



THE HASHEMITE KINGDOME OF JORDAN
MINISTRY OF ENERGY AND MINERAL RESOURCES
PETROLEUM AND OIL SHALE DIRECTORATE



JORDANIAN
Oil SHALE 2019

Introduction

Jordan has a very significant domestic Oil Shale resource. According to estimates, Oil Shale deposits lie under more than sixty percent (60%) of Jordan's territory. This resource can provide a secure, long term solution to Jordan's growing energy needs and also encourage development of a technologically advanced, indigenous Oil Shale industry. The presence of a large amount of Oil Shale, within an attractive and stable investment environment, poses a unique and attractive opportunity for investors.

Many studies and surveys on the utilization of oil shale have been made for several locations in the country. Their outcome was encouraging and indicated that the utilization of oil shale either for generating electricity by direct combustion or for producing oil by retorting processes is economically viable option.

Oil shale is widely distributed in Jordan and can be identified in few outcrops and mostly in the subsurface. The most important Oil shale deposits occur in the lower part of the Upper Cretaceous Muwaqqar Chalk Marl Formation which outcrops across many areas of central northern and central southern Jordan. Although the oil shale is widespread, it varies in thickness and oil content.

Oil shale is defined as sedimentary rock where organic content (Kerogen) is insoluble in organic solvents, but forms liquid oil-like hydrocarbons when exposed to pyrolysis process, i.e. to temperatures up to 500-600 °C.

The Jordanian oil shale is naturally bituminous marl, chalky limestone and is varying shade of brown, grey or black with typical bluish light-grey color when weathered.



Another characteristic feature is their content of light fine-grained phosphatic xenocrysts and Bivalve shells.

The Jordanian Oil Shale is kerogen-rich, bituminous, argillaceous limestone that was deposited in shallow marine during the Maestrichtian - Danian periods. The origin of the kerogen is the dead plants and animals that found in the ancient seas and lakes during the Upper Cretaceous period and after the burial process, heat and the pressure which caused the change from organic matter to kerogen.

Jordan's most significant oil shale deposits are can be found in more than 20 locations around the country, with the 8 most important deposits located in the central region of the Kingdom.



Area	Location
El-Lajjun	100 km south of Amman
Sultani	115 km south of Amman
Jurf Ed-Darawish	145 km south of Amman
Attarat Umm Ghudran	35 km northeast of Qatrana
Wadi Maghar	40 km east of Qatrana
Eth-Thamad	45 km south of Amman

Reserves

Area	Lajjun	Sultani	Jurf Ed-Darawish	Attarat Umm Ghudran	Wadi Maghar
Area (km ²)	25	19.23	114.5	340	625
Oil shale thickness (m)	1-87	2-65	18-157	21-104	13-108
Overburden thickness (m)	7-78	34-90	33-58	36-150	33-70
Geological reserves (mt)	1200	1180	8000	23100	40800
Indicated reserve (mt)	1170	989	2500	10400	21600

Chemical and Physical Properties

Area	Lajjun	Sultani	Jurf Ed-Darawish	Attarat Umm Ghudran	Wadi Maghar
Av. oil content (wt %)	10.5	9.4	7.8	8.79	7.8
Total organic matter (wt %)	22.1	21.5	18	--	--
Calorific value (kcal/kg)	1590	1210	864	--	--
CaCO ₃ (wt %)	54.3	46.96	69.11	--	--
SO ₃ (wt %)	0.27-4.3	2.6-5.5	3.2-6.5	0.6-2.7	1.2-3.2
Bulk density (g/cm ³)	1.81-2.1	1.8-1.9	1.87-1.99	1.5-1.89	1.34-1.9
Moisture (wt %)	2.43	2.6	2.8	--	--



Why Oil Shale

The lack of conventional oil resources in Jordan has stressed the need to find alternative energy resources. One of these resources is oil shale which underlie more than 60% of the Kingdom's territory with a total of approximately 70 billion tones, Therefore, the Government of Jordan (GoJ) has decided to enhance the program of prospecting and exploration for oil shale as source of energy and investigate the most efficient and profitable methods of producing oil of equivalent properties as conventional oil.

According to the National Energy Strategy, covering Jordan's energy requirements, the Kingdom needs to increase its energy supply security and reduce its dependence on external energy sources by leveraging national resources such as renewable energy and oil shale. The energy strategy aims to increase the contribution of oil shale sources to 15% by 2020 while reducing of imported energy sources.

Oil shale exploitation and through attracting national and international investments in this field is considered a long term strategic decision in meeting the energy demand from indigenous resources.

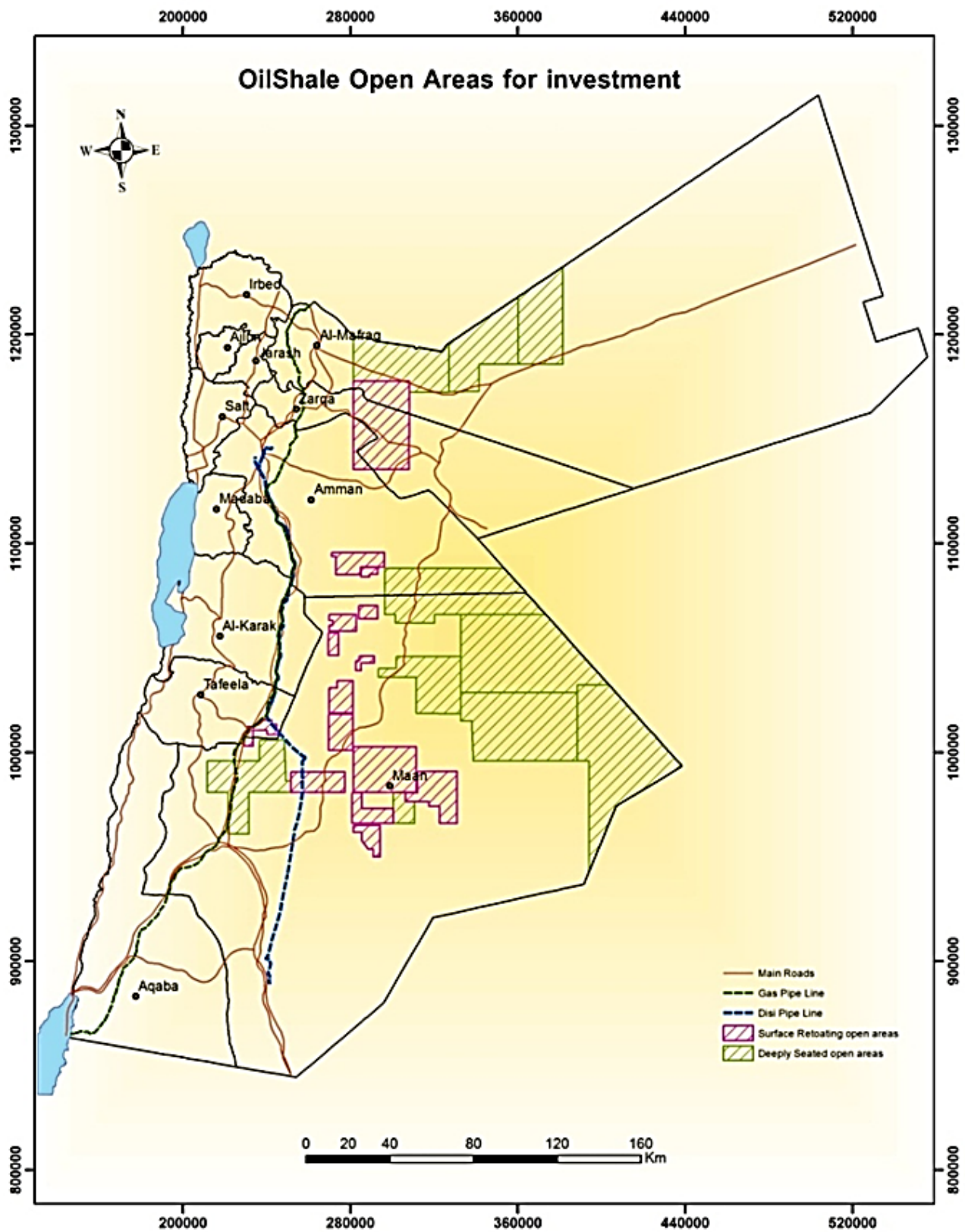


Oil Shale Investment Opportunities in Jordan

The Ministry of Energy and Mineral Resources of Jordan is promoting the Oil Shale open areas through many channels; MEMR has held the biannual Jordan International Oil Shale Symposium (JIOSS) to attract the largest number of international companies to invest in the deep and surface Oil Shale projects, And to promote the Jordanian Oil Shale resources.

Additionally, the Ministry prepares and updates the oil shale promotion packages for the open areas containing all the needed information for valuable investment opportunities.





Type of Agreements for the Oil Shale Retorting Projects to Produce Oil

1. *Exploration Phase: Memorandum of Understanding (MOU).*
2. *Development Phase: Concession Agreement (CA).*

Types of Agreements for the Oil Shale Direct Combustion Power Projects

1. *Exploration and Tariff studies Phase:*

- Memorandum of Understanding (MoU) followed by.
- Head of Terms Agreement (HoT) with NEPCO & MEMR.

2. *Development Phase:*

- Power Purchase Agreement (PPA) to be signed with NEPCO.
- Implementation Agreement (IA) to be signed with MEMR.
- Mining Agreement (MA) to be signed with Energy and Minerals Regulatory Commission (EMRC) and MEMR.
- Land Lease Agreement to be signed with Ministry of Finance/ DLS.

Concession Agreements

The Government has signed four retorting concession agreements to produce oil:

1. *Jordan Oil Shale Company B.V (JOSCO).*

A company that is owned by Dutch Shell for exploiting the deep oil shale reserves to produce oil, the concession agreement was issued as a law in 2009 and for 120 years, the company completed the first two phases during which it has constructed the Jordan Field Experiment “JFE”, the company is undergoing the technical interpretation of the JFE results in order to develop its technology accordingly.

2. *Karak International for Oil Company.*

A British company working in oil shale exploitation through surface retorting to produce oil with an approximate investment of 1.9 billion Dollars, the concession agreement was issued as special law in 2011; the agreement was amended in 2018 extending the pre-development phase for 5.5 years upon the global oil price drop.

3. *Saudi Arabian Oil Shale Company.*

A Saudi company for oil shale exploitation through surface retorting to produce oil with an approximate investment of 1.8 billion Dollars, the concession agreement was issued as special law in 2014, the company still working on the pre-development phase plan. Specific articles in the agreement were amended in 2018 according to the project special requirements.

4. *Jordan Oil Shale Energy.*

A consortium of Estonian/Malaysian/Jordanian for oil shale exploitation through surface retorting to produce oil with an approximate investment of 4-6 billion Dollars, the concession agreement was issued as special law in 2010.



Memoranda of Understanding

The government also has signed 5 Memoranda of Understanding “MoU” with many international and local companies for investigating the possibility of retorting oil shale to produce oil:

- 1. Shale Energy (JOSECO)*
- 2. Global Oil Shale Holdings Inc. (GOSH)*
- 3. Al Qamer for Energy & Infrastructure Ltd. Co.*
- 4. Questerre Energy Company*
- 5. AL-Lajjun Company.*

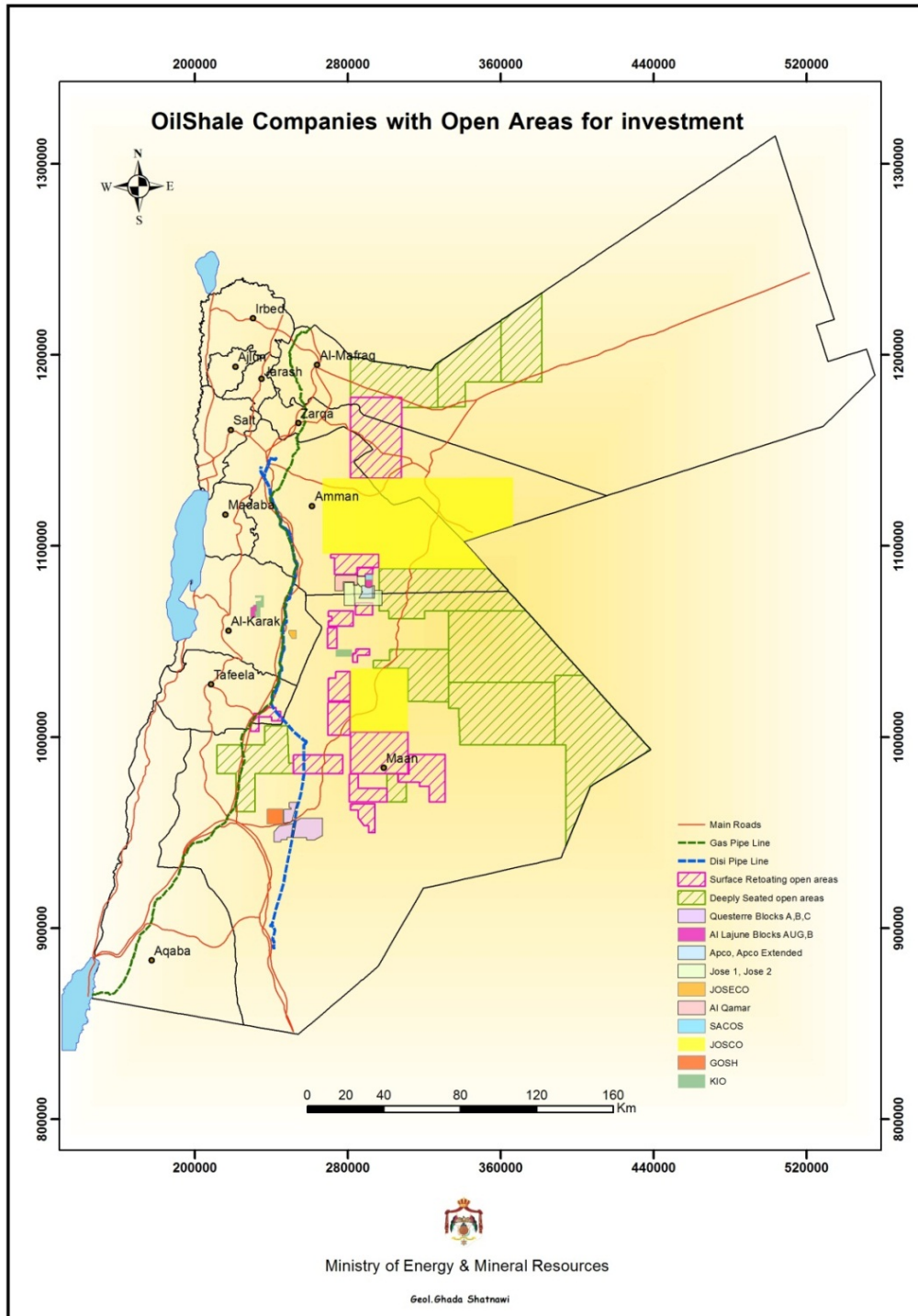
Oil Shale Direct Combustion Power Plant

Attarat Power Company (Chinese – Malaysian – Estonian Consortium) has signed the relevant agreements with the Government of Jordan to generate electricity by Oil Shale Direct Combustion. The company has already started the construction of the project on ground during the second quarter of 2017 and the first commercial operation is expected by 2020 with a capacity of 470 megawatts. This Oil Shale project is considered one of a kind in Jordan and in the region, regarding the size of the investment and type of industry.

Based on a policy that has been approved by the Council of Ministers, and based on the capacity of the electrical local grid in Jordan, the direct proposals have been stopped and competitive bidding approach will be adopted in the future.



Oil Shale Investment in Jordan



Oil Shale Investment in Jordan

The Government of Jordan, represented by the Ministry of Energy and Mineral Resources (MEMR), continues actively encouraging the development of its Oil Shale resources by supporting qualified entities in Research, development, mining, processing and production of oil and electricity from Oil Shale. MEMR encourages investments by capable developers in Oil Shale. MEMR supports projects across the Oil Shale industry, including:

- Oil production from surface and deep oil shale:
 - ✓ Mining;
 - ✓ Processing;
 - ✓ Upgrading of synthetic crude oil;
 - ✓ Processing and production of oil shale derived products;
- Generating electricity and
- Research and development

MEMR requires that certain criteria need to be met by interested developers in order to achieve the efficient, cost-effective and successful Oil Shale Development. These criteria are common to the parties that have so far been successfully selected to develop Oil Shale commercial projects in Jordan. In the interests of transparency, MEMR will publish these Guidelines, and share it with other interested Applicants. Which will assist Applicants to put proposals together and will streamline the process.



These Guidelines have been created to provide guidance to Applicants who are seeking to enter into a contract with MEMR to develop Oil Shale.

These Guidelines share the criteria and conditions under which Development will occur and seek to create a collaborative structure for the management and monitoring of all activities related to Oil Shale Development in Jordan.

Summary of application process for all Tracks

- Applicants must first submit a statement to the MEMR; letter of intent contains their track of oil shale development and demonstrates that the applicant qualifies.
- If the Statement demonstrates that an Applicant qualifies; an Applicant then prepares an Application which contains more detailed information as to the proposed project.
- If this Application is successful, the signing procedures of MOU, PPA or Concession Agreement may start.
- For Applicants seeking to develop commercial oil shale exploitation projects, MEMR expects that all companies will first enter into an MOU with MEMR, before submitting a Concession Application.

Oil Shale Investment – General Framework

