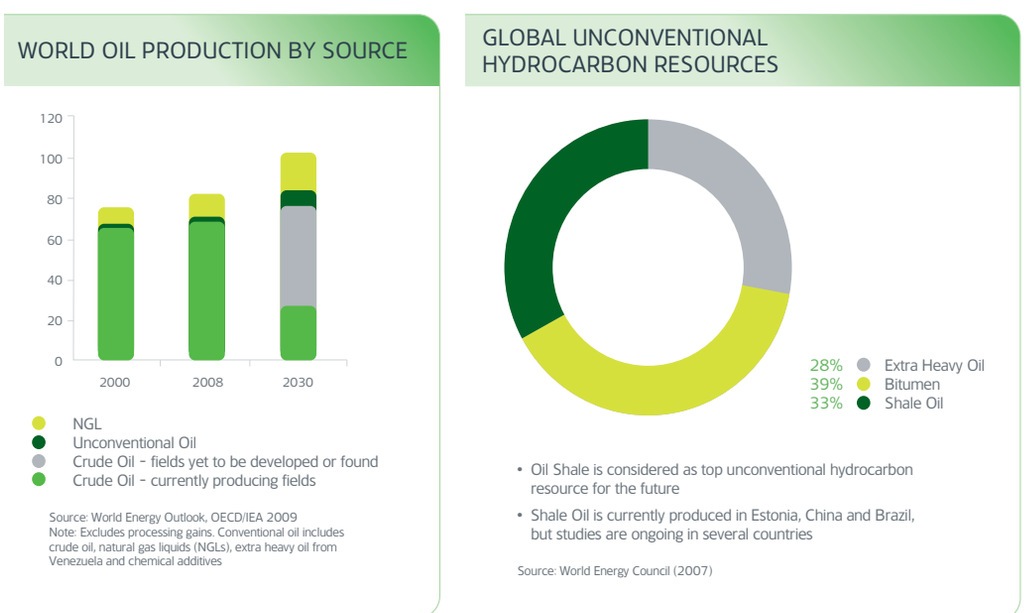

Figure 2. Traditionally, low oil prices have limited growth in unconventional fuels, but oil shale looks set to buck this trend and will undoubtedly become a top unconventional resource in the future

Eesti Energia Oil and Gas's Enefit 140 Plant in Narva, Estonia. The plant currently operates two production lines, each consuming 140 tonnes of oil shale per hour. The new Enefit 280 plant (consuming 280 tonnes per hour) is currently under construction

oil shale is water. As many of the top oil shale regions also have considerably restricted water availability, minimising water use and impacts on water resources is of the highest importance. A key point is that Enefit's shale oil extraction process itself is water-free. This is in stark contrast to the significant[7] water demands that are integral to oil sand's bitumen production. While Enefit's retorting technology is water-free, not all technologies are created equal and not all water demands arise directly from the technology. Again, similar to all mining operations and industrial processes, water is needed for mine de-dusting, ash disposal and cooling[8]. However, as water is not an integral part of the oil production process, at least with the Enefit technology, methods to maximise water reduction and recycling, such as dry ash transport and air cooling, for example, are already available and will further reduce water consumption.

Oil shale will play a leading role

Looking forward to the next World Energy Congress in 2013 brings me back to where we started. By 2013 I expect that we will already start to see the beginning of the shift. Rather than the future of the world's energy supply resting with conventional crude, we will see an increased emphasis on the very realistic role that non-conventionals such as oil shale and oil sands will play. Instead of the OPEC countries dominating the list of 'oil countries' I believe we will see Canada in the leading position, with strong developments from countries such as Estonia, Jordan, China and, hopefully, the US. To look back specifically to the US, the significant trade deficit, fuelled by 5 billion barrel a year oil imports, is a strong contributor to the declining dollar. If the US were to activate its oil shale resources, domestic production of 5bn bbl/y of shale oil would cover current imports and last for 400 years. This is an aggressive example and development needs to be carried out thoughtfully, but I am confident that oil shale will play a leading role in the world's energy future and that this can be done in an economically justifiable and environmentally responsible manner. ❑

[1]*Source: BP Statistical Review of World Energy, 2010*
[2]*Source: US DOE - Oil Shale and Tar Sands Programmatic EIS*
[3]*Source: US DOE, 2005*
[4]*Source: BP Statistical Review of World Energy, 2009*
[5]*Source: Cambridge Energy Research Associates, 2009*
[6]*Source: US Energy Information Administration (EIA)*
[7]*Source: Alberta Energy - oil sands mining requires 2.2-5 barrels of water for each barrel of synthetic crude oil (SCO) produced, insitu requires 0.5 barrels of water for each barrel of SCO produced.*
[8]*Source: US DOE, Fact Sheet - Oil Shale Water Resources - Current estimates for oil shale technologies are roughly 1-3 barrels of water per barrel of oil.*