Jordan Oil Shale Energy Company (JOSECO): A Vision Towards Oil Shale Commercialization

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Main Features of Energy Sector in Jordan

Jordan has almost no indigenous energy resources. The cost of energy imports has been a major burden to the economy.

High growth of primary energy demand.

Energy strategy seeks to increase dependence on local energy sources, from the current 4 per cent to 39 per cent by 2020.
Jordan is rich in one untapped oil shale resource which is widely distributed all over the country.

Jordan ranks third after USA and Brazil in terms of oil shale reserves.

The identified reserves of oil shale are more than 100 billion tons.

Oil shale was first used for Hijaz railway and also used during the World War I, when Germans installed the first retort plant.
Jordan Ranks Third in World Oil Shale Reserves

Oil shale is found all around the world in rocks of Carboniferous to Tertiary age: e.g., Australia, Brazil, China, Estonia, Germany, Israel, Jordan, Russia, Thailand and, most importantly, USA. Production of shale oil, however, is limited to a few countries with Estonia being the dominant producer.
The 2007 Survey of Energy Resources by the World Energy Council (WEC) reported that total world resources of shale oil are estimated at 2.8 trillion barrels (around 550,000 GL). The largest known deposit is in western USA (2.6 trillion barrels), with other important deposits in Jordan, the Russian Federation, the Democratic Republic of the Congo, Brazil, Italy, Morocco, Australia and Estonia.

Only Estonia, China and Brazil produce shale oil. The same WEC survey reported that total oil production for 2005 was 859 ML, with Estonia producing 433 ML, China 226 ML and Brazil at 200 ML.
<table>
<thead>
<tr>
<th>Retorting type</th>
<th>Oil (tpa)</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fushun</td>
<td>103000</td>
<td>China</td>
</tr>
<tr>
<td>Galoter, kiviter, Generator</td>
<td>300000</td>
<td>Estonia</td>
</tr>
<tr>
<td>Generator</td>
<td>202000</td>
<td>Russia</td>
</tr>
<tr>
<td>Petrosix</td>
<td>160000</td>
<td>Brazil</td>
</tr>
<tr>
<td>Taciuk (ATP)</td>
<td>200000</td>
<td>Australia</td>
</tr>
<tr>
<td>Country</td>
<td>C.V (kcal/kg)</td>
<td>Oil Content (%)</td>
</tr>
<tr>
<td>------------</td>
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<td>-----------------</td>
</tr>
<tr>
<td>Brazil</td>
<td>1340</td>
<td>7</td>
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<tr>
<td>U.S.A</td>
<td>1800</td>
<td>9.7</td>
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<tr>
<td>Europe</td>
<td>1500</td>
<td>13</td>
</tr>
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<td>2000</td>
<td>7</td>
</tr>
<tr>
<td>Estonia</td>
<td>1100</td>
<td>20</td>
</tr>
<tr>
<td>Morocco</td>
<td>1800</td>
<td>5.3</td>
</tr>
<tr>
<td>Jordan</td>
<td></td>
<td>79.8</td>
</tr>
</tbody>
</table>
The idea of establishing oil shale business in Jordan was first conceived in 2006 when His Majesty King Abdullah has directed the Government to immediately start implementing oil shale projects as a vital local energy sources to contribute to energy self-sufficiency for the Kingdom.

"it is so essential for the Government to speed up the search for other sources of energy other than importing oil, and in front of that is to complete the implementation of oil shale projects and any other sources of energy"

Quoted from the Royal speech of His Majesty King Abdullah directed to the Prime Minister on April 13th, 2006
In the energy sector, successive rises and fluctuations in oil prices impose upon us the need to quickly identify renewable and alternative energy sources and to expedite the implementation of nuclear energy for peaceful purposes project.

The government will define the time frame for the implementation of the nuclear energy, oil shale and wind projects, and establish the completion dates for these projects so that all Jordanians will benefit from them.
Numerous geological studies since then have shown that over 60% of the country contains oil shale deposits.

There are more than 25 surface and near surface occurrences of oil shale in Jordan.

These deposits are regarded as the richest organic bituminous marl and limestone that occur at shallow depth.
Oil Shale Characteristics in Central Jordan

- Huge reserves relatively close to each other
- **Good quality** in terms of oil content and type of host rock
- Offering favorable mining conditions:
  - Shallow and suitable for surface mining
  - Low stripping ratio (Av. 1:1 in general)
  - Beds are horizontal and structurally undisturbed
  - Soft to moderate overburden rocks.
  - Located in remote or thinly populated areas
  - Have good roads connected with asphalted highways
  - Close to the national power grid
Jordan's policy and the long experience in attempting to utilize oil shale is highlighted by the creation of JOSECO.

JOSECO was established as the first Jordanian private shareholding company representing large segments of the Jordanian people.

JOSECO is well prepared to meet Jordan’s energy security by introducing oil shale into the overall energy mix and reach the goal of meeting all energy requirements from this strategic source.
JOSECO

- JOSECO is managed by a board of directors and executive officers and managers and other professional staff and its head quarter is located in Amman.

- JOSECO is registered under the laws of the Hashemite Kingdom of Jordan with registration number of (437) dated 13/5/2007 at the Ministry of Industry and Trade.

- JOSECO shares started transaction in Amman Stock Market in June 2008 at an average share price of one Jordanian Dinar.
JOSECO’S VISION

- Building a **reliable energy supply system** that will support national energy security, create new jobs, enhance economic growth through sustainable development of the vast oil shale reserves to pursue domestic solutions to the energy problem and allow Jordan to enjoy an increasing standard of living in a way that is compatible with a safe and clean environment.
JOSECO’S MISSION

- To be a vibrant, integrated and diversified regional oil shale energy company admired for its performance, competitiveness & quality of products and services
- To build on our continued contribution in developing oil shale utilization leading to significant impact on the economy of Jordan and to reach the stage of energy self-sufficiency including export, which would support the national economy and sustained government budget
- To put Jordan on the road to greater energy independence and make it a pioneer country into commercial oil shale applications
- To focus on constant innovation and enhancement of productivity, quality and profitability of our Business
- To build value into the investments of our shareholders
One of the most important goals of JOSECO is to exploit the huge resources of oil shale in Jordan for the production of:

- Crude oil and different oil products
- Electric power
- By-products such as sulfur and petrochemicals
- Construction materials, cement and bricks from the remaining ash and spent shale
Energy Strategy in Jordan

- Oil Shale: 11%
- NG: 29%
- Renewable Energy: 7%
- Imported Electricity: 2%
- Oil Products: 51%

Local Resources Contribution: 25%
Import Energy Contribution: 75%

YEAR 2015

Oil Shale: 14% in 2020
Oil Shale as Significant Issue

- Oil prices reached **US $148 a barrel** (3 months ago)

- Oil shale deposits represent a significant energy source that could potentially lead to initiation of self-sufficiency

- Expected cost of extracting one barrel of shale oil is around **US$ 30**

- Jordan can easily produce **hundreds of thousands of barrels a day** from oil shale, perhaps a million barrels a day, potentially

- Today, more than ever, momentum is building as key factors align to make oil shale economically feasible
The Strategic Significance of Oil Shale to Jordan

- Establishing a **domestic industry** capable of profitably producing a crude oil substitute and reducing oil imports,
- Benefit from the economic profits and jobs created by this oil shale industry
- Energy **security** and sustainable supply
- Additionally, oil shale production will likely benefit **local consumers by reducing local oil and electricity prices**, and that price reduction will likely have some national security benefits
Jordan is currently working in three directions:

- **First:** exploiting of deep oil shale in cooperation with Shell
- **Second:** exploiting of near-surface oil shale (Surface Mining)
- **Third:** cooperation with Estonia to build a CFB power plant
Oil shale test results have shown that Jordanian oil shale is considered as a good and acceptable fuel to be burned in circulating fluidized bed boilers with very high combustion efficiency and very low emission.
Feasibility studies and test burns have concluded that the Jordanian oil shale burned very stably, even at loads as low as 40%, low \( \text{SO}_2 \) and \( \text{NO}_x \) emission levels can be achieved in the CFB combustor, high carbon burn out, 99% can be achieved.
- Jordan has signed several Memoranda of Understanding (MOUs) with qualified companies to conduct full-fledged bankable and technical feasibility studies for the use of oil shale in both surface retorting and in-situ conversion systems and to assess the hydrocarbon production and power generation potential.

- Under the proposed agreement, Shell will survey and develop 22,000 square kilometers of land, nearly one quarter of the country, in the northern and eastern regions of the Kingdom.
MOU’S

- Royal Dutch Shell Oil, using In-Situ Conversion Process (ICP)
- Brazilian firm Petrobras, using Petrosix technology
- Oil Shale Energy of Jordan (OSEJ) using Galloter and Kiviter technologies
- Jordanian-British Energy and Mining Limited (JEML), using ATP technology
  JEML projects to have a commercially operational plant by 2012 with the capacity of 15,000 barrels of oil a day
- International Corporation for Oil Shale Investment (INCOSIN), using UTT-3000 technology
- Eesti Energia to develop a 600-900 megawatt power plant using CFB, with the additional potential to produce 36,000 barrels of oil a day
- Jordan Cement Company (JCF)
NRA criterion to grant a concession right in the oil shale area to give confidence and to sign a Memorandum of Understanding is capability and strategic interest.

The capability assessment will be based on:

- **Track record** (as the company’s experience in oil shale or similar resource development)
- **Commercial oil shale project**
- **Technology access and assessment** (as the company’s access to specific technologies necessary for development of oil shale)
- **Project management** (as the company’s proven track record of successful large scale project management)
- **Financial capability** (as the ability to raise finance for the project)

**Strategic interest** will be determined based on the level of interest in Jordan, regional focus, and whether investment in Jordan would provide an opportunity for the companies to develop and prove the capabilities of their technology.
The Oil Shale Strategy is being implemented in two phases and is designed to achieve the following objectives:

- To encourage development of oil shale through direct burning, surface and deep-mining retorting
- To license a small portion of resources to allow companies to develop their technologies and capabilities
- To award acreage in the future to successful companies
Steps For Oil Shale Commercialization

- Signing a **strategic partnership** agreement with interested high capability companies to invest in oil shale development in Jordan (Applicants may be either a company or a joint venture or consortium)
- Choosing the **most efficient technology** that suits Jordan’s situation
- Signing a **Memorandum of Understanding** with the government
- Conducting **geological and mining exploration** program
- Conducting a **bankable feasibility study** and other related studies
- **Negotiating the main concession agreement** for either oil extraction or power generation
- Sign long term **purchase agreements** to sell energy products
- Approval of the **final concession agreement** should be endorsed by:
  1- NRA’s Board of Directors
  2- The Board of Ministers
  3- The House of Parliament
JOSECO and its partner will:

- Develop and raise financial resources for such an oil shale commercial venture
- Complete engineering conceptual design and capital cost estimate for commercial plants
- Indicate recovery of main products and by-products and complete marketing studies
- Conduct economic analysis and evaluation based on investment cost, operating costs, indirect costs, depreciation, and return on investment, using key financial parameters
- Conduct Environmental Consideration Studies
- Conduct Water Requirement Studies
- Complete Plant construction design including shale oil upgrading
- Conduct Refinery design, engineering and construction
Bayir Area is 50 square km located in the southern part of the Kingdom was promised to be granted to JOSECO if a strategic partner and a proven technology are secured.

It is believed that this area is rich in oil shale (Quality and quantity) expecting that the thickness of oil shale layer is 65-70 meters and the oil content in some bores reached 12% by weight.
Oil Shale Viable Projects

- Dermatological medicinal product (ICHTHYOL-GESELLSCHAFT) Germany

- Power Generation in Estonia (4000MW)

- Oil Sand (One million Barrel per day)

- Zement (The only cement factory in Europe which produces Portland shale cement)

Jordan Cement Company has concluded that with fuel oil, it is possible to use oil shale up to 25%
On May 31, 2001, the Aviation Fuels Committee of the United Kingdom Ministry of Defense classified oil shale as a suitable feedstock in the manufacture of aviation jet fuel.
<table>
<thead>
<tr>
<th>Companies and Current Technologies</th>
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<tbody>
<tr>
<td><strong>In-Situ</strong></td>
</tr>
<tr>
<td>Chevrolet USA</td>
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<tr>
<td>E.G.L. Resources</td>
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<tr>
<td>Earth Search Sciences / Petro-Probe, Inc.</td>
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<tr>
<td>ExxonMobil Corporation</td>
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<tr>
<td>Independent Energy Partners</td>
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<tr>
<td>James A. Maguire, Inc.</td>
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<tr>
<td>Mountain West Energy Company</td>
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<tr>
<td>Phoenix-Wyoming, Inc.</td>
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<tr>
<td>Raytheon Corporation</td>
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<tr>
<td>Shell Frontier Oil and Gas, Inc.</td>
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<td>Red Leaf Resources</td>
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**Surface Technologies**

- Pyrolysis
- Fluidized Bed Reactor
- Value-Enhancement
- Vertical Retort
- Alberta Taciuk Process
- Gasification/Rotary Kiln
- Gasification
- Microwave Separation
- Gasification/Purification

**In-Situ Upgrading**

- CRUSH
- Closed Loop In-Situ
- Superheated Air
- Electrically-Enhanced
- Electro-Frac
- Geothermic Fuel Cell
- Gas Extraction
- Borehole Microwave
- RF/Critical Fluid
- In-Situ Conversion
- In-Capsule

**Surface Upgrading**

- Microwave Separation
- Gasification/Purification
Retorting tests have shown promising results and indicated that oil yield is 10% and gas yield is 5% by weight.

The tests have also shown that the reaction of limestone with sulfur resulting in very low SO$_2$ emission.
Syncrude contains:

- 10% naphtha
- 40% kerosene
- 40% diesel fuel
- 10% nitrogen rich residual
- The naphtha, kerosene, and diesel fuel are all refinery grade blend stock
Twenty years ago, we have conducted Lajjun oil shale industrial test (1100 tons) in Fushun retort with oil yield about 75~80% of Fischer assay.

Fushun retort can not treat lumps smaller than 8 mm, has lower oil yield and much lower capacity than other retorting process, such as Galoter I and ATP.

Jordan shale oil has too high sulfur, about 9 %, and cannot be sold as fuel oil, for which requirement is S content <2 %. To meet standard, a hydrotreating unit should be applied.

Pilot test needed to investigate the hydrorefining catalyst, pressure, temperature and velocity parameters for commercialization.
## ATP

### BASIC YIELD STRUCTURE - JORDAN SHALE

( wt% of moisture-free shale )

<table>
<thead>
<tr>
<th>Kerogen content</th>
<th>22.65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fischer Assay</td>
<td>12.0 + 0.8</td>
</tr>
<tr>
<td>Pyrolysis Products:</td>
<td></td>
</tr>
<tr>
<td>Oil C4+</td>
<td>12.65</td>
</tr>
<tr>
<td>Gas C4- &amp; H₂S</td>
<td>2.10</td>
</tr>
<tr>
<td>Coke</td>
<td>7.90</td>
</tr>
<tr>
<td>Retort Water</td>
<td>1.5 (est)</td>
</tr>
<tr>
<td>N₂ + CO₂</td>
<td>1.9 (est)</td>
</tr>
<tr>
<td>Mineral Residue</td>
<td>73.95</td>
</tr>
<tr>
<td>Free Moisture</td>
<td>1.0</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The ATP technology is a unique thermal desorption and hydrocarbon cracking system for separating and extracting water and organic substances from host solids. Diagram depicts the processor.
Conclusion:

- Excellent coordination & Team work (NRA-JCF), very good support from MOE, MOA, MOW & Kerak Governorate to make Jordanian dream (Utilizing Oil Shale) is more closer to reality.
- Without using Pet-Coke installations (15 MJD) in Fuhais & Rashadiya, this industrial test wouldn’t be possible.
- A successful substitution of 12% of fuel (60 tpd) is possible. Reaching the 25% target is still to be checked.
- Impact on Environment, Safety & Quality is insignificant. Impact on Process at more than 14% is questionable (To be checked).
- Saving compared to Normal fuel is clear but with Gas is narrow.
- Calorific value of used OS in the Industrial test is (1600 kcal/kg). Hope to have better calorific value in the new quarry location.
- Oil Shale Ash is a very good additive to Cement (potential for lowering CO₂).
Calcium ash of Jordanian oil shale is suitable for a wide range of uses as construction material such as: bricks, tiles, light weight aggregate, cement mixing, construction of road bases and stabilization of soils.
The technology is based on the method of high-speed oil shale pyrolysis by solid heat carrier “Galoter” (Russia).

The developer of the method is the G. Krzhizhanovskiy Institute of Energy – JSC “ENIN” (Moscow).

The Oil Factory at Narva, Estonia Two TSK140 retorting systems. 130,000 t/yr of shale oil.
The preliminary results of the Jordan shale thermal processing tests have shown that the technology developed by ENIN makes it possible to use shale of any fractional composition and quality without their preliminary sizing for producing high calorific liquid and gas fuels.
The study concluded that the Jordan oil shale is fully suited for highly efficient use in UTT–3000 plants which is a highly efficient and environmentally safe facility to produce oil and fuel gas or a thermal power station where shale is used as a source fuel.
Perfection and distribution of UTT technology around the World based on matured UTT-3000 installations as well as development, perfection and distribution UTT-7000 and UTT-10000 installations.

Federal State Unitary Enterprise the Saint Petersburg Research & Design Institute “ATOMENERGOPROEKT” has contributed patent “Installation for thermal processing oil shale with solid heat carrier” (variants), priority of 05/12/2005 and has reserved exclusive rights for designing works for all agreements concluded by the Association with third parties concerning UTT (SHC) installations. Doing this FSUE “ATOMENERGOPROEKT” has contributed its rich experience in designing oil shale based facilities:

The two units of UTT-3000 in Narva take up to now the leading place in the world as to the quality of oil and gas obtained from oil shale, ecological indicators and economic efficiency. The main advantage of pyrolysis by means of UTT units is the possibility of oil shale processing of any fractional composition and quality.
Schematic diagram of thermal processing of Baltic oil shale Unit UTT-3000

(SHC” and “UTT” mean the same)

Achievements

- Since 2006 the Association has concluded LOIs, MOUs, contracts and agreements for involvement in next projects with provision Know-How and technical documentation:
  - Project for oil shale development in Brazil, (4xUTT-3000, 6,000 bopd);
  - Project for oil shale processing in China;
  - R&D for brown coal processing in China;
  - Establishment of Joint venture “Advant Technologies” for oil shale development in Pacific islands area;
  - Project for Leningrad oil shale deposit development in Russia starting in 2007 (3xUTT-3000 for the first stage 7,000 bopd on Leningradskaya mine field and up to 12xUTT-3000 further 30,000 bopd on Western and Eastern fields).
Achievements (continued):

- Oil Shale Project in Komi Republic, Russia
- Kashpirskoe Oil Shale Deposit Development Project, Middle Volga, Russia;
- Perelyub-Blagodatskoe Oil Shale Deposit Development Project, Orenburg, Russia;
- Project for solid wastes utilization in Russian Federation (Federal program).
- Oil Shale Development Project in Uzbekistan;
- Establishment of JV for venture financing of R&D program “UTT-10000” (expected to finish in mid-2009).
- Bankable Feasibility Study for Oil Shale Development in Jordan (18xUTT-3000, 30,000 bopd)
- Initiation of Russian Federal Program on Oil Shale Development
On-Going Negotiations

JOSECO is currently involved in reviewing of contractual documents with some developers including financial and technical studies and preparation of concession and production sharing agreements in the oil shale field.
Letter of Intent (LOI) indicating that INTER RAO UES has initiated negotiations with JOSECO to commence cooperation by establishing a legal strategic partnership/joint venture in the form of a limited liability company (LLC) to build a commercial oil shale retorting plant in Jordan rated for 3 UTT-3000 units.
INTER RAO UES

- By virtue of the strong background experience in oil shale processing economically and cleanly, INTER RAO UES is involved in the oil shale business and is uniquely qualified and committed to Jordanian oil shale development.

- JOSECO and INTER RAO UES are interested in performing a bankable feasibility study and also have a keen interest in subsequent development and construction of the most cost-effective commercial complex, including the associated treatment and upgrading and power generation infrastructure.

- INTER RAO UES has the technical, financial and management capabilities and interest in developing and implementing this pioneer oil shale project, whereas INTER RAO UES is in line with oil shale business and has two ongoing projects in Morocco.
INTER RAO UES

- INTER RAO UES is ready to undertake and move forward with the implementation of this commercial oil shale project jointly with JOSECO through carrying out a detailed exploration and conceptual engineering design and business development plan including environmental impact assessment, technical pilot tests on Jordanian oil shale and site visits to witness the UTT-3000 operational plants in Estonia.

- INTER RAO UES will sign a long term joint venture agreement with JOSECO for a forty-year license to use the UTT-3000 to recover energy from Jordanian oil shale which is necessary to support commercial oil shale extraction and processing activities.

- With this major breakthrough of the UTT-3000 technology, Jordan can lead to full energy independence with the possibility of exporting surplus oil and oil products. With this UTT-3000 technology development INTER RAO UES will be able to demonstrate to the government and to the local market the practicality of this technology.
Microwave Extraction of Shale Oil

- The two basic elements offered for all Global Resource Corporation’s applications are **insitu and exsitu**.

- Because microwave energy penetrates into the centre of relatively **large** lumps of shale some grinding costs could be saved as it is not necessary to grind the shale into such fine particles.

- Economic benefits are also associated with **reduced residence time**, **selective heating** of the shale minerals, and kerogen.

- Some R&D showed that by using microwave processing, **better quality oil is produced from the shale** than by heating in a conventional kiln.

- The process however is done **without water** and performed in an oxygen starved environment.
Oil shale is a material containing hydrocarbons that can be mined. When the hydrocarbons are exposed to a specific frequency, the hydrocarbons turn to gases that are released and can then be collected through a heat exchanger and converted to the following materials:

- 26% gasoline
- 30% diesel and kerosene
- 44% lube, fuel oil and methane gases

The spent materials are then removed from the machine as an inert carbon ash material that is considered non-hazardous.
Microwave Extraction of Shale Oil

- Because microwaves can generate heat faster than convection heating, shale can be adequately heated to extract oil within a month or two of beginning production activities, rather the year or longer for other methods.

- Microwave oil recovery from oil shale is more economical and environmentally responsible than older oil shale extraction techniques as it uses less power, does not severely disrupt the landscape or leave behind residue that can enter groundwater supplies.

- When applied in oil shale, this microwave technology performs a mild upgrading in-situ, yielding an attractive light sweet crude oil. The process is “tunable”, facilitating production of various products.
C6 Energy will launch a fifteen-ton per hour oil shale processing pilot plant in China in 2009.

With this fifteen-ton per hour oil shale processing pilot plant, C6 Energy will have the ability to run large quantities of their product on a continuous basis.
C6 License

- JOSECO is negotiating a long term license agreement with C6 Energy for an exclusive license to use the revolutionary microwave machinery to recover energy from Jordanian oil shale.
- C6 Energy is the exclusive marketing agent for all current and future applications of the GRC microwave technology.
Global Resources Corporation

- The expected cost to process one ton of oil shale is estimated to be less than $30.00 USD based on GRC's pilot plant experiments.

- Microwave technology can retrieve four to five barrels of oil for every barrel of oil consumed in the process. Other methods have reported 1½ to three barrels for each one consumed.

- In a report released in late 2007 the U.S. Department of Energy profiled Global Resource Corporation and its microwave technology as a company that could possibly help make the U.S. energy independent.
On-Going R&D and Pilot Projects

Shell In-Situ Conversion Process
- Jordanian delegation has witnessed the in-situ retorting process

Extracting oil from shale

Shell technique
Electric heating elements are sunk into the shale and turned up to 700 °C.

The elements heat the shale in an cylindrical area of about 100 feet in diameter. After two to three years the heated shale releases the liquified oil.

Frozen barrier

Oil shale

Pooled oil

Bedrock

Pressurized aqueous ammonia creates a 10 foot frozen barrier that protects surrounding ground water from contamination.

In-Situ Conversion Process (ICP)

What is it?
- Enhancement of natural maturation of kerogen by slow heating
- Results in:
  - thermal cracking
  - in-situ hydrogenation
  - high sweep vapor phase production
  - high API oil
  - Temperature limited to boiling point of diesel, i.e. essentially no bottoms

How is it done?
- Electric resistance
- Conductive heat transport

Current target resources:
- Oil Shale
- Heavy Oil / Tar Sands

High Value Products
Light Surface Processing

- Naphtha
- Jet
- Diesel
- Nat. Gas
- Hydrogen
- Chem. Feed
- Heat
Mountain West Energy’s (MWE) latest estimate for the full costs of an In-situ Vapor Extraction Technology (IVE) oil shale project including natural gas costs for heat, to be $1.7 million the first year and $1.0 million the second year. IVE technology enables good quality oil to be produced from unconventional sources, such as oil shale, oil sands, heavy oil, and depleted conventional oil reservoirs. An oil recovery rate of approximately 80 bbls per day and a total recovery of 30,000 bbls per year may be achievable.
In Situ Vapor Extraction (IVE)

- The average IVE oil shale project is expected to extract oil over 5 years and produce over 150,000 bbls of oil from a single well.
- MWE can extract oil for a fully burdened cost of less than $25-$30 per barrel.
- IVE removes the lighter fractions of oil produced during pyrolysis.
- Drilling is much cheaper than mining and the cost of drilling depends on the depth, for 140 meters (459 feet), expected drilling cost is approximately $50,000-$100,000 U.S.
- MWE expects to see oil production within 3 months after starting hot gas injection.
MWE's IVE has several important potential competitive advantages over other oil extraction technology:

1. **Low capital** and operating costs, resulting in superior profits,
2. **High quality** synthetic crude oil production, garnering premium prices,
3. **Scalable**, single well profitability insures better rates of return,
4. **Rapid oil extraction** and lower costs result in faster ROI,
5. **Low environmental** impact reduces barriers and risk,
6. **Broad applicability** to oil shale, oil sands, heavy oil, and depleted conventional oil increase revenue potential and reduces risk.
Eco Shale In-Capsule Process
Conclusions

- The Government of Jordan has approved the new policy to encourage investment in the oil shale field.
- The implementation of the energy strategy will open up the oil shale market to competition and create several investment opportunities.
- Oil shale will be on the energy policy agenda of Jordan and more attention has been directed at technology and energy market developments that might change the commercial prospects for oil shale.
Conclusions

- The development timeline requires investment now to meet energy supply, security, and environmental challenges.

- The Jordanian short-run plans for producing energy from oil shale will cut its oil imports by one-third, and will serve as a guide for other countries with oil shale deposits.

- Oil shale is undoubtedly an excellent energy source that has great abundance and worldwide distribution.

- Market forces as well as environmental factors will greatly affect the interest in development of oil shale.
Conclusions

- Jordan is the most advanced country in the world in the effort to create energy from oil shale.
- JOSECO estimated that the company would begin full-scale production in three to four years.
- UTT-3000 and Microwave processes seem to be more economical, more efficient and more environmentally friendly technologies than other methods. They also allow for more flexibility in the kind of fuel produced, do not require water and produce less waste.
2.3 Conclusions about Oil Shale Technology, Potential, and Timing

The current state of shale oil production, mining, retorting, and upgrading technologies are sufficiently advanced to support the implementation of a new generation of oil shale projects by 2011 along with the development and commercialization of a domestic oil shale industry of 2 MM Bbl/day by 2020.

Mission Statement

To succeed in shale oil production where others have failed, develop the world's largest oil shale reserve, build both consistent value for our shareholders and a rewarding environment for our employee family, and contribute to a stronger America by solving one problem at a time in the commercialization of shale oil for America's oil independence.

Oil Shale More Profitable than Gold

One ton of oil shale produces one barrel of oil. When oil is selling for $50 per barrel, that's $50 per ton of rock.

Profitable gold-ore has about $12 worth of gold per ton. So, when oil is selling at $66 per barrel, like it is right now, oil shale is 5½-times more profitable than gold.

It’s no wonder oil shale is called the richest fossil fuel on earth.
Thank You For Your Attention

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Questions?