

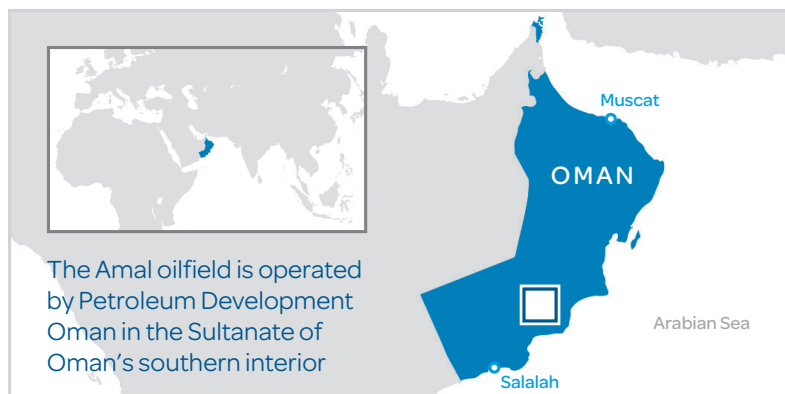
## ONE GIGAWATT SOLAR THERMAL PROJECT TO GENERATE STEAM FOR OIL PRODUCTION

### Project Overview

Miraah will be one of the world's largest solar plants. The solar thermal facility will harness the sun's energy to produce steam used in oil production. Once complete, it will deliver the largest peak energy output of any solar plant in the world. The scale of this landmark project underscores the massive market for deploying solar in the oil and gas industry.

The 1 GW<sub>th</sub> project will reduce the amount of natural gas used to generate steam for thermal enhanced oil recovery (EOR). In thermal EOR, steam is injected into an oil reservoir to heat the oil, making it easier to pump to the surface. Miraah will generate an average of 6,000 tons of solar steam each day, providing a substantial portion of the steam required at the Amal oilfield operated by Petroleum Development Oman (PDO).

The mega project dwarfs all previous solar EOR installations and is more than 100 times larger than the pilot project built by GlassPoint for PDO in 2012. The pilot was completed safely, on time and on budget, and has been operating successfully for more than two years. The pilot exceeded PDO's expectations for steam delivery and system reliability, paving the way for this significant expansion.



### Quick Facts

**CLIENT**  
PDO

**LOCATION**  
Amal Field, south of Oman

**STATUS**  
Under construction

**ENERGY PRODUCTION**  
1,021 MW thermal (1 GW)

**DAILY STEAM OUTPUT**  
6,000 tons

**TOTAL PROJECT AREA**  
3 km<sup>2</sup> or 741 acres

**TECHNOLOGY**  
GlassPoint enclosed trough

**NUMBER OF GLASSHOUSES**  
36

**CONSTRUCTION START**  
2015

**FIRST STEAM GENERATED**  
2017

**GAS SAVINGS**  
5,600,000 MMBtus/year

**CO<sub>2</sub> EMISSIONS SAVED**  
300,000 tons/year

## Client

Petroleum Development Oman (PDO) is the largest oil and gas producer in Oman. It is a joint venture between the government of Oman, Shell, Total and Partex.

## Technology Overview

The enclosed trough solar field uses curved mirrors to focus sunlight onto a pipe filled with water. The concentrated sunlight boils the water to create steam, which is fed directly to the oilfield's existing steam distribution network. The steam generated is exactly the same quality, temperature and pressure as steam produced by burning natural gas.

A glasshouse protects the solar array from harsh oilfield conditions like wind and dust storms. As a result, GlassPoint can use lightweight and inexpensive components inside the glasshouse. Automated washing reduces costs further and preserves scarce water resources.

The technology is proven and easy to scale by building projects in standard glasshouse modules. GlassPoint's production-line approach constructs several glasshouses in parallel and commissions them in modules of four for rapid deployment. That means solar steam generation will begin as soon as the first glasshouse module is completed in 2017.

## Technology Provider

GlassPoint Solar is the global leader in solar EOR. The company's enclosed trough technology is the only solar thermal system designed specifically for oilfield deployment.

*"Our partnership with GlassPoint and our investment in solar steam generation is a long-term strategy to expand PDO's heavy oil production and free gas for economic development across Oman."*

- Raoul Restucci, PDO Managing Director

### Economic Benefits

Natural gas not consumed at the field can be used for industrial development, power generation or LNG export

Diversifies Oman's oil-based economy by establishing a new solar power industry

Creates jobs and training in engineering, construction, operations and administration

Generates in-country value (ICV) through local supply chain development

*Sealed from dust and sand*



*Proven oilfield performance*



*Fully automated operation*



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