

Marsa Solar Project

Technical Feasibility Report

14/05/2025



1. Executive Summary

This report gives an overview of the Marsa solar project focusing on its technical aspects. The report introduces the Marsa solar project as part of the integrated Marsa LNG project. It gives an overview of the project site and its relocation from Shinas to Duqm due to the technical complexities encountered in Shinas. The report lists the site studies that are being carried out to showcase the site's characteristics and highlights any potential technical or environmental risks. A summary of the technical plant details is included as part of the preliminary plant design as well as the EPC and O&M strategy along with the expected timeline of the project. Finally, the regulatory and legal aspects of the project is discussed highlighting the current status and potential risks. The report concludes by summarizing the findings and highlights the next steps.

2. Introduction

Marsa LNG is a joint venture between TotalEnergies (80%) and OQEP (20%) formed to develop an integrated gas project using their share from Block 10 (150 MMscf/d) to feed an LNG plant with a capacity of 1 MTPA to provide LNG bunkering services in the port of Sohar. The LNG plant is designed to be fully electric and is intended to be carbon neutral in terms of scope 2 emissions which makes the LNG facility one of the lowest carbon intensive LNG plants worldwide.

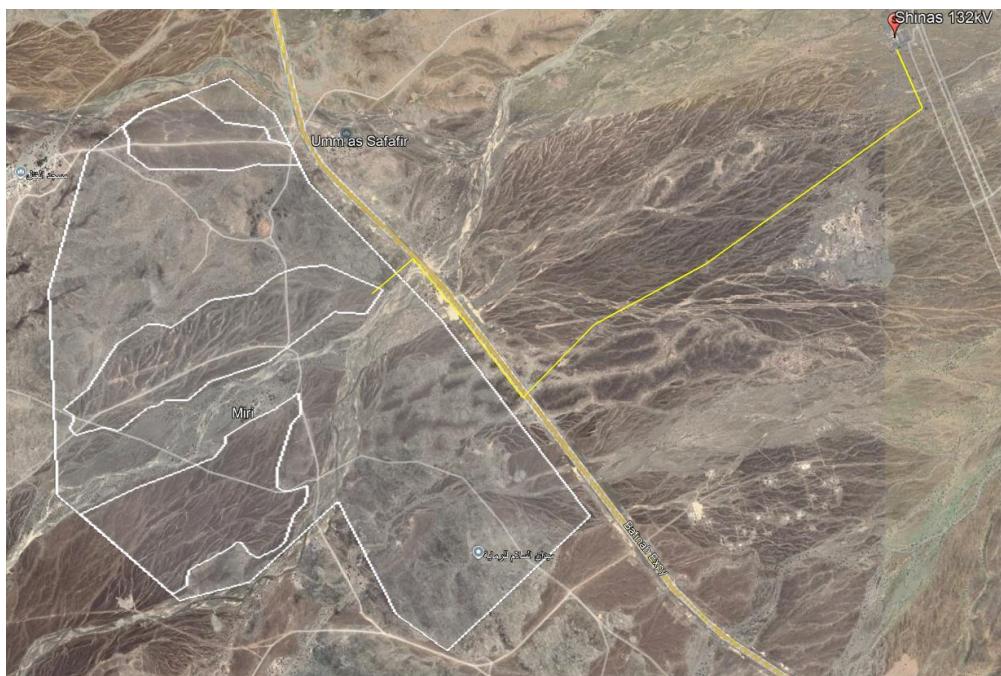
In order to achieve its carbon neutrality, the LNG facility will get 100% of its power consumption from a dedicated solar power plant. The LNG facility is designed to have an annual consumption of around 700GWh per annum. Therefore, by design the solar plant needs to be of capacity around 300MWp to be able to generate annual power requirement of the LNG facility. The Marsa LNG announced FID on 21 April 2024 for the whole project including a 300MWp solar plant. Currently, the Marsa LNG project is under construction and targeting to achieve COD by January 2028.

The solar plant is being developed as a separate joint venture between TotalEnergies (49%) and OQAE (51%), the national champion of renewable energy. Due to the vast distance between the Project site and the LNG facility, the generated power needs to be injected into the OETC grid network. Power transport management from technical and regulatory perspective is discussed in the following sections. **The COD of the solar plant needs to match that of the LNG facility which is January 2028.**

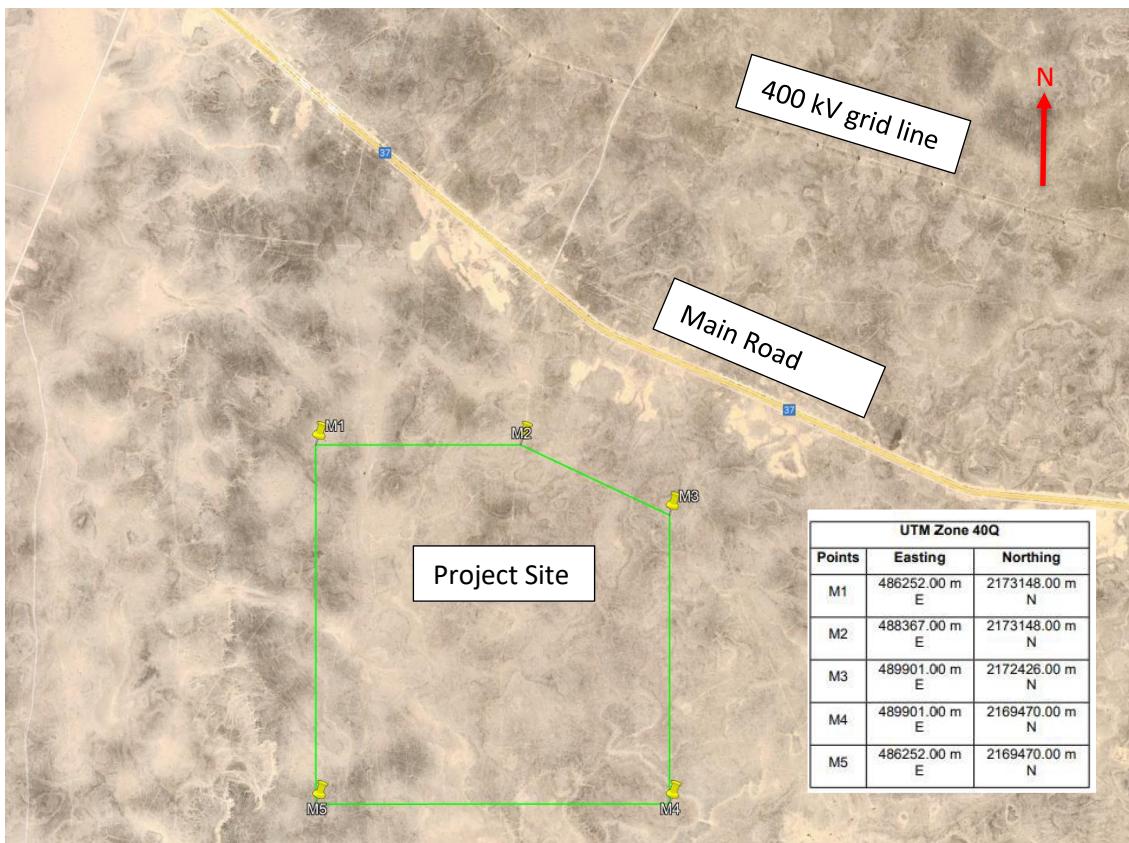
The objective of this report is to give an overview of the Marsa Solar project and its role in the successful delivery of Marsa LNG as a low emission intensive LNG bunkering hub. Moreover, the report outlines the technical aspects of the project and the current status of certain workstreams. It also illustrates the technical feasibility and legal framework associated with the Project execution.

3. Site Description

The Marsa Solar Project site was initially identified in Shinas which is around 30km away from the port of Sohar. The site was allocated for the Project and was split into 3 plots due to major wadis crossing the site. The Project was intended to be connected to the OETC grid network at 132kV through a dedicated Loop-In-Loop-Out (LILO) grid station to be built within the site boundaries by OETC. The technical assessments and site studies were conducted on the site, which showed technical risks that can be costly to overcome. After considering the site's complexities and communicating the associated cost implications to the relevant authorities, it was recommended to relocate the Project to another site with less technical risks and better solar resources. Below is a Google Earth view of the Shinas site:



The new Project site is located in AlWusta governorate about 100 km from Duqm city and 90 km from Haima city. This site is part of a bigger plot allocated by MEM to OQAE for the development of renewable energy projects. MEM has sent out official correspondence to MOHUP to prepare the krooki for the plot to be used for Marsa solar project. The site Google Earth view and coordinates are provided in the figure below.



The site's total area is 1,292 ha and has a perimeter of 14 km. The site boundary is 1.5km away from the main road connecting Duqm and Haima and has easy access via multiple available graded roads. The 400kV grid line is about 4km north of the site.

Site Description

The site topography is generally flat consisting of consolidated sands and stones in some areas. There are small trees spread over the site, bushes and grass in some parts of the site. There are no industrial activities within or near the site. There are some temporary and portable settlements within the site and some animals (camels and sheep) seen feeding in the grassy areas. There are small water streams and water accumulations within the site boundaries but no major wadis crossing the site. A more comprehensive site visit report has been prepared with more site details. Overall, there are no major risks identified on the site for the development of the solar plant. Furthermore, there are some site studies that are planned to be conducted on the site to have a better understanding of its conditions. These site studies are summarized in the below table:

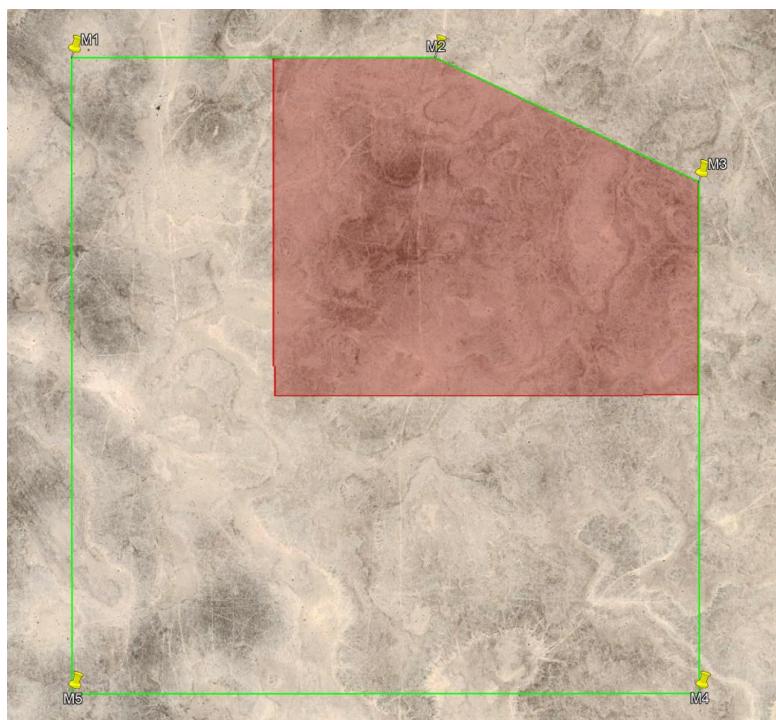
Site Study	Description	Expected Delivery
ESIA Scoping	Define the scope of the environmental and social impact assessment to be done during the full ESIA study. It is used to	5 Jun 2025

	obtain the preliminary NOC from EA for conducting the full ESIA study. It covers the full site and the potential route of connection to OETC grid station.	
Topography	Define the topography of the site identifying and potential risks associated with the terrain of the full site.	10 Jul 2025
Geotechnical	Assess the subsurface formation structure for constructing the solar plant structures. This investigation is focused only on the solar plot (430 ha).	24 Jul 2025
Hydrology	Identify potential water streams and associated hydrological risks over the full site that can impact solar construction or operation.	7 Aug 2025
Full ESIA	A full environmental and social impact assessment taking into consideration the elements identified in the scoping assessment.	25 Dec 2025

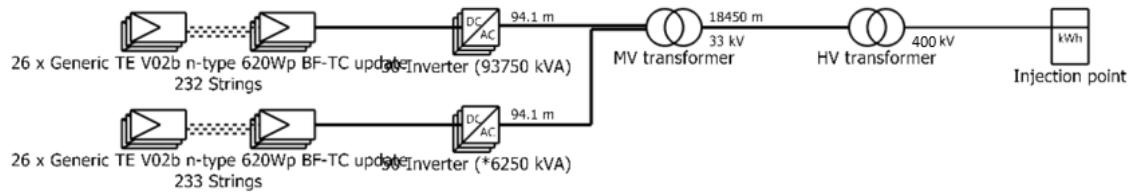
4. Technical Details

Plant Layout

The Marsa Solar Project is planned to be a Photovoltaic (PV) solar plant with a capacity of 300MWp utilizing bifacial solar modules with single axis tracking technology. The solar plant is expected to have a grid limitation of about 280 MW to be injected to the grid. The solar plant will utilize about 484,000 solar modules. and for optimum output, it is designed to have a ground coverage ratio of 35%. The solar plant will require an area of approximately 430 ha and will be located in the northern east side of the plot (indicated by the red highlighted area below).



The solar modules will be connected to string or central inverters. The output will be stepped up to 33kV through a Medium Voltage transformer and then to 400kV through a High Voltage transformer. The final output is injected to the main grid network via a grid substation. A simple indicative SLD is shown below for this configuration (figures are preliminary and are subject to further analysis):



Based on the solar resource data and after reviewing the technical aspects of the project, and taking into account some assumptions, it was concluded the solar plant will have an average yield of about 2,500 kWh/kWp/year. Therefore, the average annual generation over the 23 years is expected to be around 700 GWh (considering the plant life due to the degradation factors).

The injection to the grid will be done through OETC. The Marsa team have already communicated with OETC and aligned on the connection configuration. The connection application has been submitted and is currently under review by OETC. The connection point will most likely be a Loop-In-Loop-Out (LILO) switchgear configuration but yet to be confirmed by OETC. The connection station will be located close to but outside the Project boundaries as it is intended to serve multiple customers in the area.

EPC Approach

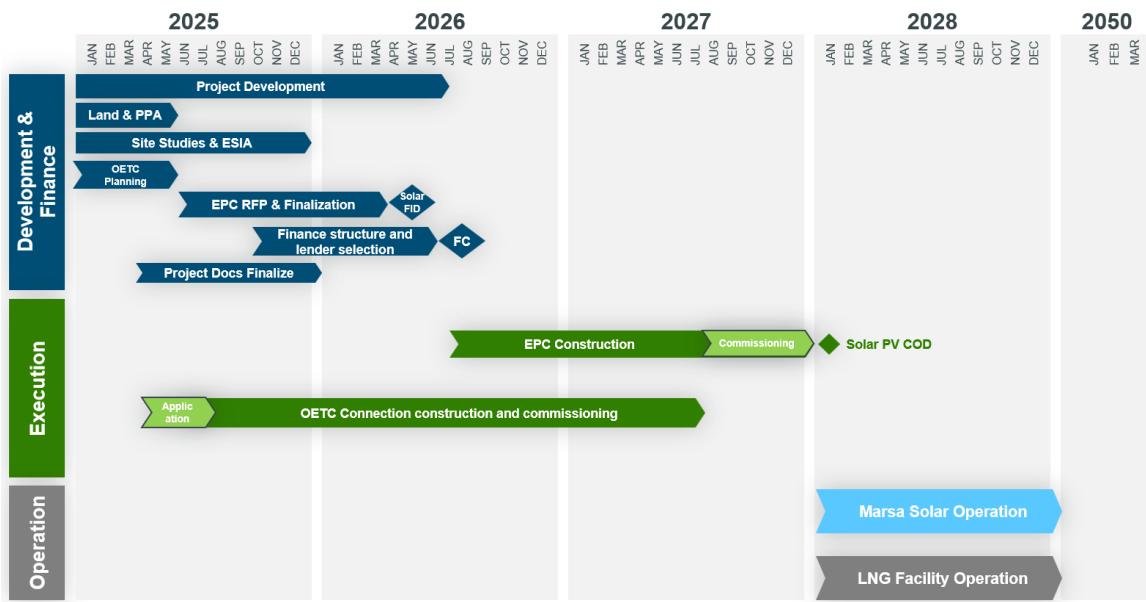
The EPC contractor to be utilized for the project will be selected through a competitive procurement process. The chosen EPC contractor should have proven experience in design, engineering, procurement, construction and operation of utility-scale PV Plants. There will be a certain minimum eligibility requirement set for the qualification of the EPC contractor to ensure successful delivery of the project including the number of solar PV plants of utility-scale size and the total capacity in MW of solar plant delivered by the contractor.

Operation & Maintenance

The maintenance program will be implemented on a regular basis to ensure the optimum performance of the plant to be conducted and monitored on a regular basis. The key activities are predictive maintenance, preventive maintenance, fixed interval maintenance, corrective maintenance, inverter management plan, tracker management, module cleaning, spare parts management, and weather and power forecast.

Project Timeline

The solar project is planned to have its COD coinciding with the COD of Marsa LNG plant which is January 2028. Below figure illustrates the main timeline milestones:



5. Legal and Regulatory Review

Power Management

Since the Marsa solar project is located several hundreds of kilometers away from the Marsa LNG facility, there is no feasible way to directly connect the solar plant to the Marsa LNG. Moreover, the solar will deliver the total daily power consumption of the LNG facility during daylight hours only. Hence, it was required to have a mechanism that allows for the transfer of power from the solar plant to the LNG facility.

During various discussions with MEM and APSR over the course of several months, few options were studied and evaluated. The most suitable option was that the solar plant is to connect to the OETC grid and sell its power output to Nama PWP through a PPA and Marsa LNG purchases its required power consumption from the grid while keeping the associated environmental attributes (i.e. carbon credits). The PPA term needs to match the Marsa LNG operation term of 23 years. This mechanism has been proposed and endorsed by MEM and was communicated to APSR and Nama PWP. Currently, Marsa is coordinating with Nama PWP to invite them to submit the offer and proceed to discussing the PPA framework.

Permitting

From a technical point of view, there don't seem to be any potential major risks associated with permitting processes. Currently, the land has been allocated by MEM to OQAE for their

renewable energy projects development. MEM has also requested MOHUP to prepare a separate krooki for the site identified above for the Marsa solar project.

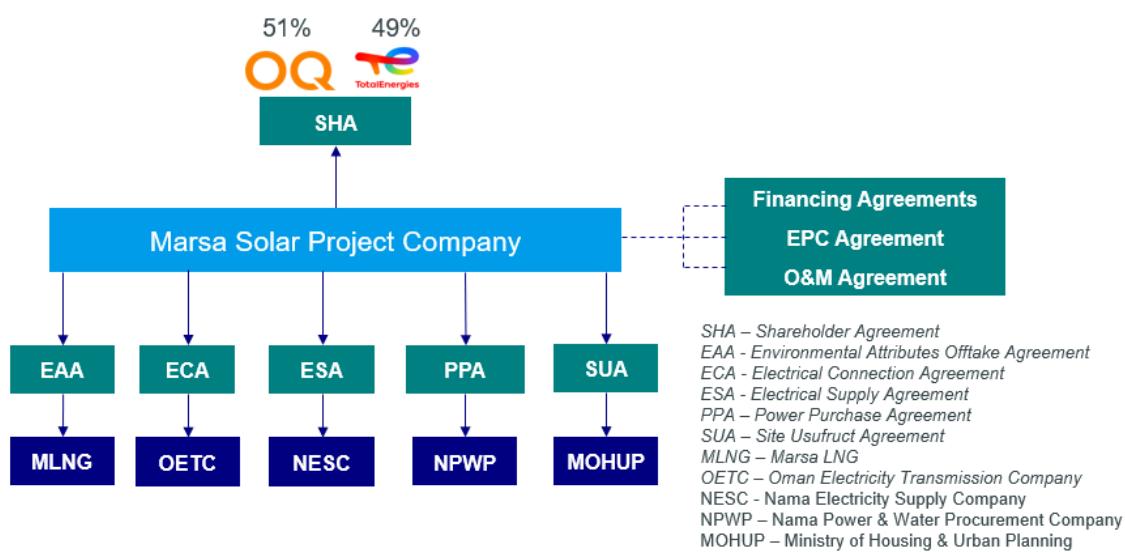
On the environmental front, Marsa team is working on ESIA and other site studies. Afterwards, the request for EA NOC and permit will be submitted. From initial investigations, there seem to be no major risks that may prevent permits from issuance.

Grid Connection

With regards to grid connection, since the relocation of the site, the team has been coordinating with OETC to identify connection points and mechanisms near the site. A few meetings have been conducted with OETC at both working level and management level to highlight the criticality of the timeline. The connection application has been submitted and is currently waiting for OETC's review and response. The preliminary timeline proposed by OETC is to deliver the connection by Q1 2029 which is not workable for the objectives of Marsa solar to deliver solar power by the COD of Marsa LNG which is Jan 2028 and its target to be carbon neutral and one of the lowest carbon intensive LNG plants worldwide.

Legal Structure

A project company will be created between OQ Alternative Energy and TotalEnergies which will go into the relevant agreements concerning the project. This is illustrated in the figure below.



6. Conclusion and Recommendations

This report provided an overview of the project and its technical feasibility. In conclusion, the project has been assessed from various technical aspects and there don't seem to be any major obstacles. The site shows good characteristics for the development of a solar plant and is currently conducting the necessary site studies to highlight any issues.

There is an available grid nearby that provides a suitable injection point. However, there is a risk concerning the timeline of delivering the connection by OETC which needs to be mitigated. The site resource has been assessed, and initial plant design has been proposed to deliver the required solar energy as per the LNG requirements. The regulatory framework has been thoroughly discussed between the relevant parties and the government represented by MEM and APSR and communicated to the offtaker (Nama PWP).

As for the next steps, Marsa team will continue working on the project development processes (site studies, EPC procurement, financing etc). More importantly, the team will need to work with Nama PWP on the power offtake aspect in order to allow achieving project documents execution in a timely manner to target achieve the COD by January 2028. Below is a preliminary timeline for that process:

Activity	TTE/OQAE proposal
1. PWP to procure authorization (if any required)	Q1 2025
2. OQAE/TTE perform development of the project incl. all site studies (Hydro/Topo/Geo/ESIA)	Q2 – Q3 2025
3. Parties to discuss and agree PPA terms and conditions	Q2 2025
4. PWP to provide invitation to bid & OQAE/TTE to submit offer (similar to PWP tender structure)	Q2 2025
5. Award by PWP to OQAE/TTE	Q4 2025
6. Execution of Project Documents	Q1 2026
7. Mobilization Milestone	Q2 2026
8. Construction Milestone / Financial Close / Notice to Proceed (NTP)	Q3 2026
9. First availability to connect to OETC substation (awaiting OETC offer/schedule)	Q2 2027
10. Initial Commercial Operation Date (ICOD) – (subject to OETC schedule/PWP approval)	Q3 2027
11. Scheduled Commercial Operation Date (SCOD)	January 2028
12. Last Commercial Operation Date	SCOD + 200 Days