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San Giorgio Group Case Study: Ouarzazate I CSP

Climate Policy Initiative

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August 2012

CPI Report

Descriptors

Sector	Multilateral Climate Finance
Region	Global
Keywords	Climate finance, concentrated solar power, Morocco, Clean Technology Fund
Related CPI reports	The San Giorgio Group Inaugural Meeting: Expanding Green, Low-Emissions Finance
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About CPI

Climate Policy Initiative (CPI) is a policy effectiveness analysis and advisory organization whose mission is to assess, diagnose, and support the efforts of key governments around the world to achieve low-carbon growth.

CPI is headquartered in San Francisco and has offices around the world, which are affiliated with distinguished research institutions. Offices include: CPI Beijing, affiliated with the School of Public Policy and Management at Tsinghua University; CPI Berlin, affiliated with the Department for Energy, Transportation, and the Environment at DIW Berlin; CPI Rio, affiliated with Pontifical Catholic University of Rio (PUC-Rio); and CPI Venice, affiliated with Fondazione Eni Enrico Mattei (FEEM). CPI is an independent, not-for-profit organization that receives long-term funding from George Soros.

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Acknowledgements

The authors thank the following organizations and professionals for their collaboration and input: Mafalda Duarte and Bertrand Belben of the African Development Bank, Paolo Martini of Archimede Solar Energy, Robert Lorentz of the European Commission Directorate General for Energy, Wolf Muth and Christoph Twerenbold of KfW, Mustapha Bakkoury, Saimi Nabil and Dayae Oudghiri of MASEN, Smita Nakhooda of ODI, Jan Corfee-Morlot of the OECD, and Jane Ebinger and Silvia Pariente-David of the World Bank Group.

Finally the authors would like to acknowledge inputs, comments and internal review from CPI staff: Ruby Barcklay, Tom Heller, David Nelson, Morgan Hervé-Mignucci, Kate O'Reilly-Jones, Elysha Rom-Povolo, Uday Varadarajan and Tim Varga. In particular, we'd like to thank Brendan Pierpont for his help on the financial modeling, Jane Wilkinson and Barbara K. Buchner for continuous advice and guidance.

Disclaimer

This report is based on publicly available information and interviews with selected key stakeholders. Detailed information on the financing and contracting of the project was not available at the time of writing due to the ongoing bidding procedure.

San Giorgio Group Case Study Overview

This paper is one of a series – prepared by Climate Policy Initiative for the San Giorgio Group – examining the use of public money to catalyze and incentivize private investment into low carbon technologies and drawing lessons for scaling up green, low-emissions funding. The San Giorgio Group case studies seek to provide real-world examples of what works and what does not in using public money to spur low-carbon growth. Through these case studies CPI describes and analyzes the types of mechanisms employed by the public sector to deal with the risks and barriers that impede investment, establish supporting policy and institutional development, and address capacity constraints.

Executive summary

Concentrated Solar Power (CSP) technology has enormous unexploited potential[1] as a reliable source of renewable energy. This is especially true in the Middle East and North Africa (MENA) region, which has abundant solar resources and good proximity to EU energy demand.

However, despite its long history of projects and trials, CSP remains in its early stages of development and is still not commercially viable. The resulting competitiveness gap between CSP and less expensive carbon-intensive energy alternatives is particularly evident in markets - such as those in MENA - where heavy fossil-fuel subsidies distort energy prices. At the same time, policies that would incentivize renewable energy sources are not in place.

This case study analyzes how the Government of Morocco, a group of development banks, and private-sector developers came together to develop the first phase of a 500 MW Concentrated Solar Power facility: the 160MW Ouarzazate I CSP plant. The plant is in the final stage of the tendering process and is scheduled to move into the construction phase before the end of 2012.

Challenges facing CSP development

Ouarzazate I's stakeholders understand that the project only makes economic sense as the first in a series of CSP installations leading to a large-scale portfolio[2] of CSP plants in Morocco and the MENA region.

Building a CSP portfolio represents a 'chicken or the egg' dilemma: in order to scale up, CSP projects need to become increasingly commercially viable — through economies of scale or through exports to Europe — to attract investment over and above finite public resources. But achieving commercial viability first requires the development of early projects which need higher levels of investment not just for capital costs, but also for capacity building and associated grid infrastructures (such as transmission lines and interconnectors).

The challenges facing the development of a CSP portfolio are financial, technical, and political. They include: attracting enough public and private financing; successfully deploying early-stage technology; building local manufacturing facilities; bringing technology costs down; brokering agreements for exports to the E.U.; and addressing competitiveness issues when subsidies for dirtier technologies create an uneven playing field.

By addressing these issues, the first publicly-supported large-scale CSP projects, such as Ouarzazate I, play a crucial role in bridging the development of a more commercially-sustainable regional CSP market.

Specifically, the Ouarzazate I project had two overarching objectives:

1. To install CSP at a scale that sufficiently tests and demonstrates the storage technology component, triggers important cost reductions, and fosters associated economic benefits, such as local manufacturing industries, improved energy security, and a shift away from fossil fuels; and
2. To test a business model that could attract and increase private-sector backing and enhance the availability of capital and 'know-how' to support the development of a CSP portfolio.

The project is still in an early stage, hence this report cannot assess whether Ouarzazate I has been successful in meeting the first objective. However, our examination reveals that, so far, Ouarzazate I has succeeded in attracting sufficient financing in its startup phase, through a public-private partnership model. This model can efficiently allocate risks among key stakeholders in the project and may be useful in the development of an expanded CSP portfolio.

Key stakeholders in the Ouarzazate I project include:

- The Government of Morocco and the Moroccan Agency for Solar Energy (MASEN) which are expected to contribute approximately USD 883 million over the life of the plant,[3] mostly in the form of operational subsidies. Their objectives are to support local economic development by creating expertise in the solar power sector and to improve the country's energy balance by shifting from expensive fossil-fuel imports.
- International Finance Institution (IFI) donors which have committed in excess of USD 1 billion for the construction of the facility in order to complete the first key phase of a CSP portfolio designed for the MENA region.

1 The International Energy Agency (IEA) estimates that CSP could provide up to 11.3 percent of global electricity by 2050 (IEA 2010).

2 Portfolio here means a series of projects sharing a similar technology and linked by a common framework (e.g.: the Morocco Solar Plan, the Mediterranean Solar Plan, the CTF CSP Investment Plan).

3 Including changes in subsidy costs and tax revenues compared to the counterfactual.

- A consortium of private developers which will contribute USD 190 million of equity capital and expertise for an estimated 14 percent after-tax rate of return.

The following table summarizes how Ouarzazate I addressed the specific concerns of each of these stakeholders.

Who	Issue	Ouarzazate I Responses and Effects
Government of Morocco	CSP technology is expensive.	Concessional finance lowered the cost for project developers and the Government of Morocco.
	Public resources are limited.	Building Ouarzazate I is part of a greater strategic plan to replace public financial resources for CSP with E.U. export revenues. The public-private partnership model has tapped private-sector capital, technical expertise, and managerial efficiency.
	Infrastructure investments are institutionally complex and involve high transaction costs.	MASEN has successfully coordinated private and public stakeholder involvement, with support from multilateral development banks. MASEN had to work closely with all concessional lenders to coordinate their loan requirements in order to reduce transaction and compliance costs. Loan syndication could further improve efficiency of this process.
International Donors/ Agencies	Size of the investment required in Ouarzazate I exceeds the available resources of a single institution.	Seven lenders were brought on board to provide concessional financing.
	CSP technology is still far from commercial viability.	Ouarzazate I is the initial phase of a regional investment plan to drive costs down and develop capabilities for CSP through deployment and learning.
Consortium of Private Developers	High capital costs, compared to alternative power sources, make the project financially unattractive.	Support from the Government of Morocco and IFIs make the project viable.
	Ouarzazate I's economics are overly dependent on support from the Government of Morocco.	IFIs' participation provides investor security in the event that the Moroccan Government faces budget difficulties.

Key elements in the design and development of the project

This case study identifies five building blocks that were essential to get the Ouarzazate I project off the ground.

1. **Strong public support and the close alignment of key public partners:** The Government of Morocco established a favorable regulatory and renewable policy framework to encourage private-sector engagement. In particular, it established a specialized entity tasked with realizing CSP projects (MASEN) and financially supports this entity's work to implement the ambitious Moroccan Solar Plan. For the Ouarzazate I project, the government earmarked funds (of an estimated USD 60 million per year) to cover the expected difference between the prices at which MASEN will purchase power from the generator and sell it onto the grid. A comprehensive reform of the fossil-fuel subsidization system is also underway but it's too early to comment on its effects.

2. **Significant financial and technical contributions from IFIs:** CSP technology is still far from commercial viability and together with the very high capital costs this meant the project was not viable without high levels of international support. International donors and lenders provided around USD 1 billion of early concessional financing, driving down

levelized costs by an estimated 25-30 percent.[4] In addition, IFIs provided necessary institutional and specialized technical support. Their engagement helped to further mitigate private investors' perceived risks.

3. **Strong engagement and coordination of donors:** Early coordination and agreements with donors allowed MASEN to clearly indicate the terms and costs at which capital would be offered. This transparency appears to have supported competition among private investors, resulting in required rate of returns that are in line with other, less risky renewable energy projects in the country. It also appears to have supported bids in line with or below projected levels. However, donor coordination and alignment of conditions, safeguards, and reporting rules was time-consuming and challenging.
4. **A carefully designed public-private partnership model:** The public-private partnership model allows the optimal alignment of risk between public and private players. For example, in Ouarzazate I, the private developer bears construction and operational risk while the Government of Morocco bears electricity market risk (revenue risk). MASEN's role in the public-private partnership is innovative: It acts as both equity investor and power purchaser (off-taker) and thus has the ability to align public and private objectives. Ouarzazate's development and operation will show whether this alignment will be realized.
5. **A project design built on past lessons learned:** Ouarzazate I benefited from exchanges with other large-scale CSP projects that are in development in India and South Africa, as well as experience gained from a CSP project supported by the Global Environment Facility. Learning from the design and implementation of other CSP projects helps reduce project costs and increase efficiencies. This in turn will support Morocco and the MENA region to develop a CSP portfolio.

Scaling up the CSP portfolio in Morocco and the MENA region

These five building blocks provide useful experience for future projects but the Ouarzazate I model will only go so far in establishing a large-scale portfolio of CSP projects in Morocco and the MENA region. To reach the scale desired by the Moroccan and Mediterranean Plans, the CSP portfolio will require a significant amount of additional capital. Given the scarcity of public and international funds, more commercially-oriented financing models will be necessary. These commercially-oriented financing models will most likely require:

1. **Reduced technology/project costs** through economies of scale; and
2. **Higher market revenues**, such as E.U. export revenues.

By 2020, economies of scale are expected to reduce technology costs, but not to the level required to reach grid parity in Morocco and the MENA region. Were the Government of Morocco to succeed in phasing out fossil-fuel subsidies, this would further reduce—though not eliminate—the competitiveness gap between CSP and high-carbon alternatives.

It is rather feasible that renewable power exports to European markets could fill the remaining gap in the medium- to long-term. However, considerable political support will be crucial to secure E.U. Member States' demand and to broker specific agreements that make the exports a reality. Interestingly, the possibility of exporting power presents a trade-off between financial viability on the one hand, and domestic energy and environmental effects on the other. While power exports significantly lighten the financial burden of Ouarzazate I on the Moroccan national budget, they also reduce the amount of fossil-fuel electricity displaced in the country, and therefore, the energy security and environmental benefits associated with CSP. Instead, Morocco would gain export revenues and economic development.

Scaling up a CSP portfolio in the MENA region and elsewhere in the world will be challenging, given the high costs of developing early projects and the necessary infrastructure to support them. The Ouarzazate case indicates that financing specific projects is possible with the close alignment of public, international, and private stakeholders, and careful design and coordination. Such an achievement, however, may not be enough to scale up a national or regional portfolio. This greater goal may be met only if projects are commercially viable, through a reduction in costs and access to higher market revenues, both of which will require considerable political support from national and international players.

4 Financial elaboration based on initial projections. The exact impact will be known only when the winning bid is selected and the amount of each concessional loan is confirmed.

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Introduction

In October 2011, Climate Policy Initiative (CPI) and the World Bank Group, in collaboration with China Light & Power (CLP) and the Organisation for Economic Co-operation and Development (OECD), launched the San Giorgio Group, a new working group of key financial intermediaries and institutions actively engaged in providing green, low-emissions finance.[5]

The San Giorgio Group recognizes that a major barrier to scaling up climate investment flows is the limited availability and understanding of empirical evidence or 'on-the-ground' examples of financial practices, environmental policies, and political signals that drive green investment. The goal of the San Giorgio Group is to fill this gap by drawing on the experience of its members to track and analyze the life cycle of existing projects, programs, and portfolios, and assess results and mechanisms that affect financial and environmental performance of these investments. Through this, we aim to distill lessons about evolving financing practices, provide insights on how to scale up climate finance, and spend resources more wisely.

Our analysis is framed by four overarching questions:

- What is the role of public finance?
- How can public money be best delivered (instruments and institutional channels)?
- How do we ensure the alignment of international and national public investment flows with private investment flows?
- How can we ensure effective investment and continued learning?

The San Giorgio Group case studies share a systematic analytical framework. They explore in depth the role of project stakeholders, the sources of return for the various stakeholders, the risks involved and arrangements to deal with them, and case-specific developments and lessons in replicating and scaling up best practices.

We explore the questions above through the Ouarzazate I Concentrated Solar Power (CSP) project in Morocco. This project is an example of how a public-private partnership (PPP) model can support risk sharing between the public and private sectors, given that CSP is an expensive early development stage technology and the ambitions to develop a much larger portfolio of CSP in Morocco and the region.

Section 2 introduces Ouarzazate I and its key stakeholders, providing an overview of the context in which the project has developed. Section 3 examines the project economics, looking at the costs and benefits of the project as a whole and from each key stakeholder's perspective. In Section 4, we review the risks involved in the project and explore the tools and design aspects that have mitigated or transferred those risks. Section 5 focuses on the public-private partnership model employed by the project, looking at how risks have been shared between the key parties involved in the project that include the Government of Morocco, international donors, and a private-sector consortium. Section 5 also considers the role of international donors and describes the process involved in engaging those international donors in the project. Section 6 draws out key lessons from Ouarzazate I that could be applied to similar large-scale CSP projects in the region and considers whether Ouarzazate is replicable and scalable.

5 For additional information see CPI website, http://climatepolicyinitiative.org/event/inaugural-meeting-of-the-san-giorgio-group/.

- Ouarzazate I is the first step in an ambitious plan to create a portfolio of CSP investments in Morocco and the MENA region.
- An attractive mix of policy incentives and international concessional finance under a public-private partnership model has been designed to attract private investors/developers.

An overview of Ouarzazate I

Project background

To meet fast growing demand for electricity, Morocco needs to double its power generation capacity by 2020. This substantial challenge is compounded by Morocco's high reliance on energy imports that currently account for 97 percent of total supply. To address the twin challenges of improving energy security and promoting sustainable development, the Government of Morocco announced a new energy strategy in 2010[6] and established the Moroccan Agency for Solar Energy (MASEN). The strategy established a set of overarching goals to:

- reduce reliance on oil to 40 percent of energy consumption by 2030;
- increase energy efficiency, inducing energy savings of 15 percent by 2020 and 25 percent by 2030; and
- increase renewable power generating capacity to 42 percent of installed power generating capacity by 2020, through the commissioning of an additional 6000 MW of wind, solar and hydro.

Also in 2009, the Government of Morocco launched the Morocco Solar Plan and set a goal to install 2000 MW of solar power capacity by 2020 through five concentrated solar power projects. The government committed to finance the cost of the Plan and set up MASEN to develop the projects, starting with the first phase of the Ouarzazate 500 MW concentrated solar power (CSP) plant, Ouarzazate I, in Morocco.

Unlike many other developing countries, private producers already generate more than 50 percent of the country's total electricity needs (CDER, 2009).[7] Building on this, the government aims to make private production the cornerstone of its two ambitious renewable energy installation programs: (1) the 1000 MW Integrated Wind Energy Program; and (2) the 2000 MW Morocco Solar Plan. Both investment programs will be developed using a public-private partnership model to gradually attract private capital into the country's fledgling renewable energy market. If successful, Ouarzazate could become a business model for future CSP projects, both in Morocco and the Mediterranean region.

CSP technology is a potentially reliable source of renewable power in regions with high 'Direct Normal Radiance' (DNI), or solar incidence, particularly if storage can extend supply to cover peak evening demand periods. CSP components are not intrinsically expensive and as experience builds, costs are expected to fall (WB, 2011a). However CSP is still at the commercial-demonstration stage—the basic technology is proven but critical energy-storage components require further demonstration.[8] As a result, CSP costs remain high and uncertain compared to other forms of power generation and producers and investors are not yet ready to develop projects without substantial public support.

Currently, several Middle East and North African (MENA) countries,[9] South Africa, Australia,[10] China[11] and India are all developing CSP projects, in many cases with the support of International Financial Intermediaries (IFIs) (Kulichenko and Wirth, 2011). However, to date, Spain and the United States have the most significant experience with CSP.[12]

6 The government of Morocco promulgated both the 13-09 Renewable Energy Law and the 57-09 MASEN Law in March 2010 (see Figure 1 for more details).

7 Three contracts of concessions with guarantee of purchase signed directly by each independent producer (IPP) with ONE have been in operation for several years: Jorf Lasfar Energy Company (Coal), Compagnie Wind of the Strait (Wind) and Electric Power of Tahaddart (Natural Gas) (ENPI, 2011).

8 Abengoa of Spain is currently developing a large-scale 280 MW CSP plant in Arizona that will feature a six-hours molten salt storage component—the plant will begin operation in 2013 (Abengoa, 2012). In the case of Ouarzazate I, there is a high risk associated with the freezing of molten salt which will be used as the heat transfer and storage fluid (WB, 2011a).

9 Including three combined gas-solar thermal plants with 20MW of solar power: Ain Beni Mathar in Morocco supported by a USD 43 million Global Environment Facility (GEF) grant; Hassi-R'mel in Algeria financed by the Government of Algeria; Al Kuraymat in Egypt, with support from GEF and the Japan International Cooperation Agency (JICA).

10 Australian Solar Flagships Program.

11 In January 2011, Chinese authorities selected a developer to build a 50 MW CSP plant in Inner Mongolia.

12 Kulichenko and Wirth (2011) estimate that 1000 MWe of parabolic trough

Ouarzazate I is concentrated solar power project financed by the Clean Technology Fund, International Finance Institutions, and the Government of Morocco. The project will be developed through a public-private partnership by a Special Purpose Vehicle—a consortium of private developers and the Moroccan Agency for Solar Energy (MASEN). The project is made possible through a substantial subsidy from the Government of Morocco, in the form of a power purchase agreement covering the expected 25-year lifetime of the project. The plant will have a capacity of between 125 and 160 MW and will use the most mature CSP technology currently available—parabolic trough—with three hours of molten salt thermal energy storage capacity. Construction of the plant is expected to start before the end of 2012.

Morocco and the MENA region have high CSP potential. With high solar incidence and proximity to E.U. markets, ambitious plans to export energy to E.U. markets are already in development. Country-led and/or regional plans in place or under development include: the E.U. funded Mediterranean Solar Plan to install 20GW of capacity on the south shore of the Mediterranean; the Desertec Industrial Initiative (DII) which aims to create a market for renewable power from the MENA region; Medgrid which aims to develop interconnections to deliver up to 5GW of Saharan solar energy to Europe by 2020; and the World Bank Arab World Initiative which aims for greater regional cooperation between Arab countries. Complementing these, the Clean Technology Fund's (CTF)[13] "Investment Plan for Concentrated Solar Power for the MENA Region" led by the World Bank and the African Development Bank has catalytic potential with plans to install 1.2 GW across Algeria, Egypt, Jordan, Morocco and Tunisia.[14]

CSP was operational in 2012. They report much lower installed capacities of other CSP technologies (10 MWe or lower of each of the other main CSP technologies including Fresnel Trough, Molten Salt Solar Tower, Water Steam Solar Team and Parabolic Dish). Of the parabolic trough projects, the United States appears to be hosting the greatest installed capacity (354 MWe in the famous SEGS plant in the Mohave Desert and 324 MWe in recently built plants), followed by Spain (550 MWe across three sites, mostly already commissioned), and the UAE (100 MWe on one site). One further project in the pipeline in the United States would however add a further 1000 MWe.

13 The Clean Technology Fund (CTF) is one of two multi-donor Trust Funds within the Climate Investment Funds (CIFs). It promotes scaled-up financing for demonstration, deployment and transfer of low-carbon technologies with significant potential for long-term greenhouse-gas emissions savings. Funds are channelled through the African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, and World Bank Group. The CTF finances 12 country programs (called Investment Plans) and one regional program (the MENA CSP Investment Plan). The World Bank is the Trustee and Administrating Unit of the CTF Trust Fund (ODI/Heinrich Böll Foundation, 2012).

14 The Investment Plan represents approximately 15 percent of the projected global pipeline of CSP projects and, if realized, would almost double the current global installed capacity of CSP.

The long-term vision of these initiatives is to promote the development of an economically sound CSP market that could foster associated social benefits. The steps along the way constitute a critical series of building blocks. To lay the foundations of such a market, the Government of Morocco and a selection of IFIs have committed substantial concessional finance to develop early CSP projects such as Ouarzazate I. However, a functioning market may still be some years away. Moving from a fragmented approach toward a portfolio approach would speed up achievement of this vision in the region.

Along with other large-scale CSP projects **the primary higher-level objective of the institutions backing Ouarzazate I is to install CSP at a scale that sufficiently tests and demonstrates the storage technology component, and triggers important CSP cost reductions.** Other factors will also help reduce costs including building up experience with the public-private partnership model, achieving economies of scale, and improving technology (WB, 2011a).

Other higher-level objectives include promoting green growth and local economic development by building up Morocco's renewable energy industry, improving Morocco's energy security, shifting subsidies and the Moroccan energy system away from fossil fuels and reducing Morocco's trade deficit. In addition to building CSP capacity, interconnections and development of a sizeable regional electricity market, with the possibility to export power to more lucrative E.U. markets, will be important to spur the development of a local industry at scale.

The Moroccan Government is an early mover and hopes to benefit from its contribution to the development of the CSP market in the region. To do so, it will be crucial to learn early lessons from projects being developed and to keep an eye on the long-term objectives of the portfolio.

Project details

A public-private partnership has been designed to manage and finance Ouarzazate I, drawing together private developers and/or investors and IFIs. The partnership incorporates Power Purchase Agreements (PPAs), and sets the terms for a large amount of concessional finance provided by the Government of Morocco and IFIs, some of which has been distributed via the Clean Technology Fund (CTF). This model allows the government to share costs and risks with international and private financiers and project developers. It also helps to drive overall costs down.

MASEN, the solar energy agency established by the Moroccan Government, plays a key role linking the project company and the governmental support for the project. It is currently offering private partners/consortia to take a 75 percent equity stake against its 25 percent equity stake in the Solar Power Company (SPC) special purpose vehicle, which will develop the project. The SPC/PPP partners are expected to take a total equity stake of approximately USD 253 million.[15] Under the first of two 25-year PPAs, MASEN will purchase power from the SPC at the cost of the power generated. Under the second PPA,[16] the Office National de l'Electricité of Morocco (ONE)[17] will buy all power from MASEN, at the grid price, and dispatch it from the plant.[18]

The Government of Morocco has agreed to finance the costs of the Moroccan Solar Plan through a convention which guarantees the financial stability of MASEN. A project specific convention specifies the support to be provided for Ouarzazate I to compensate MASEN for the price difference between the two PPAs. This represents the incremental cost of the CSP technology for the Moroccan market—and initial projections estimate this subsidy to reach around USD 60 million per year (WB, 2011a).

To date, IFIs have pledged over USD 1 billion in concessional loans to support construction costs and a further USD 200 million loan which provides the Government of Morocco with a safety net should it be unable to financially support the subsidy to MASEN.[19]

Importantly, without the Government of Morocco's agreement to fund the substantial viability gap and concessional financing terms provided by IFIs, the project would not be a viable investment prospect.

Project timeline

Figure 1 charts key project milestones and the roles of individual stakeholders. Commitments from IFIs to provide concessional finance[20] and agreements specifying support from the Government of Morocco to meet the viability gap and for the Office National de l'Electricité of Morocco (ONE) to purchase power were all laid out well in advance of the release of the request for proposals for a private development partner. Three full proposals from private-partner consortia are currently under consideration.

Project stakeholders

A broad group of international, national, government and non-government stakeholders are involved in Ouarzazate I. Based on publicly available sources of information, Figure 2 categorizes and maps the financial links between the stakeholders involved in the Ouarzazate I project. This case study identifies three main groups of stakeholders involved in the project: the Government of Morocco and governmental bodies (including MASEN and ONE), SPC equity providers/the private consortium, and IFIs providing grants and loans. Table 1 lists in detail the stakeholders that have contributed to the project, focusing on their financing role.

15 The SPC/public-private partnership is estimated to earmark USD 253 million as equity for construction and (MASEN only) USD 126 million to build associated facilities (WB, 2011a).

16 In the rest of the document, this second PPA is referred as Power Sale Agreement (PSA).

17 Following the merger with the Office National de l'Eau Potable (ONEP) in April 2012 ONE has been renamed Office National de l'Eau et de l'Electricite (ONEE)..

18 Morocco has a relatively stable political and regulatory environment and the PPA model goes even further to lower risks for potential private investors (Norton Rose, 2010).

19 In addition, the German Ministry of Environment (BMU), has pledged a grant of USD 19 million and European Commission Neighbourhood Investment Facility (EC NIF) a grant of USD 37 million.

20 Announcement dates for commitments to the project by IFIs are not shown in the timeline due to lack of available data. Instead commitments are plotted according to official approval dates.

Figure 1: Ouarzazate I Concentrated Solar Power project timeline

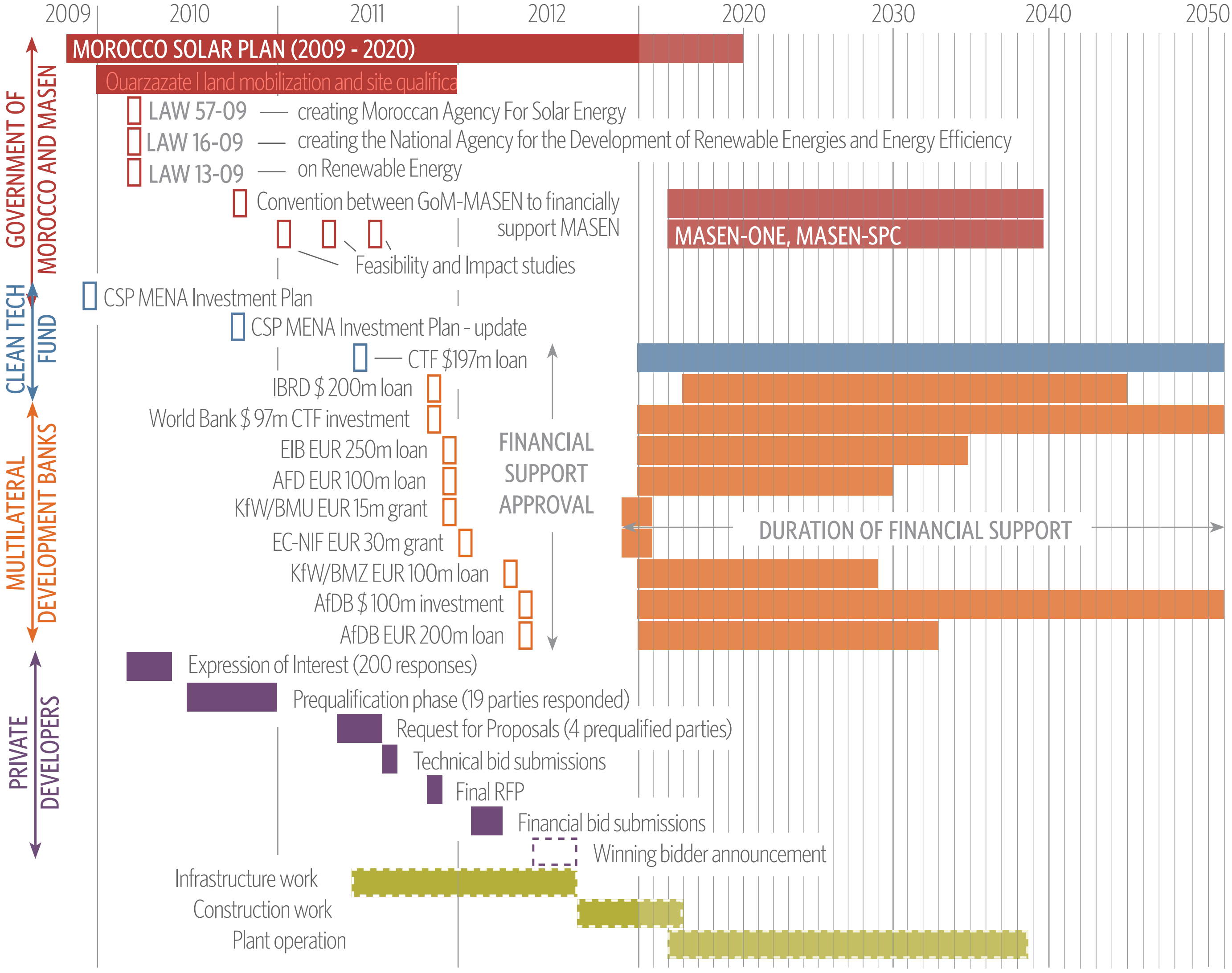
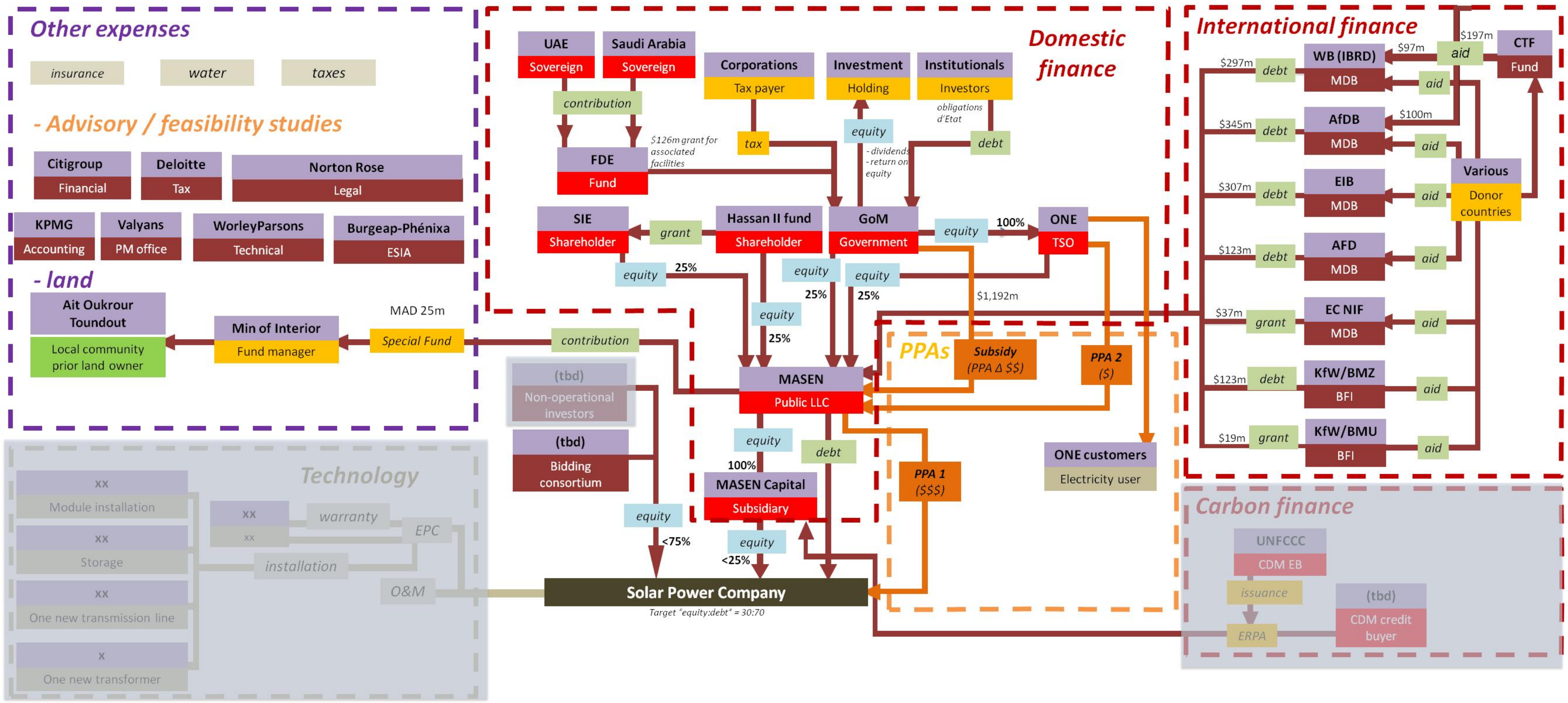


Table 1 Stakeholders description and role

	Stakeholder	Description and role	Financing role
Government of Morocco	Moroccan state	• Shareholder in MASEN	Subsidizes difference between two PPAs present in the project through the State Budget
Government of Morocco	Ministry of Interior	• Manages special community fund	N/A
Government of Morocco	MASEN	• Moroccan Agency for Solar Energy • Limited liability company (LLC) with the Moroccan State, ONE, Fonds Hassan II and the Société d'Investissements Energétique (SIE) as equal shareholders • Responsible for managing bidding process and selection of private consortium • Monitor SPC • Ownership of the CSP plant upon commissioning • Semi-annual financial reports, independent annual audit and progress reporting to donors (financial statements, physical progress and procurement) • Support R&D, training and technical innovation • Implementation of the FESMP[1]	• Finance and manage the Associated Facilities (for water supply, grid connections and land) • 25 percent equity stake in the SPC • Onward lends IFI debt and manages reporting to IFIs
Government of Morocco	ONEE	• Office National de l'Eau et de l'Electricité incorporating Office National de L'Electricité and Office National de l'Eau Potable • Construction of the transmission lines and water supply infrastructures • Power dispatch, transmission, and distribution • Environmental Management Plan for transmission lines and water supply • Shareholder in MASEN	Required to purchase all power generated by the plant from MASEN
Private	Private consortium	• Project implementation including design, construction and performance optimization of the plant • Preparation and implementation of project specific ESIA and ESMP,[2] financial reporting • Project Implementing Entity	75 percent equity stake in the SPC
International donors	AfDB	• African Development Bank	• Channel CTF financing • Provide additional concessional financing towards construction
International donors	WBG/IBRD	• World Bank Group and International Bank for Reconstruction and Development • Support to MASEN and Government of Morocco to initiate the project	• Channel CTF financing • Provide additional concessional financing to support Government's PPA subsidy
International donors	EIB	• European Investment Bank • Coordinates European donors	Concessional finance provider
International donors	AFD, KfW/ BMZ	• L'Agence Française de Développement, German Development Bank and German Development Cooperation	Co-lenders linked to EC NIF grant
International donors	BMU, EC NIF	• German Ministry of Environment, European Commission Neighbourhood Investment Facility	Grant providers

[1] The Framework Environmental and Social Management Plan (FESMP) includes institutional settings, general mitigation measures and a monitoring plan for the potential impacts expected from project activities during construction and operation stages (WB, 2011a).
[2] Environmental and Social Impact Assessment (ESIA) is to be carried out by the SPC and include a detailed Environmental and Social Management Plan (ESMP) (WB, 2011a).
Sources: various.

Figure 2: Ouarzazate I Stakeholder Mapping



© CPI, 2012

Notes:

(1) The exact amount of financing by all parties will be finalized during the project's evaluation phase.

Source: CPI compiled this information from various sources. Carbon finance and technology are blocked out at present due to lack of available information.

- The Government of Morocco provides a subsidy that will cover the difference between the price at which MASEN buys, and then sells power. This subsidy is essential for the project's viability. Without it, CSP technology is still too expensive for the local market as the price of power generated is substantially higher than local grid prices.
- The Solar Power Company's revenue stream is heavily subsidized by the Government of Morocco and by IFIs' concessional finance.
- The Government of Morocco and IFIs are betting on the project's contribution to the development of a CSP market in the region that will bring longer term and broader economic benefits.

Investment, return, and profitability of Ouarzazate I

This section addresses two main San Giorgio Group questions: *What are the public and private financial inputs and what are the main outcomes of Ouarzazate I?* To assess the return profile of the Ouarzazate I project, we first consider the total project costs broken down across equity and debt contributors and across project phases. Then, we estimate returns and profitability at the overall project level and those accruing to each project contributor. Finally, in order to assess if money has been invested wisely, we apply CPI's emerging Effectiveness Framework to identify causal relationships between inputs (for example policy incentives and financing) and relevant outcomes. To the extent possible, given available data, we attempt to quantify impacts that will derive from the investment.

We have performed all our analyses on the basis of initial projections and estimates of the project sponsors and concessional financiers. In the past few months, project developers have submitted bids but, at the time of writing (August 2012), a winning bid had yet to be announced and the exact content of individual bids remained uncertain. Hence, we have relied on initial financial metrics, projections and charts to inform our overarching analysis. For a limited number of metrics (i.e. capital expenses, levelized cost of energy [LCOE], governmental subsidies), we have calculated results implied by the estimates of the lowest bid.

Project costs and sources of return

Project costs

Expected project development and operational costs are presented in Figure 3 below.[21] Project development costs include around USD 3 million[22] for land and USD 126 million for associated facilities (water connections, transmission lines, and other infrastructure requirements such as access roads).[23]

Ouarzazate **capital expenses** (CAPEX) were originally estimated at between USD 960 million and USD 1,304 million.[24] However, the lowest bid received during the tender process indicates a much lower figure: between USD 700 and USD 800 million.[25] The component contributions to CAPEX were initially estimated at 62 percent for the solar system (field and heat transfer fluid), 21 percent for the power block, 13 percent for storage, and 4 percent for site preparation. The expected equity to debt ratio for the project is 20:80.

MASEN estimates that **operating expenses** (OPEX) will amount to approximately 11 percent of gross annual revenues, which we assume includes costs for lease of water, land, and road infrastructures and should amount to approximately USD 26/MWh.[26]

21 This case study's estimated value is based on the initial projections. As with most of the financial estimates, the final amounts will be known only once the winning bid is selected.

22 Land was purchased by MASEN via ONE from the community and will subsequently be leased to the SPC.

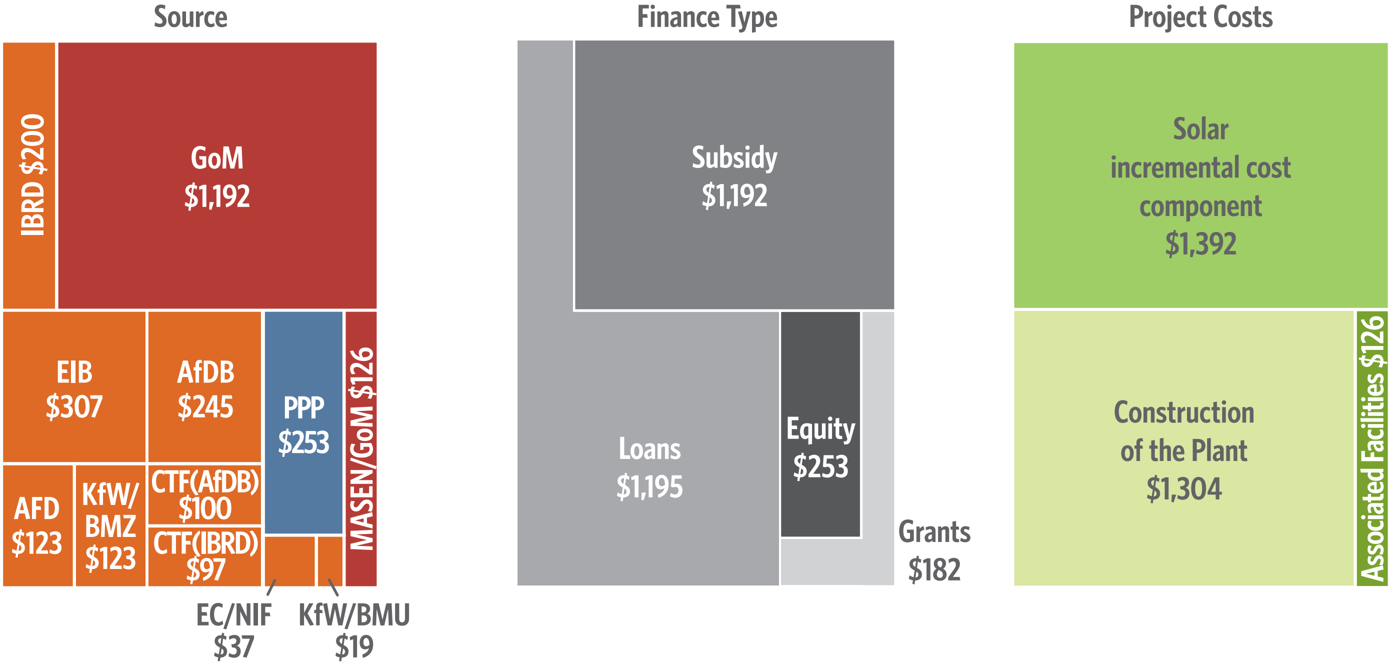
23 Funded by the Government of Morocco via MASEN, then leased to the SPC.

24 Original estimated investment cost was USD 6000/kW (WB, 2011a, p.95), resulting in USD 960 million for 160 MW installed. Sum of contributions for construction components, as reported in various sources, is USD 1,304 million, building in some room for contingency.

25 In April 2012, Project Finance Magazine reported: "The Acwapower/Aries/TSK consortium submitted a bid of USD 0.189711/kWh – around 30 percent below the other two bidders. The Enel Green Power/ACS Cobra consortium bid USD 0.244235/kWh and Abengoa/Taqa/Mitsui bid USD 0.244271/kWh, while the Solar Millenium/Orascom consortium did not bid" (Project Finance, 2012). Inserting the lowest bid in our financial model provides an estimated investment cost between 3,500 and 4,000 USD/kW(almost 40 percent lower than projected), a new LCOE of USD 194/MWh, and a governmental subsidy required of USD 40 million per year. Our estimate of the subsidy required is based on strong assumptions regarding likely wholesale electricity prices in Morocco (see footnote 30 for further information).

26 Based on initial projections (WB, 2011a). .

Figure 3: Attribution of project costs by source, financing type, and cost component (amounts in millions of USD)



Notes: Total burden on the Government of Morocco does not include fuel subsidies saved and tax revenues (netted figure estimated around USD883 million). Commitments in original currency (where not USD) are: EIB €250 million, AfDB €200 million, AFD €100 million, BMU €15 million, EC-NIF €30 million. Sources: World Bank (2011a), CIF (2011a), and AfDB (2012b).

At the time of writing (August 2012), **financing costs** for the SPC were unknown; they will be determined by the extent to which MASEN passes on the terms of IFI concessional loans. Based on lenders' indications, our financial modeling estimates a blended interest rate for the overall IFI concessional financing of approximately 3.1 percent.[27] Figure 4, below, compares this to a commercial interest rate of 9 percent (Kulichenko and Wirth, 2011) and highlights the impact of this cheaper debt provided by IFIs on the project cash flow stream (the aqua-colored area).

Expected generation and levelized cost of energy (LCOE)[28] calculations

Ouarzazate I is expected to produce an average 370 GWh of power per year for 25 years, following three years of construction. We estimate levelized cost of energy (LCOE) using the initial projections for capital expenses, the estimated value of the PPA and Power Sales Agreement (PSA), together with assumptions about the timing of cash flows and a blended rate of 3.1 percent for financing. Based on these factors, the LCOE is calculated at approximately USD 245/MWh.[29] Capital expenses account for 90 percent of costs, and operating expenses for 10 percent.

International donors and concessional lenders clearly have a substantial impact on the project's LCOE by providing up-front lower-cost financing. For example, if we replaced all concessional financing with commercial capital at a blended rate of 9 percent (Kulichenko and Wirth, 2011) the resulting LCOE would be approximately 30 percent higher, or USD 320/MWh.

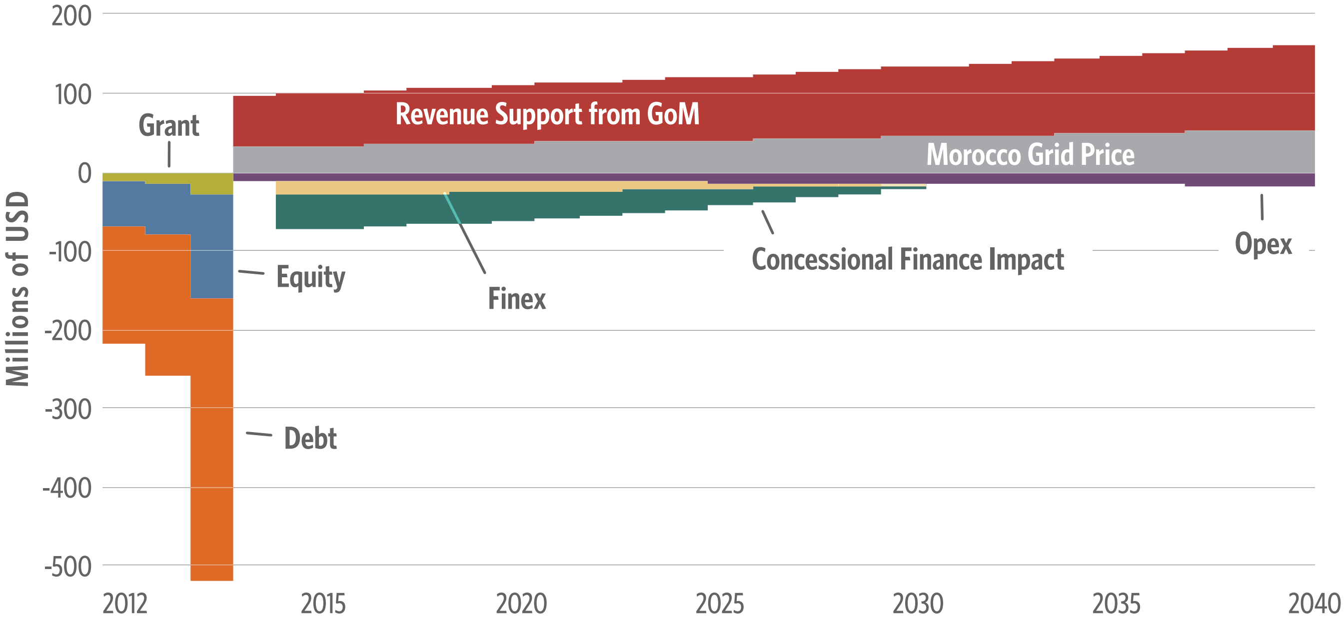
Given national grid prices of approximately USD 81/MWh, without concessional financing and continuous revenue support from MASEN, it would be impossible

27 This case study assumes that all concessional financing from IFIs is passed on directly from MASEN to the SPC. At the time of writing, the pre-announced terms were as follows (AfDB, 2012b): Clean Technology Fund's 'softer' concessional: 0.25 percent service charge and an embedded grant element of 75 percent; AFD: 4 percent interest rate, 17 years maturity with 4 years grace; AfDB: 4 percent interest rate, 20 years maturity with 5 years grace; EIB: 4 percent interest rate, 23 years maturity with 3 years grace; KfW: 2.5 percent interest rate, 15 years maturity with 3 years grace.

28 By a levelized cost, it is meant the (present value of) total project costs for each kWh of energy generated by the CSP. This provides a single, aggregated measure of costs associated with energy production that can be compared across technologies (Varadarajan et al., 2011). The LCOE method calculates the levelized cost of energy to the final user by actualizing all cash flows related to a specific energy source. Consistent with previous CPI reports, the calculation has been based on the expected after-tax internal rate of return of the project, based on anticipated cost and revenue estimates.

29 This LCOE estimation appears consistent with the our estimation for PPA price indicated by the project financiers (WB, 2011a), as well as estimates from the European Investment Bank (EIB) for CSP technology in MENA (EIB, 2010) and the projections from European Solar Thermal Electricity Association, Estela (ATKearney, 2010).

Figure 4: Project Cash Flows



Source: CPI Elaborations

for CSP to compete with lower-cost alternatives. Even if high government fossil-fuel subsidies were removed and national grid prices rose to USD 113/MWh, the cost differentials would still be difficult to overcome. (Please see Box 1 for a more detailed discussion of fossil-fuel subsidies.)

Project sources of return

The SPC's main source of return will be from electricity sales to MASEN via the PPA. We estimate the price for this at approximately USD 244/MWh. While the terms and the projections of the PPA between the SPC and MASEN are confidential, we estimate its value by adding MASEN's projection of the government subsidy (USD 60 million per year for the duration of the project) to our estimate of the PSA between MASEN and ONE. This case study assumes that the PSA will be linked to the Moroccan market's prevailing power price and, in practice, will be driven by coal generation prices. It has not been disclosed whether the PSA price will be fixed for 25 years or if it will be indexed to the grid price over time. Taking current industrial electricity tariffs in the country as a benchmark, we estimate the PSA will be set at a price of $81/MWh. This assumes that ONE does not place any margin on power purchased from MASEN before selling it.[30]

Overall Project Return

Assuming 25 years of operation, a degradation factor[31] of 0.5 percent per year, an annual escalation factor for both operation expenditures and PPA of 2.6 percent,[32] and a corporate tax rate of 30 percent, we estimate the pre-tax internal rate of return (IRR) at 9 percent and the after-tax, levered IRR for the SPC at 13.6 percent (taking into consideration the 80:20 leverage factor at project level). This figure compares closely with reported IRR benchmarks for renewable energy generation under another concessional scheme for wind energy in Morocco (Attijari, 2010).[33]

The cash flow profile over the lifetime of the project, based on the assumed project costs and revenues, is illustrated in Figure 4. The lower half of the graph shows the high upfront capital costs of the project in the first three years, as financed by debt, equity and, to a lesser extent, grants. Other costs, spread over the duration of the project are also shown, including operating and financing costs. In terms of sources of project revenue (on the upper half), the figure shows the crucial

30 This assumption derives from considering that both ONE and MASEN are public entities owned by the state and that any margin charged by ONE onto electricity sold to MASEN would have to be compensated by the government itself via the convention with MASEN. Given limited availability of data on wholesale electricitytariffs in Morocco or on the likely rate of the PSA between ONE and MASEN, we assume a PSA of 81 USD/MWh, based on electricity tariff data published online by the Moroccan Investment Development Agency (MIDA, 2012).

31 The degradation factor is the annual power generation loss due to continuous aging and fatigue of the equipment.

32 Inflation rate forecast from IMF.

33 Attijari Finance Corp reported benchmarks vary according to the chosen business model, from the less risky generation under a concessional scheme with ONE (10-12 percent IRR), to the generation directly from ONE (11-12 percent), to self production (greater than 12 percent).

support provided by the Government of Morocco to make the project profitable by filling the viability gap between high-cost CSP power and the marginal costs of power production, and also shows the income flowing from ONE to MASEN for the sale of power to the grid. The figure also illustrates savings for the SPC as a result of the concessional financing terms - actual financing expenses (FINEX) - as compared to counterfactual commercial financing terms (aqua).

Table 2: Stakeholder benefits

		Gov't of Morocco	MASEN	SPC equity holders[1]	IFIs	General public
Financial returns / benefits	Income from Solar Generation (PPA)		√	√		
	Concessional public finance	√	√	√		√
	Viability gap[2] subsidy		√	√		
	Carbon market revenues	√	√			
	Avoided subsidy and import costs	√				√
	Taxes	√				
Non-financial returns / benefits	Greenhouse-gas savings	√			√	
	Technology-cost reduction	√	√	√	√	√
	Learning	√	√	√	√	
	Green growth	√	√		√	√
	Green jobs	√	√	√	√	√
	Energy security	√			√	√

[1] Private consortium plus MASEN.

[2] Viability gap is defined as the difference between the PPA price paid from MASEN to the SPC and the PSA price paid from ONE to MASEN multiplied by the annual power generated.

Returns to individual project contributors

The expansion of CSP technology in Morocco is geared toward meeting multiple objectives and delivering multiple benefits. Table 2 summarizes both direct and indirect (portfolio-related) returns to project contributors followed by a discussion of these returns.

Government of Morocco

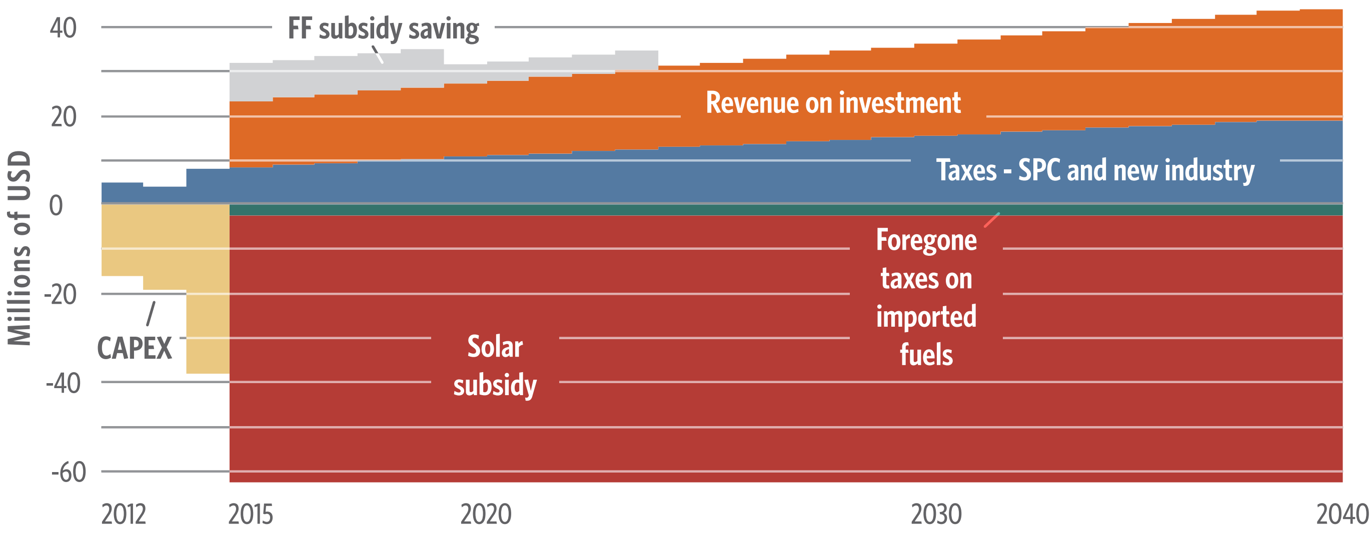
The Government of Morocco is investing heavily in the Ouarzazate I project through an annual subsidy (estimated at around USD 60 million per year), channeled through MASEN. The purpose of this ongoing subsidy is to fund the viability gap between the price MASEN pays to purchase power from the SPC, and the price at which it sells power to ONE. The Government of Morocco is betting that long-term economic benefits or higher-level objectives, that would be triggered with a move towards a CSP market in the region, will more than compensate for its early investment.

The Government of Morocco is also set to receive some revenue streams through its equity holding in MASEN, as well as tax revenues associated with the SPC, new industries and/or jobs. Figure 5 illustrates this balance of costs and benefits. The top half of the graph shows sources of revenue and budget savings for the Government of Morocco, including tax receipts, return on investment (as a stakeholder in MASEN) and savings derived from fossil-fuel subsidies displaced by Ouarzazate I. We assume that under a business-as-usual scenario, fossil fuel subsidies will be halved by 2020 and phased out entirely by 2025. The bottom half of Figure 5 shows costs incurred by the government, including through its contribution to the capital cost and the incremental-cost subsidy.

One of the Government of Morocco's primary higher-level objectives is to capitalize on its early mover advantage by becoming a hub for the CSP manufacturing and generation industry which could be a driver for long-term economic development. Evidence of the Government of Morocco's effort to embed longer-term goals in the project design includes MASEN's request for private developers to include local content valued at 30 percent of the plant capital costs in their bids.[34] Bidders are free to choose how to fulfil this request but MASEN suggests the following options: (1) indirect investment in a renewable energy manufacturing, operations and maintenance, engineering or R&D facility; (2) direct local procurement of goods and services; or (3) a combination or both.

34 WB, 2011a

Figure 5: Government of Morocco's Cash Flows



Source: CPI financial modeling (based on World Bank 2011a).

The CTF's impact indicators project that Ouarzazate I will have little if any discernible impact on local industry development, employment, and CSP cost reduction (WB, 2011a). However, combined with its second and third phases, Ouarzazate is expected to initiate local industrial development activities and to generate some local servicing and maintenance jobs. Moreover, Morocco's Solar Plan as a whole is expected to create significant local and national industrial benefits. A World Bank-commissioned study on the potential to manufacture CSP components locally in the MENA region[35] makes the following projections based on an assumed level of installed capacity of 2GW of CSP by 2020 and local content of about 30 percent in 2015, 50 percent in 2020 and 60 percent in 2025:

- creation of USD 4.6 billion of cumulated value add by 2020;
- creation of up to 11,000 full-time equivalent jobs in construction, manufacturing and operations and maintenance by 2020; and
- more than USD 3 billion of cumulated export revenues by 2020.

35 Gazzo et al. (2011)

The project will also help to shift subsidies, and the overall Moroccan energy system, away from fossil fuels. ONE's analysis estimates the government will save approximately USD 64 million in subsidies over the lifetime of the project.[36] In the first few years of the project, this corresponds to approximately USD 8.5 million/year saved, compared to the Government of Morocco's total annual fossil-fuel subsidies cost of between USD 1 and 4.3 billion (2009-2011). Most of the value of the fossil-fuel subsidy savings derives from Ouarzazate I's storage technology, which allows Ouarzazate I to displace (imported and expensive) oil-based generation used to fulfill peak demand.

The Government of Morocco will also benefit from expected **CO_2 savings** of around 240 kt per year (valued between USD 1.2 and 3 million per year).[37] The eco-

36 Amounts of fossil fuel displaced (in the baseline scenario) have been estimated by ONE and valued at the following prices and quantities: Coal: 32,000 tons at 150 USD/ton; Natural Gas: 354,000 mbtu at 10 USD/mbtu; Fuel Oil: 67,000 tons at 450 USD/ton. The estimate assumes that the Government of Morocco follows through on its subsidies phasing-out policy.

37 This assumes a displacement of the average electricity fuel mix (18 percent coal, 15 percent natural gas, and 67 percent fuel oil) although it is hoped that the use of storage technology will enable the plant to also displace peak

Box 1: Fossil-Fuel Subsidies in Morocco

Moroccan electricity generation largely relies on heavily subsidized, imported fossil fuels. Both fossil fuels and electricity are sold to the consumer below the cost of supply through a compensation system financed directly and indirectly (through the state utility) by the state. Over the past three years (2009-2011), the total burden of these subsidies on the government budget has ranged between USD 1 and 4.3 billion, or around

1-4.3 percent of the country's GDP.[1] Besides representing a heavy drain on public resources and incentivizing over-consumption of carbon-intensive energy, fuel subsidies also widen the competitiveness gap of renewable energies by lowering the average grid price by roughly 30 percent.[2]

The Government of Morocco is currently working to reform the existing subsidization system which is thought to favor wealthy citizens and failing to improve energy access for the poorest Moroccans.[3] The government has announced that fuel subsidies will be replaced gradually by targeted cash grants for families in need. Indeed, IFI appraisals of Ouarzazate I economics already factor in the halving of current subsidies by 2020 and a complete phase out by 2025. However, these changes have already sparked strikes and threats of social unrest (Achy, 2012), confirming that a direct reduction or complete removal of fossil-fuel subsidies remains a challenging political hurdle.

Increasing the deployment of renewable energy sources is a way to reduce demand for imported fossil fuels and, indirectly, the subsidies required to maintain them. However, at today's technology costs, CSP power is still too expensive for Morocco and requires high levels of public support that outweighs those savings. In the case of Ouarzazate I, the plant requires an estimated USD 60 million of direct subsidies to achieve viability, but only displaces USD 12 million of fossil subsidies per year.

Though certainly helpful, the removal of fossil-fuel subsidies alone would not be sufficient to make CSP power more competitive and sustainable. From this perspective, achieving the technology cost reductions targeted by the Morocco Solar Plan and by the CTF Investment Plan will be the cornerstone to making CSP power competitive.

1 WB, 2011a.

2 We have inferred an average level of subsidization of 30 percent from the overall value of fossil-fuel imports for 2010 (8.3 billion USD) and the cost of the fuel subsidies for the same year (2.5 billion USD).

3 In 2008, a study by Morocco's High Commissioner for Planning concluded that 20 percent of wealthy households receive three-quarters of the government-allocated support for diesel and gasoline while 40 percent of needy families receive only 5 percent (Achy, 2012).

nomic value of **environmental cobenefits** in terms of avoided local pollution (for SO_2, NOx, PM)[38] are estimated at USD 2.3 million over the life of the plant, and increase to USD 7.2 million for the complete Ouarzazate portfolio and USD 28.8 million for Morocco's Solar Plan as a whole.

Ouarzazate I's impact on Morocco's **energy security** is minimal due to its relatively small scale. In the long run, however, a larger portfolio of CSP in the country and development of a regional electricity market[39] could improve Morocco's energy security, reduce dependency on energy imports,[40] diversify energy sources towards renewable energy, and create new generating capacity to help meet high electricity demand growth.[41] Indeed, the CTF's impact indicators show that Ouarzazate I will reduce electricity imports only by a small amount (lifting renewable energy sources' share of power generating capacity to 2 percent), but that more significant reductions would follow realisation of the complete Ouarzazate portfolio (to 8 percent) and the Morocco Solar Plan (42 percent). Noting that increasing world oil prices have caused Morocco's trade deficit to balloon in recent years (by 21 percent in 2010-2011), decreasing energy imports will **enhance Morocco's balance of trade** and improve overall economic security. Improved energy security and import savings will, however, ultimately depend on the share of the CSP generated power that is kept for the local market and not exported into Europe.

load which is currently met by fuel oil.

38 Sulfur Dioxide (SO_2) valued at 5,220 USD/ton; Nitrogen Oxide (NOx) valued at: 5,165 USD/ton; (PM) valued at 20,823 USD/ton (ExternE).

39 Double 400-kV interconnections with Algeria and Spain already exist. The latter provides access to the Spanish and Portuguese markets and will provide access to the French market when the FR-ES interconnection is upgraded, which is expected to be completed in 2013.

40 Currently 97 percent of energy consumption (WB, 2011a).

41 An average 6 percent per year growth in domestic electricity demand necessitates 700-800 MW per year in new generating capacity (WB, 2011a).

MASEN

MASEN has multiple interests in the Ouarzazate I project and stands to receive multiple benefits.

As the project developer, MASEN will benefit from international concessional finance and the Government of Morocco subsidy. MASEN's cash flow profile is determined by the **guaranteed revenue stream** from the Power Sale Agreements with ONE (estimated at between USD 30 and 35 million a year) and the **fees** it receives from the Solar Power Company (SPC) under the lease to use MASEN-owned site infrastructure, 'associated facilities' (water, transmission lines, and road access), and the CSP infrastructure itself. On the negative side, MASEN is impacted by the costs of the PPA signed with the SPC (around USD 97-100 million a year) but this is compensated through a convention with the government to subsidize the costs of paying the Power Purchase Agreement with the SPC.

Other benefits may include profit on margins it generates through **repackaging concessional debt**, grants from IFIs, dividends as an equity holder of the project company, and sales of CO_2 emission rights under the **Clean Development Mechanism**.[42] The latter could amount to between USD 1.2 and 3 million per year (based on a USD5/t and USD13/t carbon price respectively).[43]

SPC equity providers

A consortium of private equity providers (including MASEN) stand to benefit from **a guaranteed revenue stream** through MASEN's PPA. This will cover SPC costs after concessional finance is factored in, plus an acceptable margin that we estimate at 13.63 percent on a levered basis. There could also be a return from patents that are generated as a result of this project. The cash flow profile of the SPC equity holders is integrated in Figure 4 and highlights both revenues and costs.

The private consortium will also **develop considerable experience** from their involvement in Ouarzazate. This will put them in a good position to invest in similar projects throughout the region.

Over time, some of the benefits will include those that stem from scalability. These include reduced technology costs, a ready workforce, and access to a wider electricity market along with other regional developers.

IFI grantors and lenders

IFI grantors and lenders provide funding to the project on the basis of its **contribution to the higher-level environmental and development objectives**. Lenders also aim to recoup the capital lent with **a minimal return on the investment**. (We estimate a blended concessional rate of 3.1 percent). As discussed, the standalone contribution of Ouarzazate I is insufficient to meet higher-level objectives. However, as the first stage of a new portfolio, it is almost inevitable that Ouarzazate I will bear some early-development costs (or "vintage costs") to which future projects will not therefore be subject. IFIs will most likely remain involved in the subsequent phases of Ouarzazate and will continue to pursue those same objectives.

General public

The general public stands to benefit from **local economic development opportunities** (jobs and training) that result from the project during construction and operation, improved energy security, and from the, eventual, technology-cost reductions that the Morocco Solar Plan will achieve. At the local level, the income (USD 3 million) from the sale of the land for the plant to ONE/MASEN is being used to fund the Ait Oukrour Toundout community's **local social development plan**. MASEN and other public stakeholders will also contribute to this fund on a voluntary basis.

Has Ouarzazate I been effective?

The San Giorgio Group aims to facilitate an overall assessment of whether money is being spent effectively. To do this, we map out the policy steps and financial inputs that support implementation activities, through outputs and eventually, to final outcomes, in order to clearly identify the causal links between policies, investments, and final impacts (see Table 3).

Based on this analysis, we identify the main factors that determined the performance of the individual intervention, and good practices which could be scaled up and replicated in other sectors, technologies, and geographies. We use a common set of appropriate criteria to systematically measure indicators such as total amount

42 MASEN's right to carbon finance revenues will be specified in the PPA between SPC and MASEN. The Ouarzazate Solar Plant Phase 1 was submitted to the CDM registry on 28 September 2011 and is currently listed at the "Prior Consideration" stage.

43 We estimate a price range of USD 5 to 13/ton as the lowest reported cost for primary CERs by Gorina (2009) and the highest paid for "pioneering primary credits" according to ICIS (2011). The amount of CO_2 emissions saved has been estimated by WB (2011a) but will have to be validated and approved by the CDM Executive Board.

invested and leveraged and the performance of financing practices in relation to green investment objectives. As we build up a larger collection of case studies, we will compare results across different settings and attempt to draw lessons about what makes climate finance more or less effective.

In the context of Ouarzazate, we assess final outcomes against Ouarzazate's expected 25 year life-cycle and associated projections.

We present the effectiveness framework as applied to Ouarzazate 1 in Table 3, which defines inputs as financial resources, outputs as direct results from the investment of those resources, interim outcomes as second order results derived from project outputs, and projected final outcomes as the cumulative benefits delivered over the lifetime of the project.

This map of interim and final outcomes highlights the expectation that Ouarzazate will yield significant environmental and economic benefits over its lifetime. The lessons generated will take Morocco and the region a step closer to the realization of a large-scale CSP portfolio.

Table 3: Summary of the effectiveness of the Ouarzazate intervention

INPUT	OUTPUT	INTERIM OUTCOME	PROJECTED FINAL OUTCOME
• Private capital: USD 253 million • Concessional public finance (grants, below-market loans): USD 1 billion • Market-like incentives (Government of Morocco subsidy): USD 1.19 billion	• Installed CSP capacity: 160MW • LCOE driven down by 25-30 percent • Local content valued at 30 percent of plant capital costs • Thousands full-time equivalent construction jobs	• Displaced fossil generation: 370 GWh p.a. • Solar Power Company IRR: 13.63 percent (after tax) • Government revenues (carbon market, taxes USD 380 million, infrastructure lease payments) • Reduced imports or additional capacity to meet rising demand • Hundreds of operations and maintenance jobs	• Avoided fossil-fuel subsidies: USD 64 million • CO_2 avoided: 240 ktCO_2 p.a. • Lessons for replication and scale up of CSP in the MENA region and beyond • Contribution to Moroccan Solar Plan eventual expected benefits: » Local economic development:[1] USD 4.6 billion value added and 11,000 full-time equivalent jobs » Shifting energy system away from fossil fuels » Improved energy security » Technology cost reduction » Development of a regional electricity market / exports to EU: USD 3 billion export revenues

[1] Local manufacturing, R&D, industrial cluster development.

Note: All figures, unless specified, refer to the whole project life time. Government of Morocco subsidy of USD 1.19 billion is gross and does not account for subsidies saved on imported fuels and additional tax revenues. Total net cost to Moroccan budget estimated at USD 883 million (WB, 2011a).

Source: data extracted from WB (2011a); AfDB (2012b)

- The public-private partnership model shares project management risks between the public and the private stakeholders. In running the plant, stakeholders' joint responsibilities help to align their interests.
- A combination of PPA contracts shifts revenue risks from the private developer (the SPC) to MASEN and the Government of Morocco, which are backed by international aid. This helps to reduce the required rate of return from the private investor and makes the project viable.
- Pre-emptive financing from international donors and multilateral banks greatly reduces the financial risks of the project while diversifying sources of capital.

Risk allocation in Ouarzazate I

To understand how risks are allocated among stakeholders, we have applied a three step risk management framework to the Ouarzazate I project. We:

1. identify and assess individual risks;
2. analyze the impacts and the mitigation instruments adopted to address critical risks;
3. Depict the overall final risk allocation framework in Ouarzazate I, highlighting the instruments and arrangements used to shift risk between entities.

In the following chapter, we explore how the Ouarzazate I risk-sharing model reallocated risks between the private and public sectors. We also review the role of IFIs in relieving both sides of some financial risks.

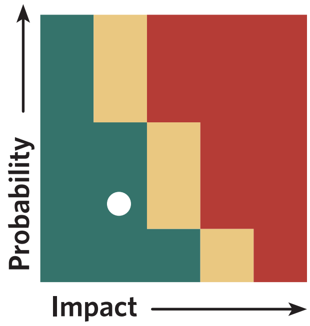
Risk identification and assessment

We first categorized risks in the Ouarzazate project along three major dimensions:[44]

- **Development risks** refer to risks associated with the design and implementation phase of the project including procurement (equipment/technology), construction, and financing risks;
- **Operations risks** include all risks associated with running the project, i.e. production and availability risks, operating costs (notably operations and maintenence risks), and revenues (power generation sale as affected by the power sales agreement and subsidy).
- **Outcome risks** refer to risks more specific to high-level public-policy objectives such as failure to meet environmental and local development targets, risk of overpaying on subsidies, risk of not impacting technology costs or providing suitable demonstration effects to stimulate replication and scale up.

Next, we systematically classify the identified risks according to two criteria: their probability/frequency of occurrence (from very low to very high) and their grade of impact on the project's financial and non-financial objectives (from very low to very high).

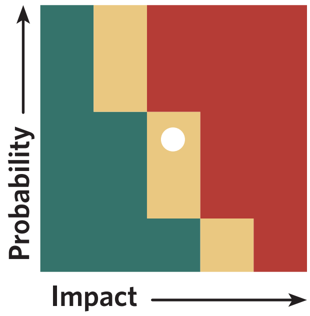
44 This approach builds upon the typical project risk breakdown along development stages by adding the 'outcome' dimension, which is dedicated to the overarching results of the program. Acknowledging the degree of subjectivity embedded in this approach, and that some risks are interrelated and may involve more than one dimension, the San Giorgio Group strives to systematically capture these three dimensions across case studies.



LOW-RISK EVENTS

Risk events with low probability of occurrence and low to-medium impact:

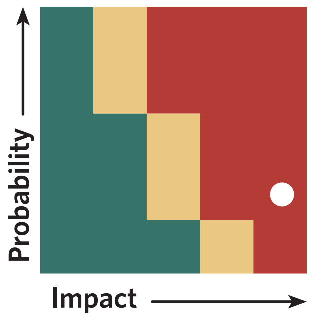
- **Project development risk**: The early-stage technology and the diverse interests of domestic and international actors make early termination a possible risk but with low impacts due to the disbursement of relatively little capital.
- **Electricity Price Risk:** This risk is borne by the Government of Morocco and international backers and is caused by low fossil-fuel prices driving wholesale prices below the benchmark set in the PPA between MASEN and ONE. This risk has low probability given the upward trend in international fuel prices (IEA, 2011).



MODERATE-RISK EVENTS

Risk events with moderate probability of occurrence, but medium-high impacts:

- **Safeguards:** The risk of non-fulfillment of social and environmental safeguards has high to medium impact as IFIs' initial assessments of the project indicate the potential for substantial environmental and social impacts.



HIGH-RISK EVENTS

Risk events with high to very high impact whatever the probability of occurrence:

- **Equipment failure:** Reduced production, increased costs, or delays could all negatively impact the financial performance of the project.[45] Plant developers bear this risk.
- **Reduced solar irradiation levels:** Reduced solar irradiation levels on a given site would result in lower than projected production output. Similar to equipment failure, the developer bears this risk, however, the Government of Morocco indirectly bears this risk since it impacts the amount of fossil fuels displaced.
- **Storage technology failure:** Failure to effectively embed the thermal storage—the least proven component of CSP technology—would render the plant unable to supply peak-load power, currently provided by expensive imported oil. This in turn would seriously undermine both the economics of the project (a risk the developer bears) and the achievement of fossil-fuel subsidy savings (a risk the Government of Morocco bears).[46]
- **Cost overruns and delays:** The project is large and applies a relatively new business model—a public-private partnership—for the country's energy sector. This makes unforeseen delays and cost overruns highly possible. As a result of EPC contractual provisions, the developers bear this risk and its costs.
- **PPA termination risk:** Should the project developers fail to deliver the project on time, MASEN could terminate the PPA and exercise the put-option in the Shareholder Agreement.[47] This is a low-probability event as MASEN is a shareholder of the SPC, however, it would have a disastrous impact on the project's financial viability.
- **Risk of insufficient funds to cover the viability gap:** Should the Government of Morocco fail to continue paying a subsidy to MASEN, the agency would be forced to default on the PPA commitment. This would make the project unviable.
- **Risk of non-achievement of project objectives and higher-level objectives:** The Government of Morocco bears this risk because Ouarzazate I is the first part of a portfolio approach that is complex, new, and in large part, contingent on the eventual export of energy to E.U. markets.

45 Norton Rose (2010) believes that solar thermal technology is now more on the proven than prototype side. Parabolic trough projects are already in place in numerous locations throughout the world and a 20 MW plant is already operational in Morocco.

46 Refer to the "Investment, Return and Profitability" section.

47 By exercising the put-option in the Shareholder Agreement, MASEN can "walk away" from the SPC by selling its shares to the other partners at a pre-determined price (Norton Rose, 2010 – WB, 2011a).

Risk analysis and mitigation instruments

Out of the high-risk events outlined above, we focus on the drivers and impacts of those that we deem the most important risks to the project fulfilling its objectives,[48] namely:

- Operating performance risk and specifically under-production as a result of equipment failure (during construction or operation) or lower than expected solar irradiation;
- cost overruns (CAPEX, OPEX, financing); and
- failure of the government to fully cover the viability gap.

The risk of non-achievement of project objectives and higher-level objectives is crucial from the point of view of public stakeholders and ultimately linked to the success of delivering the broader CSP portfolio to which Ouarzazate I belongs. A detailed analysis of this risk and of the available mitigation measures ("the five building blocks to replication") is presented in Section 6.

1. Operating performance risk

Equipment failure and uncertainty of solar irradiation levels represent risks for the ability of the plant to maintain expected energy generation levels. Equipment failure could result from operational stress of the generation processes and aging, corrosion, and fatigue of the materials. Irradiation levels can diverge from long-term forecasts due to adverse weather events, such as sandstorms, and as a result of uncertainty in original site-specific irradiation measurements.

We estimate the risk of under-production as moderately likely and quantify its impact by altering both the equipment's degradation factor from the project's initial projections, to account for equipment failure, and the forecasted level of production, to account for solar irradiance's uncertainty[49] (see Appendix B for more details).

The following factors mitigate the impacts of operating performance risk on the Ouarzazate project considerably:

- **Technology reliability**: Parabolic trough technology is the most mature of currently available CSP technologies and has been successfully implemented in several projects across the world and in similar contexts (such as Andasol in Spain, which includes storage technology), albeit at much smaller scales;
- **Expertise and advisors**: To minimize the risk of picking the wrong technology for the wrong site, MASEN has employed an experienced technical advisor and will select a capable private consortium SPC partner. To mitigate construction and operation risks, the pre-qualification phase of the tender process required bidders to have successfully[50] developed, operated, and managed large-scale thermal power plants and at least one solar power plant.

2. Cost overruns

The combination of new storage technology, the size of the power plant, and the relatively new public-private partnership financing approach make it moderately likely that project costs will go over estimates. To assess their impact, we increased both the estimated construction costs and the expected operations and maintenance charges. As expected, given the high-capital intensity of the technology, construction cost overruns have the greatest impact on levelized costs of electricity and project returns as, we assume, the project would have to raise emergency funding at more expensive commercial rates[51] (see Table 2 in Appendix B).

Specific procedures and contracts between project developers and service providers will transfer and, from the project company point of view, mitigate specific risks:

- **MASEN has undertaken to select a reputable private consortium with a successful track-record** delivering a project of similar scale and technology.
- **Engineering, Procurement and Construction (EPC) and Operations and Management (O&M)** contractual specifications, to be defined

48 Consistent with UNEP-SEFI (2008), we consider four typical risk responses: (1) **risk avoidance**, which eliminates the risk or protects the project from the risk by changing the project scope or adding resources to the project such as finances, time, and/or headcount, (2) **risk transfer**, which transfers the financial impact of the risk by contracting out part of the work to a most able party, (3) **risk mitigation**, which reduces the probability or impact of the risk to an acceptable level, and (4) **risk acceptance**, which addresses the risk should it occur.

49 Fitchtner Solar (2009)

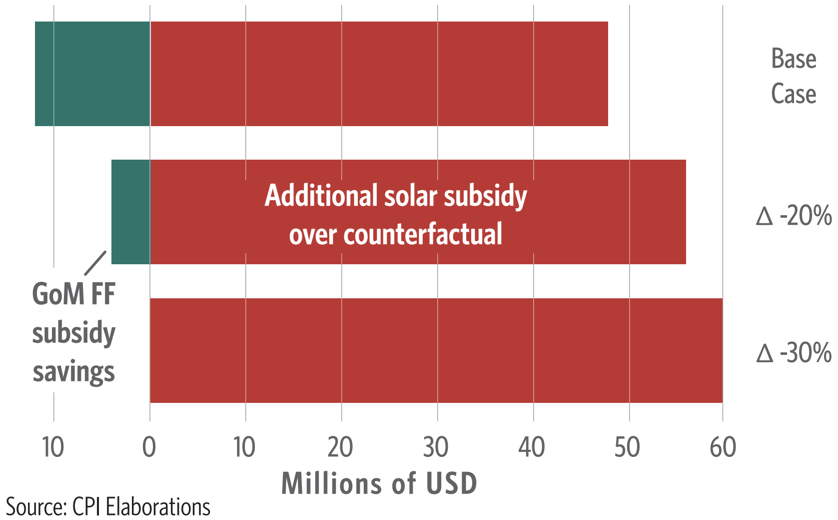
50 Successfully was defined such that the applicant had not been liable for penalties or liquidated damages in excess of 5 percent of contract value (Norton Rose, 2010).

51 Commercial lending rate estimated at 9 percent (Kulichenko and Wirth, 2011).

during the bidding process, will determine the amount of cost overruns that will fall on the project developer and sponsors and those to be absorbed by the service providers;

We anticipate the public budget will be shielded from the risk of cost overruns by the expected provisions in the PPA and the Shareholder Agreement[52] (please see the following chapter on "The Ouarzazate I risk-sharing model"). **Furthermore, the tender process will guarantee that the PPA price agreed on between MASEN and the SPC is based on a competitive projection of construction and operation costs** (with the incentive for the bidders to quote a lower price, but one they can deliver). By design, the PPA price will not be impacted by subsequent cost increases.

Figure 6: Impact of fossil fuel price changes on Ouarzazate I incremental cost



Source: CPI Elaborations

3. Support shortfalls

The ability of the Government of Morocco to support MASEN's long-term financial stability is outside the scope of this study. However, the net impact of the solar subsidy (which is key to the viability of the project) on the government budget is significant[53] and depends on the value of the fossil-fuel subsidies displaced[54] by the power that the CSP project generates. Figure 6 shows the amount of fossil-fuel subsidies that the Government of Morocco would have to pay in the absence of the Ouarzazate I project (green) and the additional solar subsidy (red) needed to meet the incremental cost of the CSP plant. As, historically, electricity tariffs for industrial usages have not shown much sensitivity to oil price fluctuations,[55] we assume that fossil-fuel price variations would not be transferred directly onto the grid price but absorbed mostly through the level of subsidization. The figure then shows that a significant decrease in fossil-fuel prices would imply a greater additional cost to the government budget compared to a scenario in which the same power is generated with conventional sources.

However, this risk is less probable given current expectations that world oil prices will continue to grow.

Risk allocation framework

In Ouarzazate I, financial engineering and policies have been designed to alter the share of the project development, operations, and outcome risks allocated to various parties. The dynamic risk allocation matrix in Figure 7[56] illustrates how risk is allocated to each major project stakeholder, on one hand, and how the overall risk profile shifts through the use of risk transfer instruments, on the other. Risk is categorized according to the estimated 'magnitude of risk' multiplied by the 'likelihood of risk':[57] 'very high' in dark red, 'high' in orange, 'moderate' in light orange and 'low' in yellow.

- As the following chapter will show in detail, in contrast to an independent power producer model (in which the private producer alone specifies the project's design and implementation), the public-private partnership model shares the management of the **project risks** between the public (Government and MASEN) and the private stakeholders.
- The amount of **construction and operation risk** that the plant developer will be able to offload to sub-contractors depends on the

52 We acknowledge that the contents of the final documents eventually signed by MASEN and the SPC may differ significantly from these expectations.

53 The solar subsidy represents approximately 0.22 percent of the total annual budget expenditures (source US Department of State, 2012).

54 Please see Box 1 in Section 3 for more details. Amounts of fossil fuel displaced (in the baseline scenario) have been estimated by ONE and valued at the following prices and quantities: Coal: 32,000 tons at 150 USD/ton; Natural Gas: 354,000 mbtu at 10 USD/mbtu; Fuel Oil: 67,000 tons at 450 USD/ton.

55 Eurelectric Electricity Tariffs (2005-2007).

56 A more detailed risk allocation matrix is to be found in Annex A.

57 Given the lack of contract-level data available on this project, this weighting system is subjective.

availability of counterparties willing to sign engineering, procurement, and construction (EPC) and operations and management (O&M) agreements.[58]

- The provision of IFIs' concessional financing before the project is initiated (pre-emptive financing) reduces the project developer's risk of capital shortages during construction (**CAPEX risk**). In turn, this significantly reduces the overall financial risk of the project including the cost of capital and required rate of return. At the same time, **the explicit backing of multiple IFIs greatly improves investors' confidence**.
- As a shareholder in the public-private partnership model, MASEN shares the plant economics, mitigating the risk perceived by the developer of an unfavorable change of renewable energy policies in the country (**policy risk**).
- During the operation phase, MASEN and the project company sign a PPA which shifts both electricity price and quantity risk (**revenue risk**) from the project developer to the public sector.

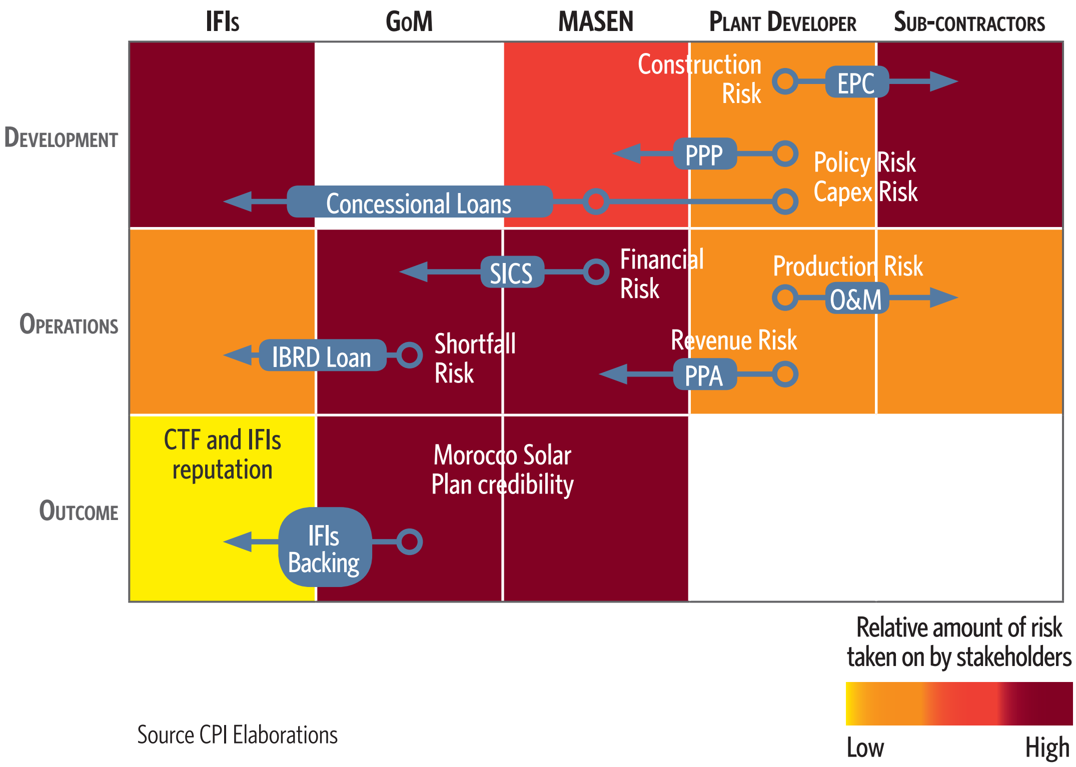
The PSA between MASEN and ONE guarantees the full dispatch to the grid of the electricity bought from the project; while the convention between the Government of Morocco and MASEN ("SICS") provides the agency with funds to meet the gap between the two power prices. Should any public budget difficulties arise (**shortfall risk**), a loan facility from the IBRD supports the Government of Morocco.

- The presence and backing of international donors partially relieves local authorities of the project implementation burden, mitigating the risk of the project failing to meet higher-level objectives (**outcome risk**).[59] However, the conditions placed on the loans and the IFI's right to object to all significant decisions increase MASEN's (and the Government of Morocco's) risk in managing the project. The following chapter provides more in-depth analysis of the public-private partnership model and the role of IFIs in Ouarzazate I, drawing lessons about how the project is being structured and implemented.

58 The availability of counterparties willing to bear full construction and operation risks is often linked with the maturity of the technology and the development of the industrial sector—hence it is usually lower for newer technologies.

59 The involvement of European donors and the European Commission may also help to mitigate the risk that subsequent phases of the Ouarzazate project would fail to access the European electricity market through power export arrangements.

Figure 7: Dynamic Risk Matrix



Source CPI Elaborations

- The public-private partnership model with competitive tendering and the two Power Price Agreements (PPAs) efficiently allocate policy risks to the public sector and project-related performance risks to the private sector. Early results from the bidding process show project costs in line with, if not below, projections.
- The process of coordinating concessional financing from lenders has been time consuming and resource intensive but has lowered transaction costs, boosted investor confidence and improved the project's economics.

The Ouarzazate I risk-sharing model

This section analyzes in detail the business model deployed in Ouarzazate I:

- the **public-private partnership model**, its principles of risk allocation and expected impacts on the project's probability of success; and
- the **role and mode of engagement of international donors**, their coordination and risk sharing arrangements.

The public-private partnership model

The commercial immaturity and the very high capital costs of CSP in Morocco mean that high levels of national and international support are necessary for the project to proceed. However, for future phases of the project, the high levels of concessional support present in Ouarzazate will not be sustainable. For this reason, the Government of Morocco designed a public-private partnership that, through a tendering process, taps financial resources, managerial capacity, and pursuit of technological innovation from the private sector, while retaining control over the quality and the quantity of the output (Burger, 2008; Teichmann, 2011).

Typical public-private partnership structures[60] align the objectives of public and private partners by transferring operational delivery risk to the private partners. These structures aim to balance the amount of both exogenous and endogenous risks[61] the public agent (MASEN in this case) transfers to the private actor, with the higher-risk premiums required by the latter. The optimal risk allocation rests on the proper identification of the nature of the risks and of the stakeholders best suited to bear them at the lowest costs. In most cases, endogenous risks (those directly related to the project, such as construction and performance risks) are best allocated to the private partner, giving them the incentive to execute the project as efficiently as possible; while exogenous risks (those external to the project, such as policy and regulation risks) are more effectively allocated to the public partner (Teichmann, 2011).

Interestingly, **in Ouarzazate I, the public partner is on both the supply and demand side** of the public-private partnership: MASEN is both the purchaser of the service and a shareholder of the company operating the plant. This feature theoretically shifts the risk burden more towards the public entity than it would with other concessions/privatizations. **This in turn should incentivize bidders to lower their required rate of return (OECD, 2008).[62] At the same time, it also allows MASEN greater control and active participation on the production side of the service.** The joint responsibility for running the plant improves the alignment of stakeholders' interests and mitigates the risk that the private project developer might inflate costs and/or operate the plant inefficiently once revenues have been granted.

60 There is a lack of consensus around the structure of a "typical" public-private partnership and its definition. In this work we refer to the definition advanced by the OECD: "A public-private partnership is defined as an agreement between the government and one or more private partners (which may include the operators and the financiers) according to which the private partners deliver the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partners" (OECD, 2008).

61 Endogenous risks are the ones in which the project developer/sponsor has control to a certain extent and can directly manage in order to influence the actual outcome (e.g. technology, management of financial resources, counterparty). Exogenous risks are those onto which the project developer has neither control, nor ability to mitigate (e.g. political risks, adverse changes in national policies, currency devaluation). (OECD, 2008).

62 However, the perceived risk of dealing with the public entity as shareholder could offset this risk reduction. Given the early stage of the tendering process, this instance has not been verified.

In Ouarzazate I, the majority of risks are allocated between parties via two contracts:

- the **Shareholder Agreement between MASEN and the private consortium** (yet to be selected);
- the **PPA between MASEN and the SPC**.[63]

The Shareholder Agreement defines the allocation of shares, profits, and voting rights under the public-private partnership. It regulates the representation of minority shareholders on the Board and establishes quorum rules for management decisions. Finally, it defines liabilities and allocates the company's management risks between parties. In particular, to shield MASEN from construction risks, the agreement grants the agency a put-option, that is, the right to sell back its shares to the Consortium at a pre-defined price in the event that MASEN decides to terminate the PPA as a consequence of the private partner defaulting on its obligations (WB, 2011a).

The PPA obliges MASEN to purchase all of the power generated by the plant during its expected 25 years of operation at a pre-determined price set through the competitive tender. This guarantees the required rate of return requested by the private investor during the tender and shields the private partner from exogenous risks affecting the value of the electricity generated. These exogenous risks include oil-price spikes, government policy on fossil-fuel subsidies that would affect the electricity price on the national grid, and changes of the government policy towards renewable energy.

The PPA also requires the consortium to pay financial lump-sum penalties to MASEN in case of construction delays or failure to deliver the contracted capacity. It grants MASEN the right to terminate its purchasing commitment if the plant's performance and/or its consortium management fail to meet pre-determined requirements (WB, 2011a). In contrast to other examples of PPAs in the region, this PPA grants the emission credit rights that may eventually be assigned to the plant under the Clean Development mechanism to the power off-taker MASEN (Norton Rose, 2010).

At this stage of the project, the public-private partnership design seems to follow the principles of optimal risk sharing, allocating endogenous risks to the private partner and exogenous ones to the public agency.

However, it is too early to draw conclusions on whether this has meaningfully reduced the private sector's perceived risk and required return. More evidence is needed to establish if the lower-than-anticipated private-sector bids can be attributed to the public-private partnership design or if they are caused by lower-than-expected project cost. Early bids under the tender process suggest that levelized costs (LCOE) per unit of power are projected in line with, if not below, the LCOE estimated at the beginning of the project.[64] If the lower bid of USD189.7/MWh prevails, it would imply a lower unit cost of approximately USD 4700/kW (20 percent reduction over the projected figure) for the plant. Importantly, this would reduce the amount of incremental public subsidy required to compensate for the price difference between the PPA and PSA, from USD 60 million to USD 40 million per year.[65]

International financial institution engagement and coordination

Concessional financing drives down the levelized cost of energy generated by Ouarzazate I by around 30 percent[66] by reducing the cost of capital and the uncertainty about its availability. The International Bank for Reconstruction and Development's (IBRD) provision of a facility to partially guarantee the government subsidy also adds to investors' comfort, visibility of long-term revenues, and the credit worthiness of the PPA counterparty. Furthermore, the donors and multilateral development banks bring their project design, implementation experience, and political clout, reducing the likelihood of project failure.

In this section, we focus on the specific arrangements and coordination efforts that have facilitated the engagement of several donors and banks, helping to achieve affordable finance at scale in a relatively short time-period.

Concessional financiers in Ouarzazate I are organized around three lead-financiers: the AfDB, the WB, and the EIB (representing European donors), with the WB and AfDB channeling CTF funds. MASEN is the sole borrower of the concessional loans as well as the sole direct beneficiary. MASEN negotiated directly with IFIs and functions as a lender of funds to the SPC through a unified package that blends together the terms of the different loans. Interestingly, financing has not been pooled or syndicated[67] as is typical with the involve-

63 The exact terms of these documents are still confidential and most likely subject to changes before the tender and/or contract process is complete.

64 See note 25 in Section 3.

65 See Section 3 for details on the estimation of the PSA and PPA reference prices.

66 See Section 3 for more details.

67 "A syndicated loan is one that is provided by a group of lenders and is

ment of commercial banks. Instead, each IFI agreed to its own terms and conditions for the loan with MASEN and, more importantly, will sign a "no-objection" letter to approve all major decisions in the project. MASEN's efforts to coordinate and harmonize donors' requirements and procedures was crucial to move the process forward quickly. However, the process remains cumbersome and further improvements are needed to streamline financing arrangements and minimize transaction costs.

One key risk that requires management going forward is the likely coexistence of different interest charges, loan tenders and collateral guarantees across the loan portfolio. European donors (EIB, KfW and AFD) avoided this complication by choosing not to syndicate their contributions, but rather to contribute through a joint financing package with synchronized loans. The EIB coordinated two umbrella agreements laying down the provisions for donors' coordination:

- The **Pari-Passu Implementation Agreement** ensures that the disbursement of funds towards the project is conducted in a 'fair way' (pari-passu) across financers, that is, simultaneously on a pro-rata basis.
- The **Cross-Collateralization Agreement** stipulates that the same asset acts as collateral for all the loans included in the agreement.

To minimize the compliance burden on the borrower, all lenders developed a common set of procedures (covering procurement rules and social and environmental standards), and agreed to adopt the World Bank's procurement rules and standards for all the loans. This process has been relatively time and resource intensive but should allow a smooth ongoing operation of the financing arrangement and timely monitoring of the investment.

Importantly, early coordination and agreement with donors has allowed MASEN to provide clear guidelines on the terms and costs at which capital would be offered to private investors who are bidding for the project. This transparency appears to have incentivized competition among investors, resulting in required rate of returns in line with other, less risky renewable energy projects in the country (Attijari, 2010), and in bids in line with or below the projected levels.

structured, arranged, and administered by one or several commercial or investment banks known as arrangers" – source: Standard & Poor's (2010).

- Five key building blocks underpin Ouarzazate's progress to date. These include: (1) strong public support and the close alignment of key public partners, (2) financial and technical support from international financial institutions, (3) strong donor engagement and coordination, (4) a carefully designed business model and tendering procedure, and (5) a project design that is built on past lessons learned. These building blocks could be replicated by other large scale CSP projects in the region, given the right economic, political, and policy contexts.
- Given the finite nature of public resources, more commercially-oriented financing models will need to emerge. These financing models will most likely be supported by lower technology costs, lower project costs, and higher market revenues (e.g. E.U. export revenues).
- By 2020, technology costs are expected to come down but not to the level that is required to reach grid parity in domestic MENA markets (even accounting for phase out of fossil-fuel subsidies).
- It's feasible that renewable power exports to European markets could fill the remaining viability gap in the medium- to long-term. However, considerable political support will be crucial to secure EU Member States' demand and to broker specific agreements that make this a reality.

Is Ouarzazate I replicable and scalable?

Ouarzazate's stakeholders understand that it is one of the first in a series of CSP installations that should lead to a large-scale portfolio of CSP plants in Morocco and the MENA region. Indeed, Ouarzazate I only makes economic sense in the context of a portfolio of CSP projects which, through technology cost reductions and the development of an integrated, regional CSP market, delivers significant net economic benefits.

Herein lies a 'chicken or the egg' dilemma: **In order to scale up a CSP portfolio, given limited public resources, projects must become increasingly commercially viable.** Costs must come down through economies of scale and revenues must be enhanced through exports to Europe. But achieving commercial viability requires experience, capacity, and associated infrastructures (such as transmission lines and interconnectors). Because commercial viability and the development of a portfolio of projects are interdependent, there is no 'low-cost' first step.

Therefore, the first publicly-supported large scale CSP projects play a crucial role bridging the development of a more commercially-sustainable, regional CSP market. These first projects should reduce uncertainties about costs and risks for investors, including commercial banks. They will do this by demonstrating that the technology can deliver, that the project can be realized on time and within a budget, and that contractual arrangements allow for reliable revenue streams.

The Clean Technology Fund CSP Investment Plan alone contains USD 550 million of concessional finance for CSP projects in the MENA region over and above Ouarzazate I. IFIs that will channel this finance have expressed willingness to co-fund these projects with their own resources (CTF, 2012).

We now explore which elements have worked well so far in Ouarzazate I, and consider whether replicating elements would be sufficient to support the next round of large-scale CSP projects in the region.

What is working in Ouarzazate I?

The Ouarzazate I project is in the late stages of design specification. It is therefore premature to assess whether its implementation has been successful. However, early indicators—such as significant support from international development banks and interest from private-sector bidders—suggest that the project has potential to progress towards the final stages of development and, subsequently, operation.

As other similar large-scale CSP projects begin to get off the ground in the region, it is valuable to draw out lessons from Ouarzazate I that could be replicated by future projects. In doing so, we recognize the significant diversity among countries in the MENA region and acknowledge that new challenges could arise in each case. These could include variations in electricity market structures, as well as economic, political, and policy contexts that differ from those in Ouarzazate I.

This aside, we identify five decisive building blocks in the Ouarzazate I project which could potentially be replicated in other large-scale CSP projects in the region.

1. *Strong public support and close alignment of key public partners*

The Government of Morocco and MASEN have played a crucial role in designing and implementing an appropriate framework to support Ouarzazate I. The Government of Morocco established a favorable regulatory framework for private-sector engagement in the electricity market and a strong renewable policy framework. In particular, the government has set clear and ambitious development targets for renewable energy sources (both wind and solar);[68] it has established a specialized professional entity tasked with realizing CSP projects (MASEN) and is financially supporting MASEN's work to implement the Moroccan Solar Plan. The further opening of Morocco's electricity system to the private sector will itself help to attract financing, expertise, management skills, and entrepreneurial efficiency.[69]

Legal agreements ensure alignment between key government players. The agreement between the Government and MASEN provides certainty that the viability gap will be covered while a second agreement between MASEN and ONE guarantees connection to the grid and full dispatch of electricity.

MASEN has led the Ouarzazate project to date and plays a critical role within the public-private partnership structure. It sought expert advice to develop a project design that promotes efficient risk sharing between public and private partners. Importantly, it successfully secured substantial amounts of concessional finance from a range of international donors, whose early commitments attracted potential private-sector partners.

2. *Significant financial and technical contributions from IFIs*

IFIs have provided both financial and specialized, technical support to the project. A high level of early and sustained IFIs engagement has fostered the project's credibility and helped to mitigate risks perceived by private-sector investors. For example, the African Development Bank and the World Bank worked closely with MASEN on project design and all donors committed significant resources to make the project work, in some cases making compromises on loan requirements to reduce the burden for MASEN. This commitment to the project's success could be replicated in future interventions.

3. *Strong engagement and coordination of donors*

Considerable effort and strong coordination between IFIs and Moroccan stakeholders has been essential to get such a large and complex project off the ground. Donor coordination to harmonize conditions, safeguards, procurement, and no-objection and reporting rules was time consuming and challenging. However, it established a valuable model for subsequent projects. In the future, the syndication of loans, for example, could help reduce the project developers' burden to deal with multiple lenders and their separate loan rates, conditions, and procedures.

As subsequent projects are designed, including Ouarzazate Phase II, it will be important to promote the participation of commercial banks and capital markets, thereby increasing the leverage ratio of concessional finance. While this will be essential in order to increase the amount of capital for the technology, it will also introduce new challenges for coordination and risk sharing between parties. As Ouarzazate I has demonstrated, there may be significant benefits in dealing with these issues preemptively and transparently.

The eventual phase out of IFI support will be both unavoidable, given finite resources, and necessary, to avoid crowding-out the private finance that is core to realizing the scale of investments required (OECD, 2012).

4. *A carefully designed public-private partnership and competitive tendering procedure to attract the right expertise and efficiently allocate risk*

The public-private partnership model allows the optimal alignment of risk between public and private players, according to their expertise. For example, the private developer takes on construction and operational risk while the government takes on electricity market risk (revenue risk). MASEN's role in the public-private partnership is innovative: It acts as both equity investor and purchaser of the power (off-taker) and it has the ability to align public and private objectives. Ouarzazate's development and operation will show whether this alignment will be realized. Through MASEN's role as an equity shareholder and a conduit for concessional finance, the Government of Morocco shows it has skin in the game. This allows the government to exercise

68 Namely the 1000 MW Wind Integrated Energy Plan, the 2000 MW Morocco Solar Plan, and the 13-09 Renewable Energy Law.

69 Here we echo recent work of the OECD in indentifying, beyond financial support and policies, clear national goals, competitive and transparent processes, and private sector engagement as critical elements of a regulatory framework that supports climate-resilient investments (OECD, 2012).

greater control over the project and share in the projects' successes or failures.

In addition, MASEN has led a transparent and well-managed two-stage competitive tendering process that has attracted considerable private-sector interest. The invitation to tender expressed clear guidelines for the terms and modalities of public sector support. The SPC's ability to access sufficient concessional financing provided potential bidders with more certainty over financing costs and lowered their required rates of return.

Early indications suggest that MASEN is functioning well as a professional agency and is actively forging a conducive investment model in which it participates actively. The experience points to the benefits of setting up a new, specialized government agency to drive forward implementation of ambitious renewables objectives.

5. *A project design built on past lessons learned*

Prior to the Ouarzazate I project, the Global Environment Facility (GEF) provided support to a program that developed several CSP projects in Mexico, Morocco, and Egypt (see Annex C). All of these encountered numerous challenges and delays, including untested technology, a lack of opportunities to build up economies of scale, and unsuitable business models, which contributed to project failures.

The Ouarzazate I project benefited from exchanges with other large-scale CSP projects that are in development in India and South Africa, as well as experience gained from the above-mentioned GEF project (WB, 2011a). As such, Ouarzazate I was designed at a scale large enough to contribute significantly to building a portfolio that will drive technology-cost reductions. Partners selected a business model, the public-private partnership, which provides explicit measures to align the objectives and expectations of host governments (creating local opportunities), donors (building the experience of the public and private sectors which can be applied to future projects) and the private sector (providing investment security and opportunity). Finally, numerous studies were carried out to choose an appropriate technological mix.

Sharing lessons from the design and implementation of CSP projects will help reduce project costs and increase efficiencies that will help Morocco and the MENA region develop a CSP portfolio. The Government of Morocco is actively engaged in a number of knowledge platforms e.g. through the Climate Investment Fund, the Mediterranean Solar Plan, Medgrid, the Desertec Industry Initiative, etc.

Scaling up the CSP portfolio

Replicating the Ouarzazate I financing model will not be sufficient in and of itself to support the development of a large-scale portfolio of CSP projects. To reach the scale desired by the Moroccan and Mediterranean Plans, significant sums of additional capital will be needed. Given the scarcity of public and international support, more commercially-oriented financing models will need to emerge. These commercially-oriented financing models will most likely require:

1. Reduced technology/project costs, and
2. Higher market revenues (e.g. E.U. export revenues).

In addition, to support and stimulate the development of an active CSP market, predictable and stable policies will be required to generate positive incentives for private investors. For example, Morocco has renewable energy and solar targets in place but supports projects on a project-by-project basis instead of applying standardized policy support measures across sectors or directed toward particular technologies (e.g. feed-in-tariffs / premia, tax incentives, tradable certificates or renewable portfolio standards, carbon taxation or trading). Such a piece-meal approach could limit the potential for scale-up and replicability and ultimately slows the speed of development of CSP in the region.

The presence of conflicting policies that support fossil-fuel consumption also make it difficult for renewable technologies to compete, drain financial resources away from low-carbon investments, and weaken the perception of the country's commitment on its climate targets.[70] On a positive note, the Government of Morocco's desire to embrace private energy producers,[71] the transparency of the Ouarzazate I competitive tender, and the commitment of public resources (through MASEN) to improve the project's viability provide important incentives that should attract private investors to the country and lower the perception of regulatory and policy risk.[72]

70 Other investment barriers reported for Morocco include: inadequate institutional structures, insufficient coherence and cooperation between Ministries, insufficient strategic guidance, insufficient information made available to investors, a lack of experience in the administration, and a lack of financial incentives (EU, 2010).

71 ONE can issue competitive tenders for IPPs to supply capacity greater than 10MW and auto-producers can sell power surplus to ONE up to 50MW with tariffs including a 20 percent uplift compared to ONE's normal tariffs.

72 As a comparison, despite similar policy targets, Tunisia is struggling to attract the same interest from international private investors because there is

We now briefly consider progress toward reducing technology costs and realising renewable exports.

1. *A critical mass of publicly supported CSP projects will help to drive faster reductions in technology costs; combined with the removal of fossil-fuel subsidies, this will help move CSP towards grid parity.*

Capital costs of CSP plants remain very high. Initial estimates of capital investment costs for Ouarzazate I stood at USD 6000/kW[73]—or about three times the initial investment costs for an average coal power plant.[74]

Costs are gradually coming down and have the potential to come down much further. Hinkley et al. (2011) estimate that CSP costs have decreased by 15 percent with each doubling of cumulative deployment over the past twenty years. Meanwhile, Kulichenko and Wirth (2011) estimate that CSP levelized costs have the potential to fall from USD 0.21 – 0.26 /kWh in 2010 to USD 0.17 – 0.18 /kWh (19 percent) by 2020.[75] Figures available in initial proposal documentation for Ouarzazate I indicated LCOE of approximately USD 0.25/kWh while bids reportedly range from USD 0.19/kWh - USD 0.25/kWh (see footnote 28 in Section 3). These initial projections and the high end bid suggest that CSP costs might remain high, in line with 2010 estimates presented above. Further examination of the USD 0.19/kWh bid may shed light on whether technology cost reductions were a significant factor in driving down this consortium's price.

Nonetheless, even the lowest Ouarzazate I bid is still far from grid parity. Achieving parity would in fact require an LCOE of around USD 0.08 /kWh—a further cost reduction of 11 cents per kWh. We estimate that removal of fossil-fuel subsidies would increase grid prices to approximately USD 0.11 /kWh, which would necessitate less steep reductions of 8 cents per kWh.[76]

The current increase in the scale and number of CSP projects should help to facilitate faster technology cost reductions by building economies of scale in manufacturing, learning curve effects, and technical innovation. A critical mass of publicly supported large-scale early projects could help to drive cost reductions at a faster rate than has been witnessed to date, in turn paving the way for more commercial players to come into the market and complete the regional CSP portfolio.

a perception of lower commitment from the government and a higher level of political and regulatory instability.

73 Not yet publicly disclosed bids indicate lower capital costs. See Section 3 and note 25 for more details.

74 Hypothetical coal plant investment costs reported in the Tanger Wind Park CDM PDD are approximately USD 1,800/KW (ONE, 2007).

75 The lower end estimates are based on projections of cost reduction potentials for parabolic trough components while the higher end estimates consider a range of CSP technologies and the effect of performance data. The estimates were produced by modeling reference plants (location not specified) and do not include costs related to transmission connection, land or water.

76 Please see Box 1 for a more detailed treatment of the impact of fossil-fuel subsidies on the project.

Box 2 Preconditions for the export of renewable power to E.U. markets

- ***Bilateral and Multilateral Agreements:*** The E.U. Renewables Directive (2009/28/EC) (EU, 2009), Article 9, provides the legal basis for E.U. Member States to meet part of their renewable energy targets for 2020 by importing renewable power from neighboring countries. However, the electricity needs to be imported physically and to be consumed in an E.U. Member State.[1] Trade conditions have to be established in the form of bilateral or multilateral agreements. Morocco has already signed cooperation agreements with France and Germany and expects to sign further agreements with Spain and Italy in the near future.[2]

1 There is a limited possibility to rely on statistical transfers (i.e. the electricity is consumed domestically, but is counted toward the renewable energy share of a supporting E.U. Member State for compliance purposes under the Renewable Energy Directive) if an interconnector is under construction before 2016 to enable physical imports into the E.U.

2 In May 2011, the Desertec Industrial Initiative and MASEN also signed a Memorandum of Understanding to develop a 500MW solar Reference Project to demonstrate the feasibility of exporting solar power from Morocco to Spain, with exports expected to commence between 2014 and 2016. Source: http://www.dii-eumena.com/country-focus/morocco.html

- ***Removal of Subsidies:*** The E.U. Renewables Directive outlaws domestic operational support (such as a FiT) for electricity that is exported, to avoid double subsidization.[3] However, upfront support (concessional finance, investment grants, etc.) is permitted. The presence of a heavily subsidized PPA rules out the ability to export power generated by Ouarzazate I. Furthermore, it implies that to achieve export potential, electricity generated in following phases of the project will not be able to rely on operational support secured by the Government of Morocco.
- ***Physical Investments:*** Interconnector capacity needs to be available to export renewable power to Europe. Spare capacity seems to be available on the existing 700MW interconnection between Morocco and Spain,[4] which, for the time being would primarily allow access to Spanish and Portuguese markets,[5] although an additional interconnection to Spain is planned. An interconnection exists between Algeria and Morocco with a maximum transmission capacity of 700 MW each way, which could provide alternative routes to Europe in the future as part of an integrated E.U.-MENA market. In order to attract project developers, Office National De L'Electricité (ONE) and the Government of Morocco will need to provide clear signals regarding export revenue potential.
- ***Demand from E.U. Member States:*** The final major precondition for exports to E.U. Member States is the willingness of the states themselves to purchase renewable power from the MENA region. The European Commission's assessment of Member State National Renewable Action Plans (NREAP) indicated that the 27 E.U. Member States expected to exceed the 2020 20 percent renewable energy target in the "additional energy efficiency scenario" (20.6 percent) and only slightly miss it in the reference scenario (19 percent) (EC, 2012). This suggests there may not be much demand from E.U. countries. There are two exceptions: Luxembourg and Italy. Italy, according to its NREAP, requires a substantial amount of renewable electricity to fulfil its target under the Renewable Energy Directive and is seeking cost-effective means to achieve its obligations. At the same time, some Member States, such as Germany, have policy objectives that go beyond those of the E.U. renewable directive, and promote adoption of a post-2020 view that acknowledges the need for imports.[6]

3 In order to avoid the possibility that costs could be subsidized through E.U. concessional loans or domestic public finance, and then again through subsidized power purchase prices.

4 http://tdworld.com/underground_transmission_distribution/power_bridge_two_continents/

5 As the interconnector to France is currently congested until the planned upgrade in 2013, further physical export to France and beyond is not possible. Additional electricity from North Africa would have to be consumed in the Iberian Peninsula.

6 For example, Germany's energy concept foresees imports from North Africa by 2050 to meet its ambitious targets for GHG reduction of 80 percent by 2050 (on 1990 levels) and for the amount of renewable energy as a proportion of gross final energy consumption of 18 percent by 2020, 30 percent by 2030, 45 percent by 2040, and 60 percent by 2050.

2. *Exports to E.U. markets could make CSP production in the MENA region viable.*

One objective of the Moroccan and Mediterranean solar plans is to sell electricity to the European Union markets, given that current MENA domestic grid prices are significantly lower than current CSP generation costs. Higher power prices and existing support schemes for renewable power available in some European countries could already be sufficient to exceed the costs of CSP generation in the MENA region, thus opening the potential to achieve mutual economic benefits. MASEN's financial model simulated the expected revenues from power sales to E.U. export markets at a 30 percent premium above generation costs.

Based on the Ouarzazate I financial model and the list of plants to be developed under the Moroccan Solar Plan, MASEN could reach financial equilibrium thanks to increasing exports, from zero percent in 2015 to seven percent in 2016 and 46 percent from 2019 onward (WB, 2011a). However, there are **several preconditions** that need to be resolved before exports to E.U. markets from the MENA region can be realised (see Box 2).

Of note, the possibility to export power from Morocco's CSP plants into European markets presents a trade-off between financial viability on one hand, and domestic energy and environmental effects on the other. On one hand, 'diverting' power away from the Moroccan market through sales to Europe would significantly lighten the pressure on the national budget of covering the cost of subsidies. On the other hand, diverting renewable power away from the domestic market reduces the potential to displace fossil-fuel electricity (and hence reduces the savings that could be achieved through decreased imports and subsidies). Diverting power to E.U. markets also limits Morocco's opportunity to improve domestic energy security.

In summary, exports of renewable power to European markets are a feasible means of filling the financial viability gap, in the medium- to long-term. However, considerable political support will be crucial to secure demand from E.U. Member States and to broker specific agreements that will make exports a reality.

Scaling up a CSP portfolio in the MENA region and elsewhere in the world will be challenging, given the high costs of developing early projects and the necessary infrastructure to support them. The Ouarzazate case indicates that financing specific projects is possible with the close alignment of public, international, and private stakeholders, and careful design and coordination. Such an achievement, however, may not be enough to scale up a national or regional portfolio. This greater goal may be met only if projects are commercially viable, through a reduction in costs and access to higher market revenues, both of which will require considerable political support from national and international players.

Conclusions

CSP technology has enormous unexploited potential, particularly in the MENA region, but is still not commercially viable. This is particularly evident in markets, such as those in MENA, where energy prices are distorted by heavy fossil-fuel subsidies. **It is still too early to know if Ouarzazate I will be large enough to prove the commercial maturity of its storage component technology and to meaningfully drive the technology costs down**. However, meeting early milestones will be crucial to maintain financial backing from both the Moroccan Government and international lenders, whose early support is essential to deliver the whole portfolio of projects contained in the Moroccan Solar Plan and the MENA CSP Investment Plan.

The early signs are encouraging. **In the case of Ouarzazate, public resources have played a decisive role in getting the project up and running. Significant up-front international concessional finance has covered early-development costs** and will help the technology develop until its level of profitability is sufficient to attract unsubsidized private capital. **At the same time, international lenders need to improve the coordination and harmonization of lending packages to avoid excessive transaction costs, lengthy procedures, and unbearable compliance requirements.**

The Moroccan Government has provided generous domestic backing for the project, covering the significant price differential between power bought from generators and sold onto the grid. This has made the project viable for public and private entities. Together with the support to renewable energies, the government is also committed to phase out fossil-fuel subsidies and is currently reducing its compensation system. While this alone would be insufficient to make CSP power commercially viable, it is a necessary step towards the development of a policy framework that truly supports low-carbon investments.

MASEN's innovative design for the governing public-private partnership seems to have effectively allocated risk between private and public stakeholders.[77] Giving early notice of financing terms and costs allowed prospective investors to factor savings into their bids, attracted their interest early, and resulted in levelized cost estimates in line with, and for some bids lower, than what was projected. The public-private partnership allocated risks to the stakeholders who were best equipped to manage those risks. Construction and operating risks were assigned to private developers while political and policy risks rested within the public sphere.

In the future, CSP power will remain expensive in the Moroccan market even with fossil-fuel subsidy phase outs and technology costs reductions. **Public support alone will not assure the financial viability of the Ouarzazate project (including phases II and III). Favorable economics will only be achieved if Morocco and/or MENA succeed in establishing an export market with the E.U.** However, this will **require further investments in physical assets** (for example, transmission lines) and a **strong commitment from E.U. Member States** to go beyond their existing renewable targets. At the end of the day, this will be a question of political will, as likely as not subjected to the prevailing winds of international progress toward a post-2020 international outcome.

77 This point will be proved once the winning bid is selected and its content is made public. However, initial indications available at the time of writing support our assumption.

Index of Acronyms

AFDB	African Development Bank
AFD	Agence Française de Développement
CAPEX	Captial Expenditures
CO_2	Carbon Dioxide
CPS	Country Partnership Strategy (World Bank-Morocco)
CTF	Clean Technology Fund
CSP	Concentrated Solar Power
EIB	European Investment Bank
EPC	Engineering, Procurement, and Construction
ESIA	Environmental and Social Impact Assessment
FDE	Fond de Developpement de l'Energie
FESMP	Framework Environmental and Social Management Plan
GOM	Government of Morocco
HASSAN II	Moroccan Hassan II Fund for Economic and Social Development
IFI	International Financial Institution
IP	Investment Plan
IPP	Independent Power Producer
KFW	Kreditanstalt fur Wiederaufbau
LCOE	Levelized Cost of Energy
MENA	Middle East and North Africa
ONE	Office National ede l'Electricité
ONEE	Office National de l'Eau et de l'Electricité
ONEP	Office National de l' Eau Potable
OPEX	Operating Expenditures
PAD	Project appraisal document
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PSA	Power Sale Agreement
SEEE	Secrétariat d'Etat chargé de l'Eau et de l'Environnement
SICS	Solar Incremental Cost Support
SIE	Moroccan Energy Investment Company
SPC	Solar Power Company
UGE	Unité de Gestion de l"Environnement
WB	World Bank

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Annex A: Full risk matrix

	Risk	GOM	MASEN	Consortium	WB	Other IFIs	EPC Contractor	Treatment/Mitigation Measures
DEVELOPMENT	**Program devlopment risk** Early stage failure, capacity of MASEN and PPP to bring the project together, coordinate donors and their rules and various stakeholders, avoid CoI etc.	Loss of committed resources deployed			Loss of financial resources deployed			MASEN **staffing**, external advisors. **WB effectiveness conditions**. 2-stages **Bidding Procedure. Risk Management** Framework
	Equipment • CSP component failure / defect			Direct impact on returns			Non or partial payment	MASEN's **technical advisor. Experienced private partner. Contracts** for construction, financing to fulfill the obligations it undertakes in the PPP. Supplier's warranty for a limited period.
	Construction costs • Cost overrun / delays							**EPC contracts. Experienced advisor** to MASEN during selection process. Finalization of key documents subject to **WB No Objection**. Construction manager is also majority shareholder, hence **risk alignment**.
	Financing Risk • Failure to secure necessary Capex		Insufficient resources to complete project					Concessional Capital secured preemptively before bidding process. GoM also secured a lending facility from IBRD to cover incremental costs.
	Safeguards • Fiduciary, environmental, and social		Non payment of support if IFI safeguards not met		Safeguards not met		If lenders withdraw	**Support and checks** by donors. Compliance with IFI rules will be **contractually mandated**. WB will **monitor and evaluate implementation** effectiveness.
OPERATIONS	**Regulatory risk** • Change in GoM support	Risk of overpaying on subsidy	Risk of incomplete hedge by GoM		Risk of full / partial default			**Project Specific Convention (MASEN-GoM), IBRD loan facility.** Competitive tendering process on LCOE. Possibility for additional concessional funding. Work to realise EU export potential.
	Production / availability risk • Failure of technology, extreme weather events			Direct impact on returns	Risk of full / partial default		Non or partial payment	**Selection of technically capable private partner. Bonding requirements and liquidated damage. EPC contract** will pass risk to the suppliers. Supplier's warranty for a limited period.
	O&M cost risk • Cost overrun / delays	Increased CSP subsidy + guarantee + reduces FF subsidy savings						Selection of **experienced private development partner. Contractual specifications.**
	Power price risk • Lower than expected grid prices		Risk of incomplete hedge by GoM	MASEN default on PPA				Use of **IBRD support facility**. GoM shareholding in ONE allows control over generation capacity additions (**natural hedge**).
OUTCOME	**Project objectives** • Risk of not meeting electricity production, avoided GHG, local development targets **Higher level objectives** • Risk of not realizing technology cost reduction or demonstrating a successful project model	Undermines replication / scale up (e.g. Moroccan Solar Plan, Mediterranean Solar Plan, EU Exports)			Undermines CTF trans-formational objectives and ability to crowd in additional donor contributions	Undermines IFI support to Morocco/ MENA/RES/ solar		Selection of **experienced private development partner**. **Contractual specifications** in the bidding process. **Coordination** with teams working on **other CSP programs**.

Relative amount of risk taken on by stakeholders

Low — High

Annex B: Ouarzazate I sensitivity tests

i) Operating Performance

Table 1 depicts the sensitivity of the project IRR and of the Levelized Cost of Energy to deviations of annual production from forecasts due to uncertainty on the level of solar irradiance and/or to higher (or lower) than expected degradation factor.

Table 1: Production Variance

Production variance	-10%	BASE	10%
Annual Production (GWh)	333	370	407
IRR	6.2%	7.2%	8.3%
LCOE	302	276	254
Degradation Factor	1.0%	0.5%	0.3%
IRR	6.8%	7.2%	7.5%
LCOE	287	276	271

Source: CPI Elaborations

ii) Cost Overruns

Table 2 illustrates the effect on the project economics of cost overruns due to higher (or lower) than expected capital investments or for higher requirements to operate and maintain the plant. Given the capital intensity of the CSP plant, it's not surprising that the investment metrics are more sensitive to deviations on capital costs than on operations and management charges.

Table 2: Construction and Operations Costs overruns

Construction cost overruns	Δ+20%	Δ +10%	BASE
Capex ($ million)	1200	1100	1000
IRR after tax, levered	10.1%	11.8%	13.8%
LCOE	282	260	240
OPEX cost overruns	Δ +20%	Δ +10%	BASE
OPEX % of revenues	13%	12%	11%
IRR after tax, levered	12.9%	13.1%	13.8%
LCOE	245	242	240

Source: CPI Elaborations

iii) Support Shortfall

The impact of Ouarzazate I on the government's budget depends both on the solar subsidy and on the value of the fossil-fuel subsidies displaced by solar power that, in turn, depends on the fuel prices. **Table 3** quantifies the effect on the budget of a hypothetical variation on the base prices used in the initial project planning (150$/ton for coal, 450$/ton for fuel oil and 10$/mbtu for natural gas).

Table 3: Fuel Price Variance on 370 GWh of displaced FF electricity

Fuel Price Variance	Δ-30%	Δ-20%	BASE
Government FF Subsidies Savings (M$)	0	4	12
Additional Solar Subsidy over Counterfactual (M$)	60	56	48

Source: CPI Elaborations

Annex C: Lessons from GEF-supported CSP projects

Ouarzazate is the latest in a list of only moderately successful CSP projects in the MENA region. A study by the WB's Independent Evaluation Group (IBRD, 2010) explains why Global Environment Facility (GEF)-supported CSP projects in Egypt, Mexico, and Morocco have been slow to come to fruition—after 13 years, two of the projects are still under construction, one is out to tender while another, to be located in India, was dropped due to technical difficulties.

The GEF portfolio was intended to drive technology costs down but the planned capacity (120 MW) and the realized capacity (later downsized) plus its distribution over three countries made the realization of any economies of scale unfeasible. The spread across countries also undermined the creation of a local value chain.

A hybrid technology approach was chosen to alleviate concerns about power availability, combining conventional gas plants with solar technology. However, the hybrid technology was novel and further complicated project design and procurement, as several providers had to be integrated to provide different components. In some cases the scarcity of bidders required adjustments to procurement rules and caused subsequent delays.

Scarce information on technology costs, cumbersome procedures, and reduced numbers of bidders resulted in bids implying costs well above initial estimates. As the amount of the GEF grant was fixed in absolute value, the CSP plants had to be reduced in size, necessitating renegotiation and further delays, again reducing the expected effectiveness of public funds.

Finally, project sponsors required that plants would be operated under an IPP model, aiming to achieve a higher level of efficiency in the plant management compared to its operation by the state utility. Unfortunately, this management structure was not yet present in the host countries and was unappealing for state utilities, creating further institutional barriers in addition to the aforementioned technological ones. ESMAP (2011) indicates that, ultimately, the IPP/PPA schemes did not work and had to be restructured into public projects, at the cost of contract renegotiation and significant construction delays.

This whole experience has most probably informed the decision by the CTF to concentrate investments in fewer projects of a significant scale such as Ouarzazate and to work closely with local institutions in the host country (i.e. MASEN for the case of Morocco) in order to choose a business model that aligns the objectives and expectations of host governments (creating local opportunities), donors (building the experience of the public and private sectors which can be applied to future projects) and the private sector (investment security and opportunity).