

Potential of Solar Energy Applications in Oman's Oil Industry

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Abstract

Oil industry has been blamed for causing several environmental and climate impacts. Recently, renewable energies have started finding their way into several applications including the oil industry. In Oman, where solar energy resources are among the highest in the world because of its location in the Sun Belt, solar energy applications have started recently in different industrial sectors including the oil industry. This paper overviews different possible applications of solar energy in the oil industry in Oman and presents a Geographical Information System (GIS) based solar energy resource assessment study for the application of Concentrator Solar Power (CSP) technologies in enhanced oil recovery. It is found that there is a very promising solar energy potential especially that plenty of land is available and is also suitable for such applications.

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Potential of Solar Energy Applications in Oman's Oil Industry

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INTRODUCTION

- ✦ Renewable energy applications are being introduced into the oil industry in many countries in order to **save energy**, **maximize efficiency** and **optimize production cost**.
- ✦ Oman is among those countries which has used and is planning to use solar energy in different applications in its oil industry.



EXAMPLES OF APPLICATIONS IN OMAN

- ❖ Remote telemetry units
- ❖ System control and data acquisition (SCADA)
- ❖ Flow measurement and monitoring, telemetry
- ❖ Drilling meters
- ❖ Cathodic protection of equipment and pipelines
- ❖ Natural gas automation
- ❖ Process control equipment
- ❖ Lighting
- ❖ Solar water heaters
- ❖ **Enhanced Oil Recovery (EOR)**



EXAMPLES OF APPLICATIONS IN OMAN (CONT'D)



<http://www.omansolar.com/oil.htm>



ENHANCED OIL RECOVERY IN OMAN

- Oman has a considerable amount of highly viscous oil, such as bitumen from oil sand, that may be recovered using a special method of the enhanced oil recovery technologies, called steam-assisted gravity drainage.
- Oman has planned to make the steam contribution to overall oil recovery around 10% over the next 20 years.



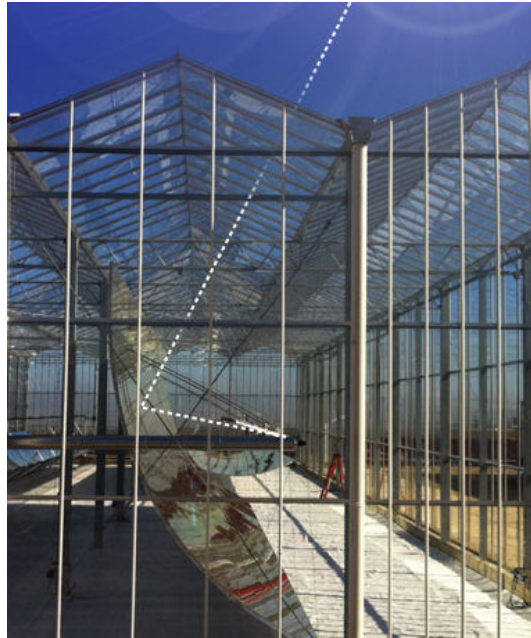
ENHANCED OIL RECOVERY (CONT'D)

- ❑ Because of the scarcity of the gas reserves in Oman and the need for more gas for other applications, there has been a move toward investigating the profitability of using solar energy instead of gas for producing steam.
- ❑ A pilot project of 7MW solar EOR system has been initiated by Petroleum Development Oman (PDO), and the contract was awarded in August 2011 to California-based GlassPoint Solar Inc.
- ❑ The project is based on Concentrating Solar Power (CSP) to heat water and generate steam.

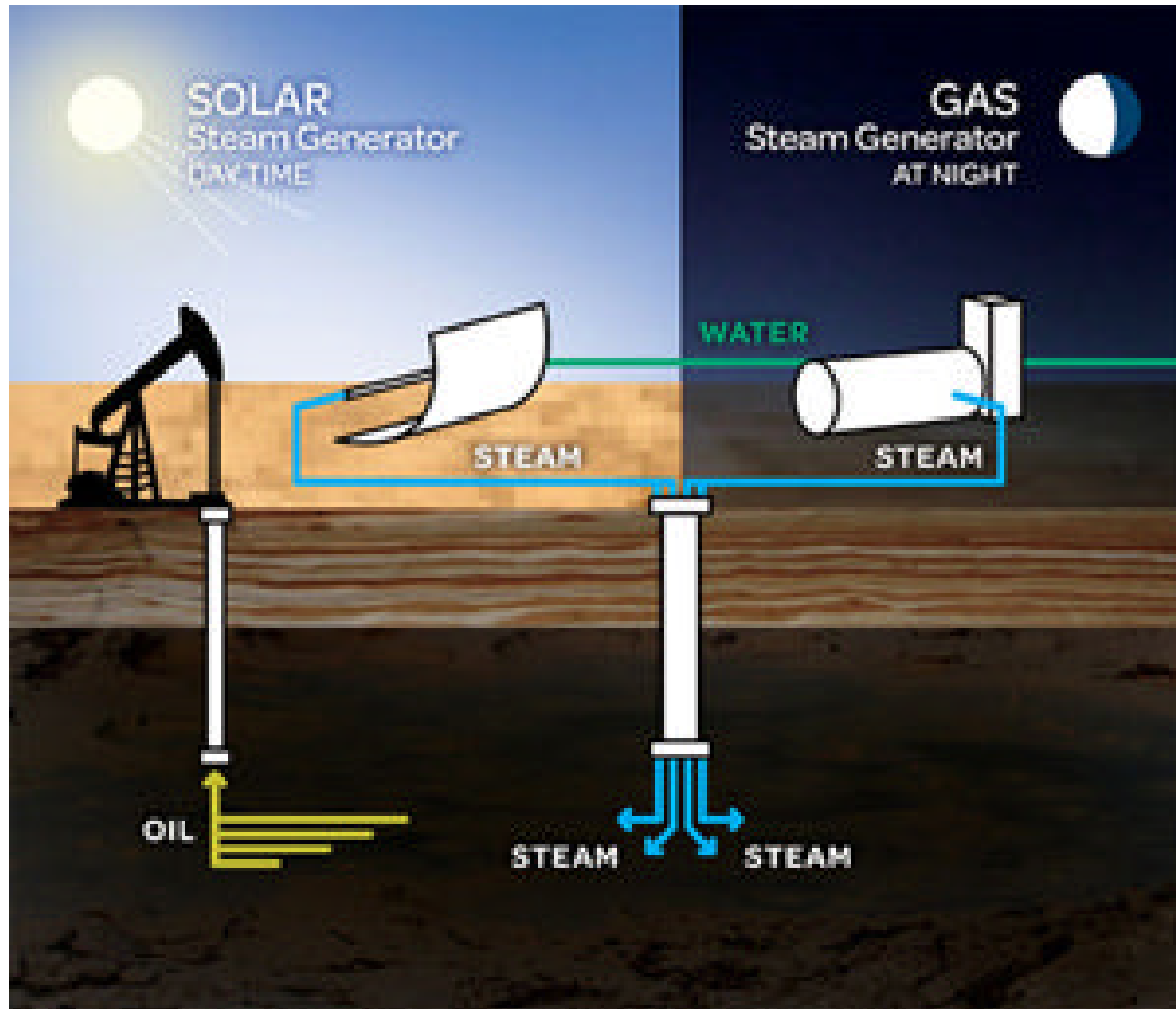


ENHANCED OIL RECOVERY (CONT'D)

PDO has decided to go for the Parabolic Trough Technology



<http://www.ifandp.com/article/0012970.html>



<http://www.ifandp.com/article/0012970.html>



SOLAR ENERGY RESOURCE ASSESSMENT FOR CSP APPLICATION IN OMAN

- ✦ Designating lands for solar steam generation and development for EOR would be a key step to creating a strong solar future for the country.
- ✦ Designating lands would:
 - facilitate the planning of new EOR facilities
 - attract more solar project developers
 - develop new research and development opportunities for solar energy applications
 - provide jobs in rural and remote areas



SOLAR ENERGY RESOURCE ASSESSMENT (CONT'D)



✦ Constraints used in solar energy resource assessment are classified as follows:

Technical	Economical	Environmental
<ul style="list-style-type: none">– Direct solar radiation– Terrain topology and slope– Land use (urban, sensitive, protected, etc.)	<ul style="list-style-type: none">– Proximity to existing oil fields– Land accessibility (proximity to roads)	<ul style="list-style-type: none">– Sensitive areas– Dust– Temperature– Hydrographic line

The water availability constraint is not considered here, even though it is an important constraint for steam generation, because most of the oil wells in Oman produce sufficient quantities of water that can be treated on site and used for steam generation and injection.



SOLAR ENERGY RESOURCE ASSESSMENT (CONT'D)



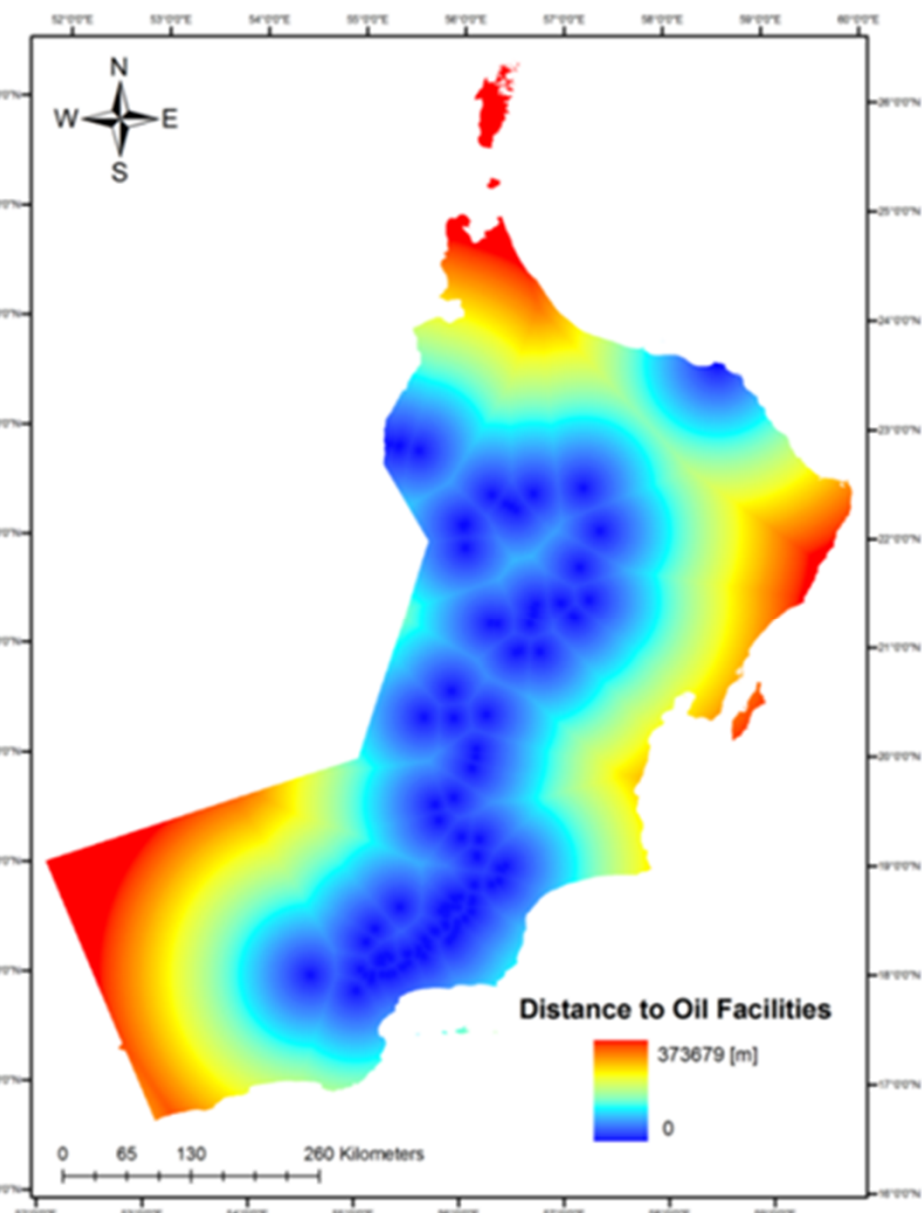
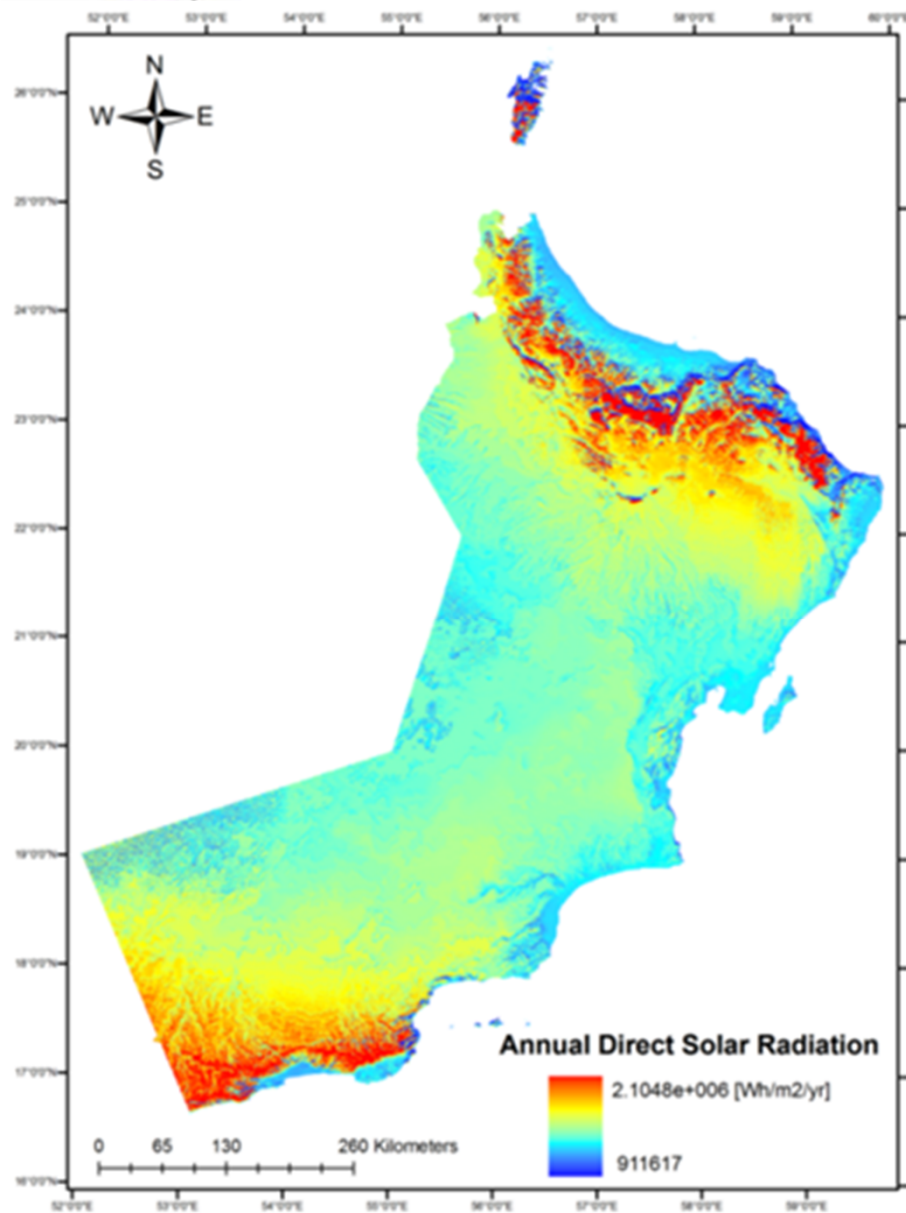
- ✦ The methodology adopted for analyzing such a complex multi-criteria process is based on the spatial Fuzzy multi-criteria evaluation approach.
- ✦ It consists of using the GIS of the land of Oman combined with multi-layers of the constraints described above.
- ✦ All the information are digitized and treated by the Fuzzy Logic Ordered Weight Averaging (FLOWA) module that was integrated within ESRI ArcMap 9.3.

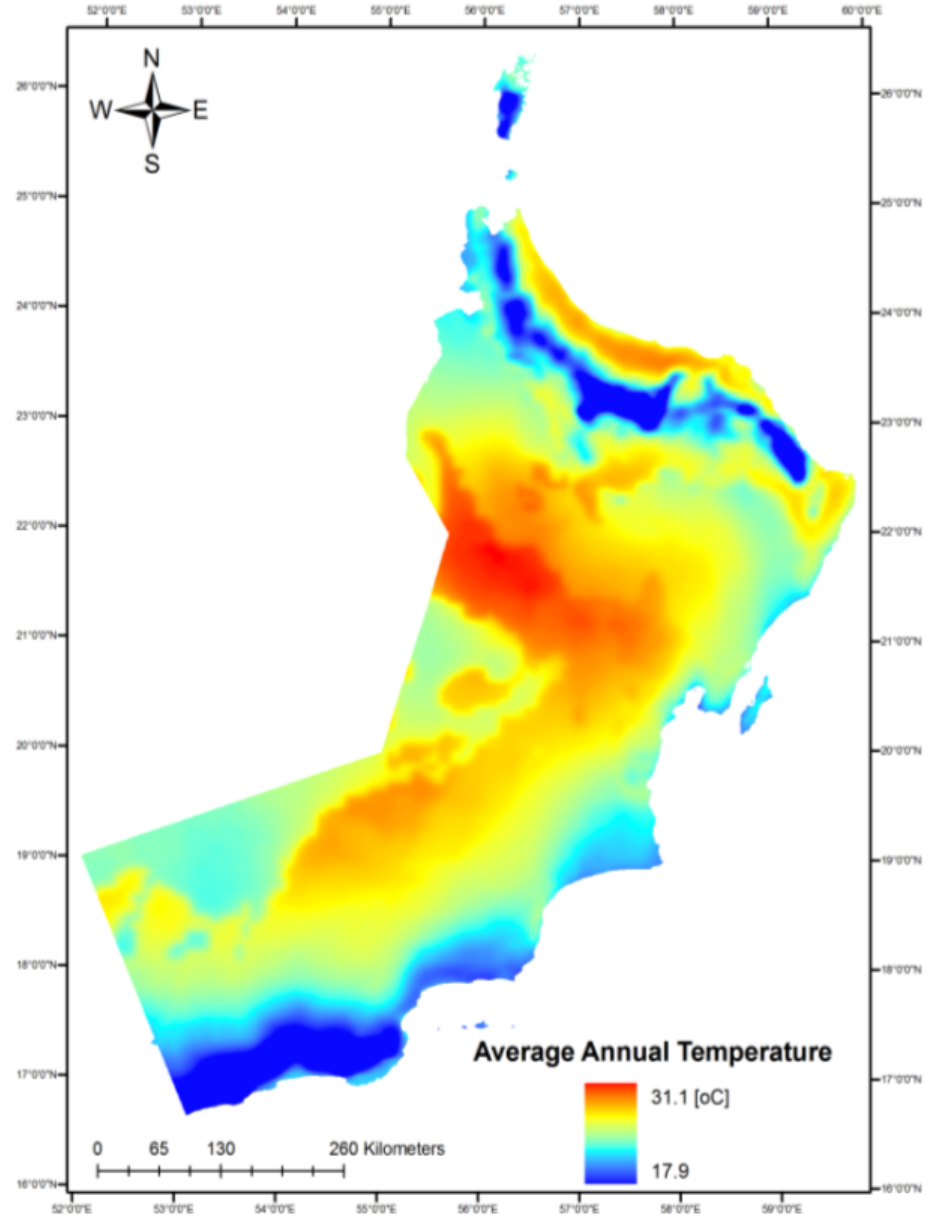
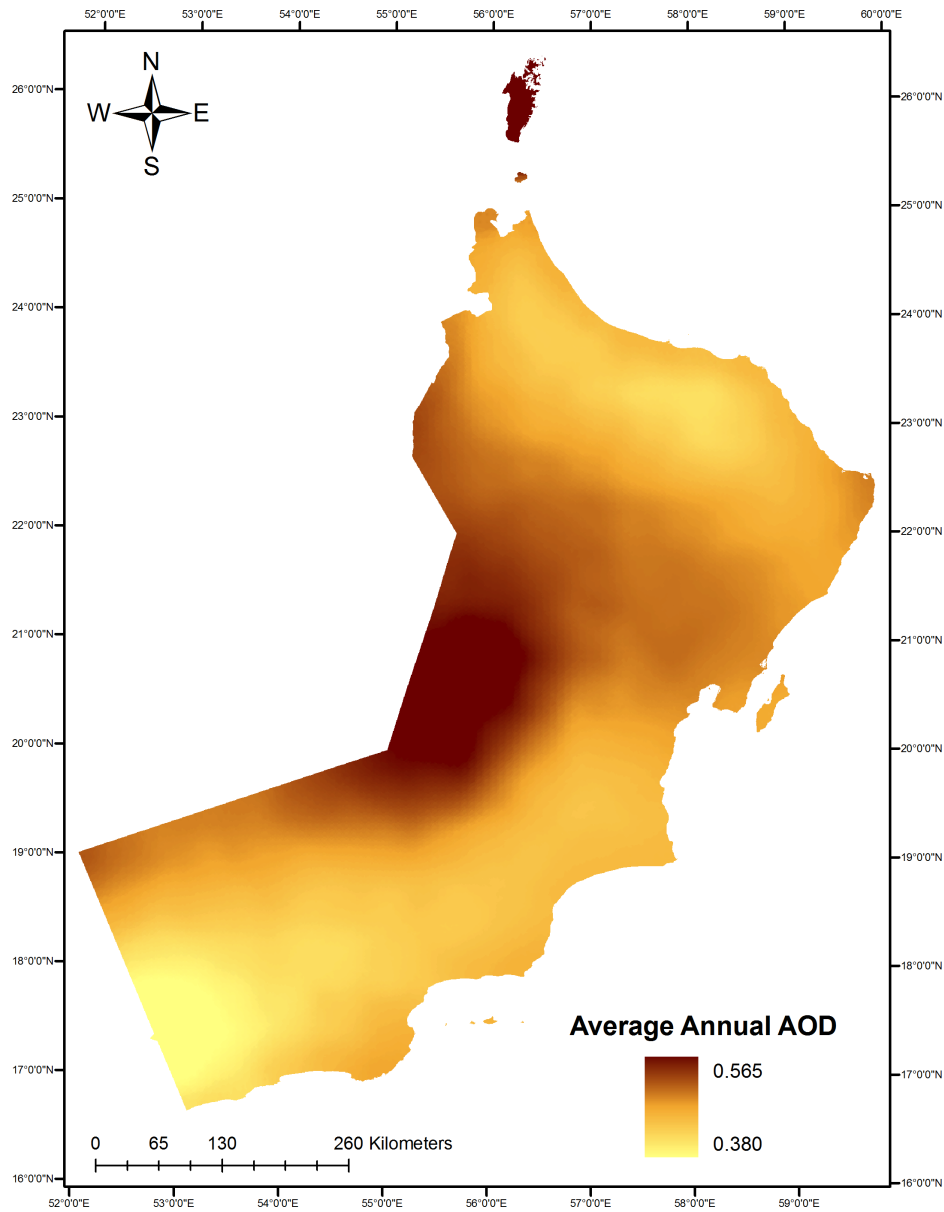


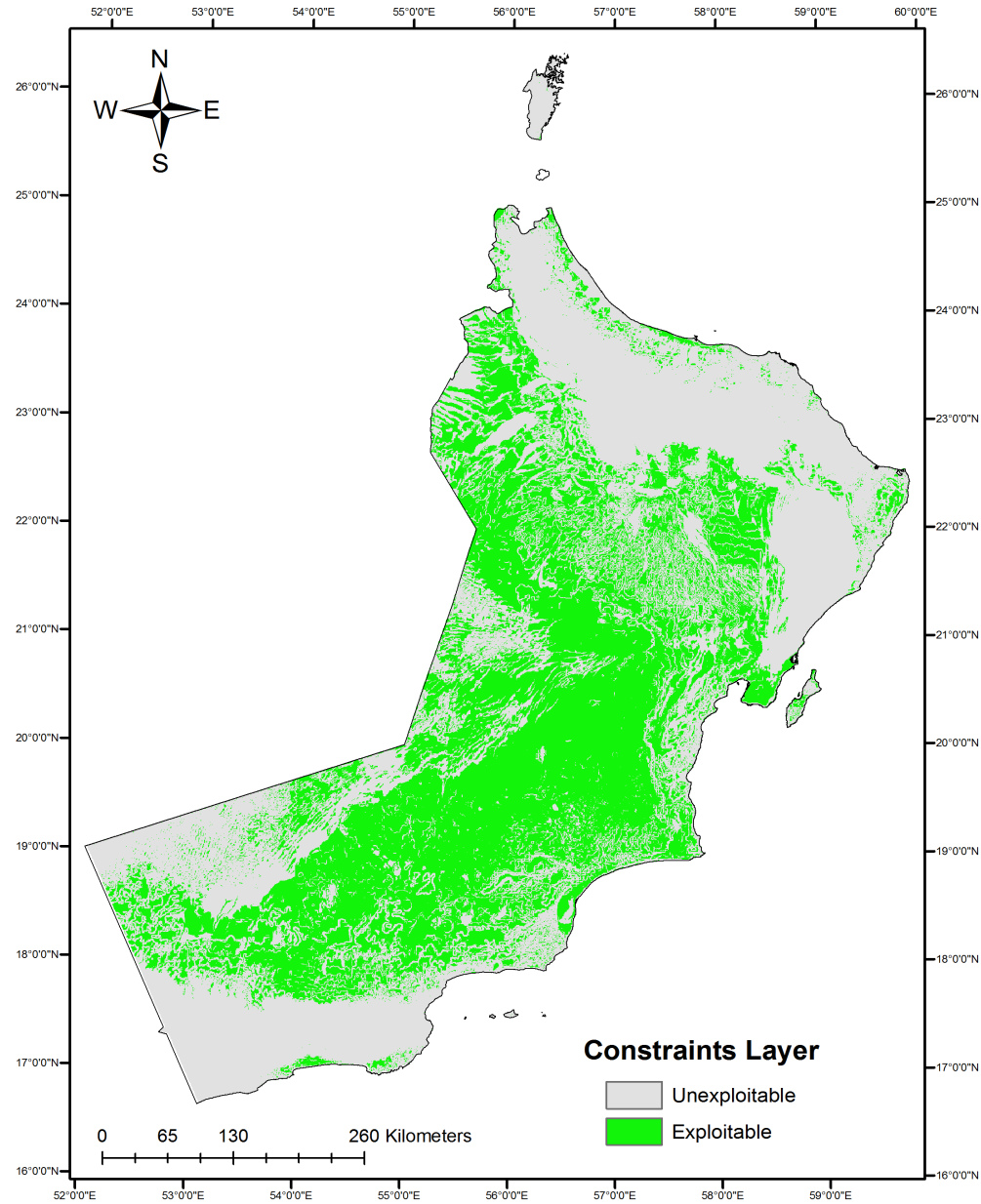
SOLAR ENERGY RESOURCE ASSESSMENT (CONT'D)



- ✦ It incorporates the concept of fuzzy (linguistic) quantifiers into the GIS-based land suitability analysis via ordered weighted averaging.
- ✦ It also incorporates uncertainty of expert opinions on the criteria and their weights, and provides a mechanism for guiding the decision-making through the multi-criteria combination procedures.

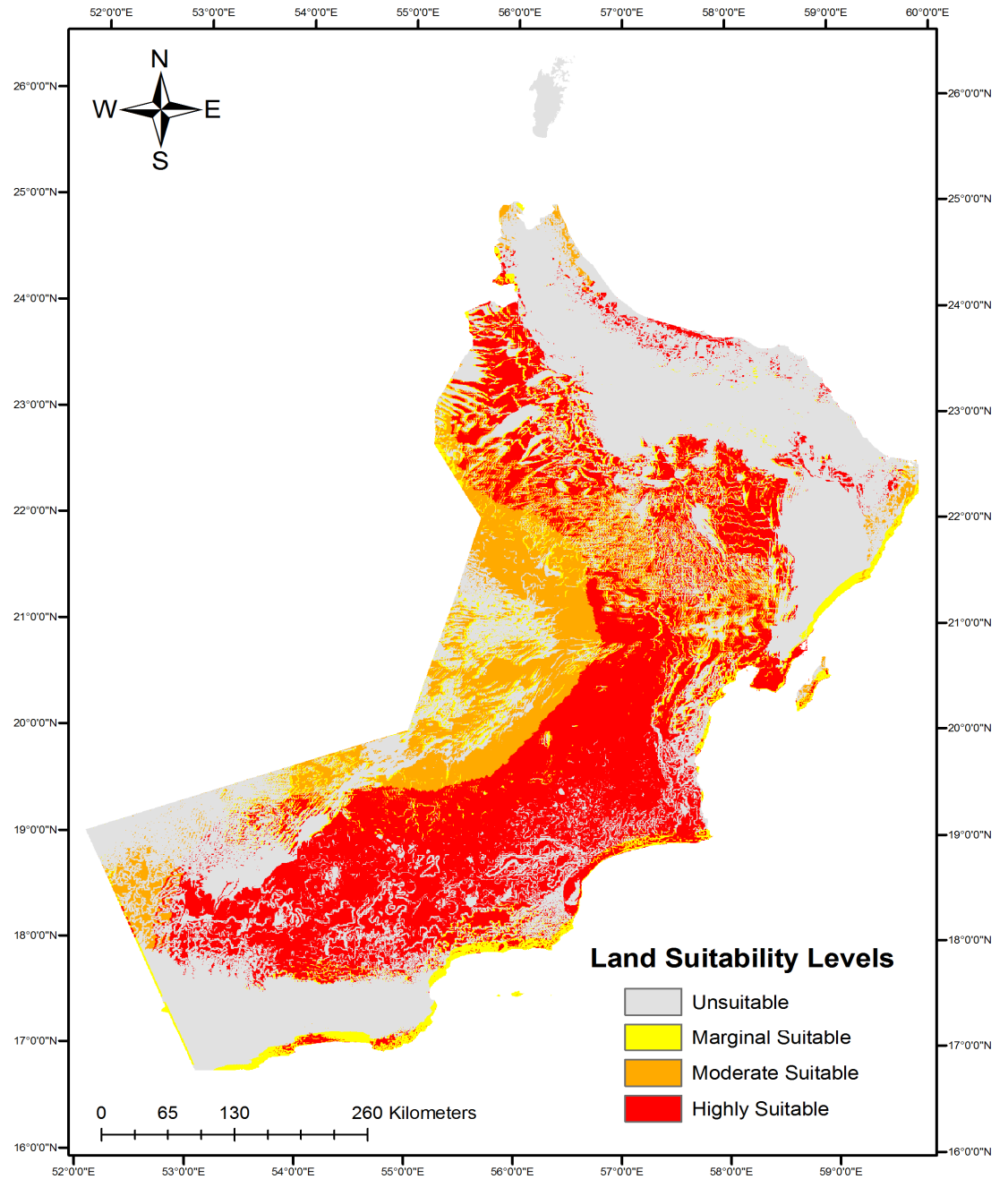


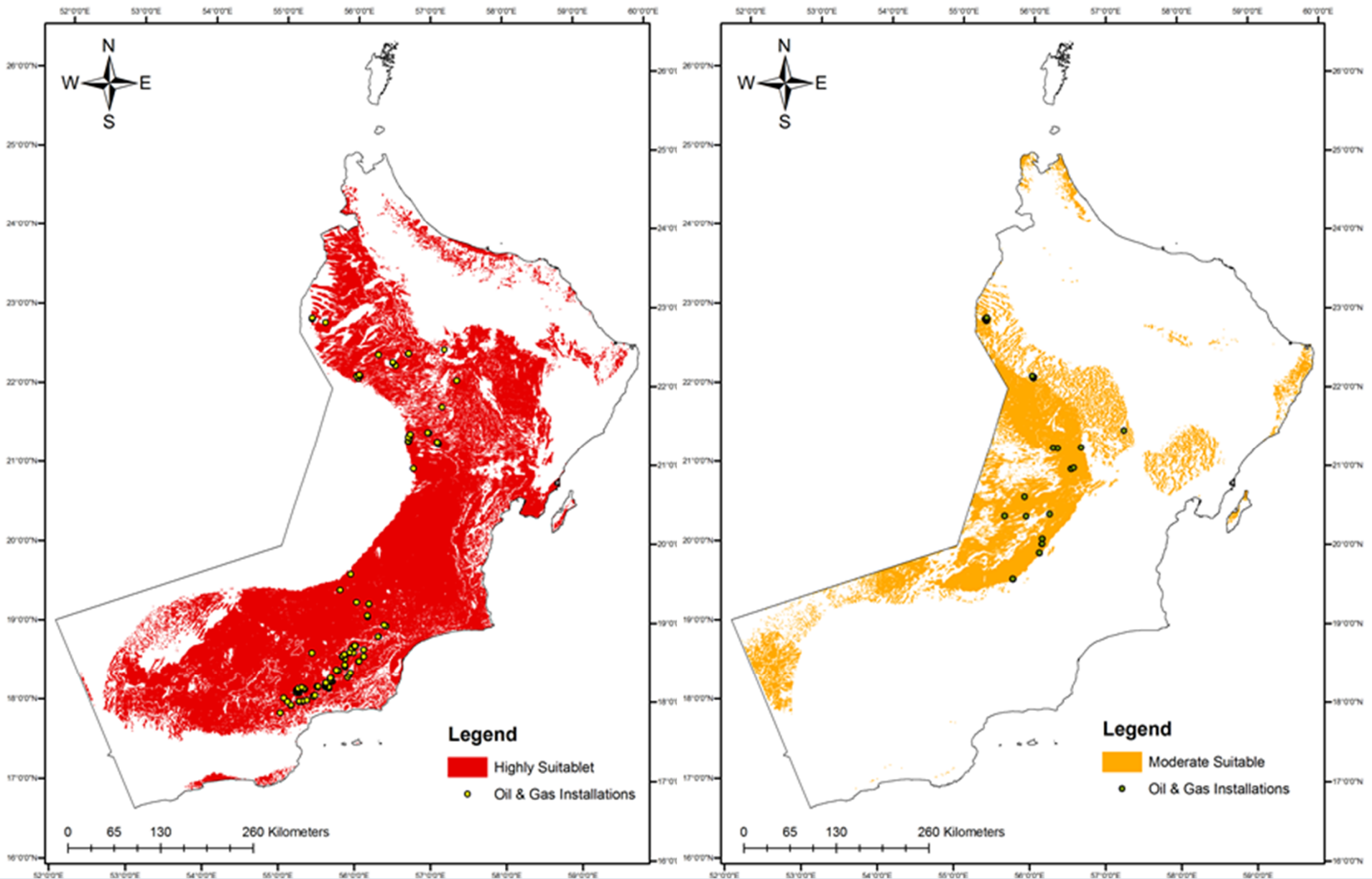






RESULTS





It is important to notice that there is a huge potential for the use of CSP in EOR in Oman. Large areas of the highly suitable lands are located close to Oil facilities where EOR is needed.



CONCLUSION



- ✦ The development of solar energy application in EOR will certainly provide several advantages to the oil and gas industry by reducing the costs of heavy oil production and decrease the wastage of gas for steam generation.
- ✦ This study has shown that there is a huge potential of solar energy for such an application.
- ✦ The solar energy will also make the heavy oil production friendlier to the environment by eliminating the greenhouse gases emitted by burning gas for steam generation.



THANK YOU