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Report No: 36485-MO

PROJECT APPRRAISAL DOCUMENT

ON A

PROPOSED GRANT FROM THE
GLOBAL ENVIRONMENT FACILITY TRUST FUND

IN THE AMOUNT OF US$ 43.2 MILLION

TO THE

OFFICE NATIONAL DE L'ELECTRICITE
(National Electricity Utility)
OF THE KINGDOM OF MOROCCO

FOR AN

INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

February 20, 2007

Sustainable Development Department
Middle East and North Africa (MNA)

CURRENCY EQUIVALENTS

(Exchange Rate Effective January 31, 2007)

Currency Unit	=	Morocco Dirham (MAD)
MAD 8.59195	=	US$1
MAD	=	US$

FISCAL YEAR

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

AfDB	African Development Bank
CDER	Centre de Développement des Energies Renouvelables (Renewable Energy Center)
MAD	Moroccan Dirham
DSM	Demand Side Management
EA	Environmental Assessment
EE	Energy Efficiency
EMP	Environmental Management Plan
EPC	Engineer, procure, and construct
ESMAP	Energy Sector Management Assistance Program
EU	European Union
GEF	Global Environment Facility
GHG	Greenhouse Gas
GoM	Government of Morocco
HV	High Voltage
IPP	Independent Power Producer
ISCC	Integrated Solar Combined Cycle Power Plant
JLEC	Jorf Lasfar Energy Company (JLEC)
LV	Low Voltage
LYDEC	Casablanca Power Distribution Company
MEM	Ministry of Energy and Mines
MoF	Ministry of Finance
MV	Medium Voltage
MW	Megawatt
O&M	Operation and Maintenance
ONAREP	Office National de la Recherche Pétrolière (National Petroleum Office)
O.N.E.	Office National de l'Electricité (National Electricity Utility)
PIU	Project Implementation Unit
RAP	Resettlement Action Plan
STP	Solar Thermal Power
UNFCCC	United Nations Framework Convention on Climate Change

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MOROCCO
INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

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MOROCCO

INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

PROJECT APPRAISAL DOCUMENT

MIDDLE EAST AND NORTH AFRICA

MNSIF

Date: February 20, 2007 Country Director: Theodore O. Ahlers Sector Manager/Director: Jonathan D. Walters Project ID: P041396 Focal Area: Climate change Lending Instrument: Specific Investment Loan	Team Leader: Nourredine Bouzaher Sectors: Power (80%);Renewable energy (20%) Themes: Technology diffusion (P);Infrastructure services for private sector development (S);Climate change (S) Environmental screening category: Partial Assessment

Project Financing Data

[ ] Loan [ ] Credit [X] Grant [ ] Guarantee [ ] Other:

For Loans/Credits/Others:
Total Bank financing (US$m.): 0.00
Proposed terms:

Financing Plan (US$m)

Source	Local	Foreign	Total
BORROWER/RECIPIENT	39.54	95.06	134.60
GLOBAL ENVIRONMENT FACILITY	0.00	43.20	43.20
AFRICAN DEVELOPMENT BANK	14.38	375.62	390.00
Total:	53.92	513.88	567.80

Borrower:

Responsible Agency:
Office Nat. de l'Electricite
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Casablanca, 20000
Morocco
Tel: 212-22-668267 Fax: 212-22-433112
berrehili@one.org.ma

Estimated disbursements (Bank FY/US$m)

FY	2007	2008	2009	0	0	0	0	0	0
Annual	15.00	25.00	3.2	0.00	0.00	0.00	0.00	0.00	0.00
Cumulative	15.00	40.00	43.2						

Project implementation period: Start May15, 2007 End: December 28, 2012 Expected effectiveness date: April 30, 2007 Expected closing date: December 28, 2012

Does the project depart from the CAS in content or other significant respects? ***Ref. PAD A.3***	[ ]Yes [X] No
Does the project require any exceptions from Bank policies? ***Ref. PAD D.7*** Have these been approved by Bank management? Is approval for any policy exception sought from the Board?	 [ ]Yes [X] No [ ]Yes [ ] No [ ]Yes [X] No
Does the project include any critical risks rated "substantial" or "high"? ***Ref. PAD C.5***	[ ]Yes [X] No
Does the project meet the Regional criteria for readiness for implementation? ***Ref. PAD D.7***	[X]Yes [ ] No

Project development objective ***Ref. PAD B.2, Technical Annex 3***
The main national objective of the project is to increase the contribution of renewable energy sources in Morocco's energy mix and add capacity to the power grid to help cope with the sustained growth in electricity demand

Global Environment objective ***Ref. PAD B.2, Technical Annex 3***
The global development objective of the project is to reduce greenhouse gas emissions from anthropogenic sources by increasing the market share of low greenhouse gas emitting technologies.

The project will also test the viability of solar thermal technology and contribute to replication of integrated solar combined cycle (ISCC) power generation technology in Morocco and elsewhere. It is one of a number of similar projects in the world to be supported by GEF as part of a program to accelerate cost reduction and commercial adoption of large-scale low greenhouse emitting generation technologies. The main global benefits of the project are: (a) contribution to the demonstration of operational viability of hybrid solar thermal power generation in Morocco; (b) contribution to accelerated market penetration of large-scale backstop power generation technologies; and (c) reduction of greenhouse gas emissions from power generation.

Project description *[one-sentence summary of each component]* ***Ref. PAD B.3.a, Technical Annex 4***
1. Construction and operation of the Integrated Solar Combined Cycle Power Plant of Ain Beni Mathar;
2. Transmission lines;
3. Substations;
4. Access road;
5. Boreholes;
6. Land acquisition;
7. Gas pipeline;
8. Environmental and social development and Management; and
9. Consultancy services.

Which safeguard policies are triggered, if any? ***Ref. PAD D.6, Technical Annex 10***

-Environmental Assessment; and -Involuntary Resettlement.
Significant, non-standard conditions, **if any**, for: ***Ref. PAD C.7*** Board presentation: Streamlined. Loan/credit effectiveness: - Engineering consultant recruited - EPC/O&M signed Covenants applicable to project implementation: Project and performance indicators monitoring

A. STRATEGIC CONTEXT AND RATIONALE

1. Country and sector issues

With a growing population, strong economic growth, and a policy of universal access to electricity, Morocco's electricity demand is increasing rapidly. Growth in Moroccan electricity demand has accelerated over the last 3 years from 6% p.a. on average during 1997-2002 to 8% p.a. during 2003-2006. Even with intensified electricity conservation and demand side management (DSM) efforts, electricity demand is expected to continue growing at a similar rate. The "Office National de l'Electricité" (O.N.E.) projects that peak demand will grow from 3300MW in 2005 to between 4825MW and 5300 MW in 2010 and 7000MW and 8500MW in 2015 depending on assumptions on economic growth and energy conservation.

Moreover, the country is mostly dependent on imported fossil fuels to generate electricity, and the role of fossil fuels is expected to increase further, given the lack of endogenous resources. Preventing a further increase in import dependency requires the urgent development of the country's renewable resources, in particular wind and solar energy.

In this context, the major issues that face the Moroccan electricity sector include:

- Urgent need for new power generating capacity addition: on current plans, capacity will not be sufficient to meet peak demand without the addition of the 472 MW Ain Beni Mathar Integrated Solar Combined Cycle Plant on schedule. Widespread power blackouts could result from a schedule slippage.
- Bottlenecks in transmission and distribution to meet growing demand while ensuring security and quality of supply.
- The need to reduce electricity demand growth through demand side management measures (DSM) to reduce both peak load demand and total demand.
- The lack of availability of natural gas in sufficient volumes to fire power plants beyond Ain Beni Mathar.
- The need to develop non fossil fuel fired power generation, renewables in particular, in order to diversify the power generation mix and reduce import dependency overall.
- Integration into a regional Maghreb power market and with EU markets, that may impose harmonization of some rules and regulations regarding market operation.
- Large financing requirements to meet growing electricity demand.
- A national electricity company which needs to invest over $1billion per year in generation and transmission/distribution infrastructure.

A number of measures have already been taken or are under consideration by the Government and O.N.E. to address these issues:

- Ambitious plans to increase the contribution of renewable energy (RE) to 10%of the primary energy demand in 2012 (or 20% of the fuel input into the power sector). A law is in preparation to ensure these objectives are met.
- An aggressive program to increase energy efficiency (EE): the example is to be shown by the Government with new programs for energy efficiency in public buildings. The RE law also covers EE.

- Drafting of a liberalization law that calls for gradual introduction of competition, starting with high voltage customers, creation of an electricity regulator and restructuring of O.N.E.
- A feasibility study for an LNG terminal, as a way to diversify sources of natural gas supply and secure access to large new volumes of natural gas after 2012 to feed the power generating sector.
- Development of tighter links with the EU institutions through various programs and initiatives under the auspices of the European Neighborhood Policy.
- Creation of an attractive investment climate in particular through a stable and predictable regulatory framework.
- Cooperation with all donors to find sources of financing for the large infrastructure investment required.
- Measures to ensure a healthy and dynamic local financial sector, that can provide local financing for power projects as was the case for the Tahaddart CCGT plant.

Overall, the private sector was actively involved in developing power generation capacity, particularly in the 1990s, and today 70% of Morocco's power is generated by the private sector. A resurgence in private sector investment is expected once the new regulatory framework is established, including for renewable energy.

Morocco ratified the United Nations Framework Convention on Climate Change (UNFCCC) on the 28th of December 1995. In addition, Morocco hosted the seventh Conference of the Parties to the UNFCCC in November 2001 and ratified the Kyoto Protocol on January 25, 2002. As a non-Annex I country, Morocco is eligible for financing from the GEF through the mechanisms established by the Convention. The proposed project has received the endorsement from the GEF Operational Focal Point and is formulated in accordance with national priorities.

2. Rationale for Bank involvement

The proposed project integrates conventional combined cycle gas turbines with solar thermal technology. It will provide urgently-needed power in Morocco (472MW), and simultaneously contribute to an important global test of a new approach to renewable energy. As noted in the Bank's report to the Development Committee on the Clean Energy Investment Framework, incentives are needed to induce technological change to a low carbon economy. The proposed project would demonstrate how de-carbonizing of the power sector could be facilitated by the large-scale development of new energy production technologies.

The proposed project is strategic for the achievement of the objectives of GEF's Operational Program 7, which aims to reduce, over the long term, the costs of energy technologies with low greenhouse gas emissions, and which are currently not cost-competitive (see below under "Higher level objectives and Rationale for GEF funding"). The Bank fully supports that pioneering objective. The proposed Morocco project is one of a series of similar projects, which together will contribute to learning about such technologies, and dissemination of that learning. In this way, Morocco, GEF, and the Bank are jointly participating in a very promising global experiment.

The proposed project is also strategic for the Bank in Morocco, now that the Bank has regained a high-level of partnership in the country's energy sector after a gap of some years (the project is included in the 2005 CAS). The Government of Morocco, O.N.E., and the Bank are engaged in an intensive policy dialogue in this key sector, and a comprehensive program of financial and technical support is being developed. Reliability and long-term involvement are the foundation of this relationship.

The first in a programmatic series of Energy Development Policy Loans (DPL) is now at an advanced stage of preparation (Board presentation is proposed in FY07). The DPL supports the Government's energy sector reform program which focuses on (i) energy security and sustainable development; (ii) increasing energy sector productivity and Morocco's competitiveness; (iii) moderating fiscal exposure in the energy sector; and (iv) enhancing monitoring, evaluation, and public communication in the sector.

The DPL is being developed in consultation with the European Commission under the auspices of the European Neighborhood Policy, and the EU and Morocco's joint objectives of closer economic integration and environmental protection.

There are clear synergies between the proposed Integrated Solar Combined Cycle Power Project (ISCC) and the programmatic DPL: (i) support for sustainable development through an experimental renewable energy technology that could prove highly efficient, if the experiment succeeds; (ii) avoidance of power blackouts in Morocco which would have serious political and economic implications, and would undermine reform; (iii) a gradual approach to electricity market liberalization which will be supportive of renewable energy development; (iv) promotion of private participation in power which would allow the eventual privatization of the ISCC; and (v) enhanced monitoring and evaluation capacity in Morocco which will be critical for global dissemination of the learning which is at the heart of the ISCC project.

The goals of the ISCC and programmatic DPL, will also be underpinned by a proposed Bank investment loan to O.N.E. This is at a relatively early stage of preparation (for Board presentation in FY08), and will focus on augmenting transmission capacity to keep pace with rapid electricity demand growth and investment in generation capacity, including ISCC. The loan will also include assistance to O.N.E. to restructure in order to respond better to the reformed policy framework, including in its support for renewable energy development.

The Bank's participation in the proposed ISCC project is intended to catalyze the financing that is essential to the project going ahead. This financing comes from GEF, the African Development Bank (AfDB), and O.N.E and the Bank's role is to help coordinate the packaging of financing and contracting to achieve the project objectives. At this late stage of project preparation, site selection and acquisition, bidding and contracting, it would be very costly to Morocco if the package needed to be reconfigured in any major way. The EPC contractor has been selected and is ready to be mobilized in March 2007. The Bank's role is to continue to coordinate so that the plant commissioning remains on schedule and the project objectives are achieved.

3. Higher level objectives and Rationale for GEF funding

In 1996, the GEF's Scientific and Technical Advisory Panel (STAP) recommended high temperature solar thermal power technologies as one of the renewable energy technologies that had significant cost reduction potential. The GEF support for solar thermal technology was mooted as a means to increase market awareness through limited scale demonstration projects in solar resource rich developing countries.

GEF Operational Program Number 7 ("Reducing the Long-term Costs of Low Greenhouse Gas-Emitting Technologies") emphasized certain limited technologies including parabolic trough based solar thermal electric technologies to be cost-effective. "For cost-effectiveness, the scope of the technologies covered by the operational program needs to be limited to those whose costs will drop significantly with economies of scale in manufacture and application."

The selection of technologies for OP 7 was made based on certain criteria; extent to which basic RD&D has already been done (for technologies where the markets are both in recipient and developed countries) or significant prior operational experience exists; size of remaining technological barriers and risks; technology's current cost; prospects for reduction in costs of the technologies in question (steep learning curves); contribution that GEF financing can make to cost reductions; and the primary market is in the recipient countries because of resource endowment and potential for that technology, when commercial, to reduce greenhouse gas emissions.

Large-scale solar-based power plants are still a long way from being cost-competitive with fossil-fuel based plants. However, within the range of solar thermal electric generation options, the integration of solar and combined cycle (ISCC) technology is the most promising in the long-term as a reliable and cost-effective source of power supply. For developing countries especially, where the primary need is electricity (not necessarily green electricity), the combination of solar energy with a large-scale fossil fuel power plant can, in the technology introduction stage, be more attractive than stand-alone solar plants. For this reason, the technology is consistent with the objectives of GEF OP7, which justifies GEF grant support in pursuit of the global program objective of increasing the market share of low greenhouse-gas emitting technologies that have not yet become widespread least-cost alternatives.

OP7 states that "the objective will be achieved by GEF's promotion of such technologies so that, through learning and economies of scale, the levelized energy costs will decline to commercially competitive levels....A project leads to reduction in GHG emissions not only directly, but also indirectly by being one of series of projects that induce cost reductions in the technology...The direct outputs of the technology are the amount of energy generated, the amount of GHG emissions avoided etc. The indirect project output, of greater programmatic interest, is the reduction in cost that it caused and the time horizon for the achievement of program objectives will typically be on the order of decades. The technologies identified under this program will require the security of funding and long-term commitment of GEF support."

Consequently, GEF and the Bank agreed to pursue solar thermal projects in India, Mexico, Morocco and Egypt as part of a strategy to facilitate the commercialization of solar thermal

technology. The India project (later dropped) entered the work program in 1996, followed by the Mexico and Morocco projects in 1999 and finally the Egypt project in 2004. The Mexico project is now under implementation, and the financing for the Egypt project has been negotiated, and the procurement process has almost been concluded. The proposed Morocco project is slightly ahead of the Egypt project: financing has been negotiated, and the contractor has been selected. After eight years of preparation, construction is ready to start - pending approval of the GEF grant.

In essence, the GEF participation in the project is intended to support primarily global program objectives, and Moroccan national development objectives only secondarily. That is the rationale for substantial grant financing from the international community through GEF. However, one-third of the financing for the solar component of the project would come from O.N.E. equity and borrowings in testimony to the fact that the global environmental objectives are closely linked to the Morocco's national sustainable energy development strategies.
In the GEF-World Bank portfolio of solar thermal projects, the preferred configuration is the ISCC. This configuration integrates the steam output from a solar field into the steam turbine of a combined cycle gas turbine (CCGT). Given that there is now significant experience relating to combined cycle operation, as well as adequate knowledge of solar field operations, the ISCC configuration is sound from a technical standpoint. However, as projects utilizing this integrated configuration have not yet been implemented, the first few projects, including the Morocco project, may face teething problems. But any problems that arise are not likely to be fundamental in nature but rather related to optimizing energy flows, particularly under transient solar conditions.

By integrating the solar field with the combined cycle technology, the ISCC configuration offers several cost reduction and operational advantages over independent solar thermal plants that make them more suitable for introducing solar field based electricity generation in developing countries. In the ISCC configuration, the need for an independent power block for the solar field is offset by utilizing a larger steam turbine in the CCGT plant, reducing the capital costs through economies of scale. Such a configuration also reduces the solar energy losses that occur in an independent solar plant due to daily start-up and shut-down. In addition, the hybrid plant can remain in continuous operation irrespective of solar availability providing much needed generation. The solar field also offers a power boost when CCGTs suffer a reduction in plant output at times of high outdoor temperatures, since that coincides with high solar radiation as well.

In 2005, the World Bank commissioned an independent assessment of the World Bank/GEF strategy for the market development of concentrating solar thermal power. The study's conclusions may be summarized as follows:

- Over the last 2 years, the industry has been reinvigorated. Several projects are presently under construction around the world. Nonetheless, these projects have not reached the kind of critical mass to suggest that the industry is now self-sustaining.
- Solar thermal electricity offers a number of advantages when considered as part of a country or region's energy generation options mix. Solar thermal, based on a hot

fluid, can integrate well with conventional thermodynamic cycles and power generation equipment.

- In most cases, the Integrated Solar Combined Cycle configuration showed lower LEC than the SEGS plants California. The reason for this is that the incremental cost of a larger steam turbine is much lower than building a stand-alone power block for a SEGS plant.
- ISCC is well-suited for market introduction because the additional marginal investment for the conventional plant components is relatively low. There are also areas of overlap, and thus cost-reduction potential, with the plant infrastructure and project implementation costs.
- The technology is not new, but stalled in its development path. There is no fundamental reason why the technology could not follow a similar cost reduction curve to wind energy and eventually be cost-competitive. Cost reductions would require a combination of plant scale-up, increased production volumes and technological innovation.
- Against the thousands of megawatts needed for CSP to reach cost-effectiveness, the GEF portfolio will not, of themselves, lead to any significant reduction in the underlying cost of the technology. However, the plant capacity of projects in the GEF portfolio is not insignificant compared to the present 300MW or so of possible-to-firm projects in OECD countries. Therefore, the GEF co-financed plants are important to maintaining momentum in the CSP industry and to developing operational experience in developing countries.
- By supporting implementation of the first solar thermal power demonstration plants, the GEF will help create confidence in the technology and institutional learning, thereby reducing the hurdle for subsequent market entry of CSP.

Several ISCC projects outside the GEF/Bank portfolio are also being developed in Algeria, Spain etc. Over the long run, it is expected that the cost of the technology will come down due to technical progress and lessons learned from earlier deployment (as in the case of the proposed project). In the Northern Mediterranean "sunbelt", several STP projects are already being planned in Greece, Spain, and Italy through national programs and the support of the EU. Bulk transmission of electricity from STP plants from high insolation sites in Southern Mediterranean countries, such as Algeria, Libia, Egypt, Morocco, and Tunisia, may also open wider opportunities for European utilities to finance solar plants in that region for electricity consumed in Europe. Reform of electricity sectors across Europe, the rising demand for "green power", and the possibility of gaining carbon credits are increasing the viability of such projects. Finally, research and development work continues in Europe and the United States to further reduce costs by improving plant components.

B. PROJECT DESCRIPTION

1. Lending instrument

A GEF grant ($43.2 million) will be used to finance part of the proposed integrated solar combined cycle power plant, by covering about two-thirds of the total capital cost of the solar

component ($66 million)[1], or about 8% of the total capital cost of the integrated plant ($568 million). The remainder of the project cost will be covered by O.N.E. borrowings from AfDB ($390 million) and O.N.E.'s own equity contribution ($135 million). See Annexes 4 and 5 for project cost details, and Annex 16 for details of the incremental costs of adding a solar component to a combined cycle power plant.

2. Project Development Objective and Key Indicators

The main national objectives of the project are to add urgently-needed capacity to the Moroccan power grid to help cope with the sustained growth in electricity demand, to increase the contribution of renewable energy sources in Morocco's energy mix thereby reducing greenhouse gas emissions, and to contribute to a program of global environmental significance.

Key specific performance indicators are the following:

- Total electricity generated from the ISCC power plant (GWh/year)
- Share of ISCC energy in total energy production (%)
- Solar output (GWh/year)
- Solar output as a percentage of total energy produced by the ISCC power plant

3. Global Environmental Objective

The global environmental objective of the project is to reduce greenhouse gas emissions from anthropogenic sources by increasing the market share of low greenhouse gas emitting technologies.

The project will demonstrate the operational viability of hybrid solar thermal power generation technology and contribute to replication of integrated solar combined cycle (ISCC) power generation technology in Morocco and elsewhere through the learning effect provided by its construction and operation, and through economies of scale as use of the technology spreads. It is one of a number of similar projects in the world to be supported by GEF, and by other financing sources, as part of a global programmatic effort to accelerate cost reduction and commercial adoption of large-scale low greenhouse emitting generation technologies. Secondarily, the project will make a modest direct contribution to the reduction of greenhouse gas emissions.

To evaluate the performance of the project in achieving the global program objective, the following indicators have been chosen:

Quantitative Indicators

- Cost of solar thermal (¢ / kWh),
- Cost of solar power as a % of natural gas price,
- Reduction in CO_2 emissions (tonnes / year) estimated at about 610,000 tonnes over the 25-year economic life of the plant,

[1] The *incremental* capital cost of the solar component is $62.5 million, which is equal to the total capital cost of that component ($66.5 million) minus the avoided capital cost of an equivalent combined cycle capacity ($4 million).

- Number of O.N.E.'s staff trained in various aspects of solar thermal technology, and
- Dissemination.

    - Number of visitors to and information requests about the plant.
    - Number of workshops and conferences in which the experience about the construction and operation of the plant was presented.
    - Information about the plant posted on O.N.E.'s external web site.

Qualitative Indicators:

- Lessons learned during the pre-construction phase (feasibility study and bidding process, environmental and social safeguards and financing.),
- Lessons learned during the construction of the plant; and
- Lessons learned from the operation of the plant and initial assessment of the viability of the technology after three years of operation of the ISCC power plant.

The dissemination and other qualitative indicators are designed to capture the global learning effect of the project, which is its overarching objective. They are considered at least as important as the quantitative indicators, which measure the modest direct impact of the project, and give some quantitative indication of this individual project's contribution to the overall impact of a long-term series of investments in the technology.

(See Annex 3 – Results Framework for baseline and targets)

4. Project components

The project includes the integration of a parabolic trough solar field (of about 183,120 m2) with a traditional natural gas-based power generating unit (combined cycle). The proposed project involves the construction and operation of a solar/fossil fuel hybrid power station of about 472 MW, of which 452 MW[2] from combined cycle gas turbine and 20 MW from the solar component with an expected annual net production of 3,538 GWh per year. The solar output is estimated at 1.13% of the annual production representing 40 GWh per year. It is expected that the solar thermal power plant will be in service by February 2010.

The plant will be built and operated through an Engineering, Procurement and Construction (EPC) cum Operation and Maintenance (O&M) contract. O.N.E. will thus be the owner of the plant. The O&M contract will last 5 years and include appropriate incentives to ensure an efficient operation of the plant, particularly the solar field. These incentives are related to the output of the solar field and efficiency of its operation and are enforced by monetary penalties. The O&M contract will also lay the ground for maximizing the utilization of the solar field over the long term through on the job training of O.N.E.'s staff in the operation and maintenance of the solar field. The bidding documents issued in July 2005 established minimum requirements for the solar thermal power to ensure that the minimum solar share target could be met. The

[2] In a previous design, the combined cycle capacity was only 207MW. However, a planned gas-fired plant elsewhere in Morocco was severely delayed, so an additional gas turbine was subsequently added to the design of the Ain Beni Mathar plant, to give a total combined cycle capacity of 452MW. The bidding process was modified to require bidders to submit 207MW and 452MW options, and O.N.E. selected the latter.

prequalification of consortia that had both combined cycle and solar thermal power experience ensured the effective integration of the solar field and the combined cycle power plant.

A breakdown of the project components is provided in the table below.

Component	*Indicative Costs (US$M)*	*% of Total*	*Bank financing (US$M)*	*% of Bank financing*	*GEF financing (US$M)*	*% of GEF financing*
1. Design, Construction and Operation of an Integrated Solar Combined Cycle Power Plant	*519.27*	*91.45*			*43.2*	*100*
2. Transmission lines	*17.84*	*3.16*				
3. Substations	*9.04*	*1.59*				
4. other infrastructure (1)	*14.24*	*2.50*				
5. Environmental and Social Dev. and Management	*2.31*	*0.40*				
6. Technical Assistance	*5.09*	*0.90*				
Total Project Costs	***567.80***	***100.0***	*0.00*	*0.0*	***43.2***	**100**

(1) See Annexes 4 and 5 for details
(2) Costs include physical and price contingencies (see Annex 4)

The timeline up to construction is as follows:

1. Pre-qualification - Done
2. Preparation of bid documents - Done
3. Preparation and submissions of offers - Done
4. Technical and commercial evaluation of offers – Done
5. ISCC Contract signature – by April 30, 2007 (date of expiry of bid validity)

5. Lessons learned and reflected in the project design

Power Sector Development in Morocco

In earlier Bank projects, some of the critical issues were the high level of subsidy provided by GoM to O.N.E.'s investment program to compensate for delayed tariff increases, the high level of arrears in subsidy payment, and the lack of autonomy of O.N.E. GoM has now shifted its policy by promoting financial sustainability of O.N.E., as well as private participation, which in turn has substantially reduced O.N.E.'s investment requirements. Recent GoM actions on electricity tariff increases and those adopted by O.N.E. to recover arrears and to streamline its organization, have substantially improved the financial and institutional performance of the

sector. This is being further underpinned with support from the programmatic energy DPLs and the proposed investment loan to support O.N.E. restructuring.

Solar Thermal Power Plant Development Worldwide

No large-scale solar thermal power plants have been built in developing countries to date, and no plant integrating solar thermal technology and combined cycle gas turbines has yet been built anywhere. GEF-supported projects are now in preparation in Morocco and Egypt, and under implementation in Mexico. The most significant solar thermal installations are in California where 354 MW of parabolic troughs, with back-up gas-fired steam boilers, have been generating electricity and selling it to the utility for more than 15 years. However, to meet the cost reduction objectives of GEF's OP7, it is necessary to move beyond the trough/back-up boiler design upon which the California projects were based. The purpose is to permit higher thermal efficiencies, improve the dispatching of the plant and encourage greater competition in the design and supply of the equipment. Such a plant would be more attractive to utilities, thus increasing the market size.

For this reason the project includes the following features: (i) bidders have been allowed to choose among qualified manufacturers for the parabolic trough designs and the gas-fired power equipment; (ii) competition is key to ensure the lowest electricity cost possible and, whenever possible, locally manufactured components; and (iii) the contractor will have incentives to maximize output from the solar field, which will bring about a focus on O&M costs, thus bringing down life-cycle costs.

To accelerate utility acceptance of a power generation technology based on intermittent energy sources such as solar, a way must be found to provide reliable backup and enable the delivery of firm power. The project integrates the STP plant with a gas-fired combined cycle power plant such that continuous generation by the hybrid plant is possible regardless of the solar radiation intensity at any particular time. Furthermore, more efficient construction, financing and operation can also be expected as a result of private sector involvement in the EPC and operation and maintenance contracts.

Bidding process

Given that no integrated solar thermal combine cycle plants have yet been built, and given that the solar thermal market includes a limited number of suppliers, pre-bidding cost estimates were subject to a high degree of uncertainty. Since the GEF grant funding was essential to allow inclusion in the overall project of a technology that is not yet cost-competitive as an energy source, and the grant size was pre-determined, the bidding process needed to safeguard against costs far in excess of the grant.

For that reason, bidders were asked to submit two offers: one for 30MW solar capacity and one for 20MW. This was deemed fully consistent with the objectives of the project, since the learning attained with 20MW of capacity does not differ significantly from learning with 30MW (see below).

This is also consistent with the recommendation of the independent study team commissioned by the Bank, which concluded that bids should not "specify a particular solar field capacity, but rather a minimum threshold, with capacity offered an assessment criterion. The resulting competition will ensure the maximum capacity possible is offered for the finance available."

6. Alternatives considered and reasons for rejection

In the eight years over which this complex project was developed, using an untested technology and during a period of significant changes in the power sector, a number of alternatives were considered, including outright cancellation. However, after due consideration, GEF, O.N.E., and the Bank retained their joint commitment to go ahead with the project in accordance with the mutually-agreed objectives.

Choice of plant site

The pre-feasibility study financed by the European Community (EC) provided the economic analysis for the 11 alternatives studied at the Jerada and Ain Beni Mathar sites. The alternative at Ain Beni Mathar (about 80 km south of Oujda), which provided the lowest levelized tariff and the highest rate of return, was selected. The selection also included criteria about the sun level, the availability of cooling water, and the location with regards to the electricity grid and gas network.

It is notable that the relatively high solar radiation (and hence temperature) and high elevation of the Ain Beni Mathar site made it simultaneously preferable for the solar component, but suboptimal for the combined cycle component (which operates with lower efficiency at high temperatures and high elevation). The choice of site was essentially a compromise permitting the effective testing of the integrated technology concept, while incurring an incremental cost for so doing. However, this choice did impose a risk: if the solar component of the project did not go ahead, because of the complexities of contracting and financing the project, the combined cycle plant would either be left in a suboptimal location, or be subject to serious delays as the whole project were redesigned in a different location. Nonetheless, O.N.E. decided to assume that risk.

Choice of private versus public sector ownership

The proposed project, along with other similar projects in the GEF portfolio, were initially expected to be implemented as Independent Power Projects (IPPs) and are now being developed as public sector power plants. The IPP approach was unsuccessful due to the risk aversion of the private sector to this new technology coupled with the general global decline in IPP interest in developing countries. In Morocco, O.N.E. launched two expressions of interest for an IPP for the solar thermal combined cycle power project in May and October 2002, but attracted no interest. Likewise, a planned seminar in May 2003 to inform and attract potential investors was not held due to lack of interest. The issue was discussed with GEF Sec which provided its written approval on July 17, 2003 for the structure to be changed from an IPP to a public sector project. The issue was also brought to the attention of the GEF council through a council paper titled

"Solar Thermal Portfolio: A Status Report" Information document number GEF/C.23/Inf.9 circulated for the May 2004 meetings.

Choice of smaller versus larger solar capacity

At the time of GEF work program inclusion in 1999, a pre-feasibility study, based on then-available cost estimates, concluded that 38MW-45MW of solar capacity could be financed with a $43.2 million GEF grant. More detailed analysis conducted subsequently, in a full feasibility study, concluded that possibly 30MW could be purchased for that amount. However, since there was very considerable uncertainty about market reaction to an untested technology with very few suppliers, the bidding process for the proposed project was designed to mitigate the risk of costs proving to be higher than expected (as described above). The bidding process therefore allowed bidders to submit two solar options: one with a minimum of of solar capacity, which was used to determine the selection of the winning bid, and one with a capacity of 30MW.

The outcome of the bidding process demonstrated the logic of that approach: even 20MW proved to cost well above $43.2 million (the lowest evaluated bid gave a capital cost for 20MW of $66 million, and for 30MW it was $70.3 million.). O.N.E. nonetheless decided to proceed with the solar component of the project – at the level of 20MW - using $23 million of its own financing to supplement GEF funds.[3] This decision was based on O.N.E.'s commitment to the agreed GEF objectives, and to avoiding the power blackouts that would likely occur in Morocco as a result of serious delays incurred through redesigning the project to exclude the solar component. Furthermore, it was recognized that use of own resources to this extent would not impose a significant tariff burden on Moroccan consumers.

However, O.N.E. decided not to spend the additional $27.1 million of its own funds that would have been necessary to reach 30MW of solar capacity, because achievement of the project objectives would not have been materially affected by that incremental expenditure, and O.N.E. would have incurred significant borrowing/opportunity costs for those additional funds.

In essence, it was recognized by all stakeholders, that the global program objectives could be achieved equally with 20MW of solar capacity as with 30MW, given that the objectives focus primarily on learning and demonstration, rather than on the direct reduction of emissions. As the "Assessment of the World Bank/GEF strategy for the Market Development of Concentrating Solar Thermal Power" acknowledged in 2004, "Given that these are first-off projects in developing countries, the risk margin is likely to be high, resulting in the possible situation where all the bids come in either too expensive for the finance available, or non-conforming (reduced field size). The capacity of these first projects is to some extent arbitrary. It is unlikely that in ten years time the issue of whether the first ISCC project comprised 25 or 28MW of solar will be an issue. What will be an issue is whether....they operated successfully."

[3] For ease of presentation. the O.N.E. contribution is given here as a portion of the total capital cost of the solar component. Elsewhere in the report, O.N.E.'s contribution is given as a portion of the incremental cost of the solar component.

Cancellation of the solar component of the project

Cancellation of the solar component of the project was considered in 2004, but rejected. Some GEF council members expressed their concerns regarding the slow pace of implementation of this portfolio at the May 2004 council meetings. In response, the Bank commissioned an independent assessment of these projects in close collaboration with the GEF Secretariat as well as the client countries and the Solar Thermal Industry. The draft of this review titled "Assessment of the World Bank/GEF strategy for the Market Development of Concentrating Solar Thermal Power," Information document number GEF/C.25/Inf.11 was circulated to the GEF council for the June 2005 council meetings for comments, and subsequently finalized incorporating the comments received. The review, carried out by a consortium led by Council for Scientific and Industrial Research (CSIR), South Africa, concluded that the World Bank and GEF should not pull out of the portfolio but rather follow a "prudent, active support of the technology, but with appropriate exit strategies if milestones are not met." Two of the key conclusions of this study were:

- The solar thermal industry, beginning again in earnest [after 354 MW additions in 1980s in the U.S], is fragile. Against the thousands of megawatts needed for the technology to reach cost-effectiveness, the Bank-GEF portfolio by itself will not lead any significant reduction in the underlying cost of the technology. However, these projects are important to the global solar thermal industry as they constitute a significant percentage of the planned projects at present.

- Given these are first-off projects in developing countries, the risk margin is likely to be high, resulting in the possible situation where all bids come in either too expensive or non-conforming due to reduced field size. Therefore, bids should not specify a particular solar field capacity, but rather a minimum threshold, with capacity offered as an assessment criteria.

Choice of small versus larger combined cycle capacity

The combined cycle capacity was initially conceived at about 100MW, at the time of GEF work program inclusion in 1999. Subsequently, it was increased to 207MW, given the rapid growth in demand for power in Morocco and the economies of scale of the larger plant. During the bidding process in 2006/7, an alternative option of 452MW was included, because another combined cycle plant elsewhere in Morocco was encountering serious delays. Ultimately, O.N.E. selected this larger option, in order to avoid electricity blackouts in Morocco, and given that the increased combined cycle capacity would have no negative impact on the achievement of the project objectives supported by GEF. In short, the solar learning experience is not significantly affected by the combined cycle capacity.[4]

[4] A similar increase in combined cycle capacity took place during preparation of the GEF-supported Solar Thermal Agua Prieta II Project in Mexico.

Choice of specific type of solar technology

The Global Environment Facility (GEF) has identified "solar thermal-electric technologies in high insulation regions, initially emphasizing the proven parabolic trough variant for electric power generation"[5], as one of the renewable energy technologies it supports through its operational program number 7. Development of solar power technology (STP) represents one of the most cost-efficient options for renewable bulk, power production, and the most cost-effective way of producing electricity from solar radiation. Indeed, STP could play an important role in meeting some of the increasing demand for electricity, with fewer emissions than the alternative plants powered purely with fossil fuels.

STP plants produce electricity in the same way as conventional power stations, except they obtain all or part of their thermal energy input by concentrating solar radiation and converting it to high temperature steam or gas to drive a turbine. Essentially, STP plants include four main components: the concentrator, receiver, transport-storage, and power conversion. Many different types of systems are possible using variations of these components. Although there are, broadly, three solar thermal technologies: the parabolic trough, the central receiver, and the parabolic dish system; the parabolic trough is the most technically and commercially proven option. However, although solar electric generating systems have proven to be a mature electricity generating technology, they do not represent the end of the learning curve of parabolic trough technology. A number of improvements and developments have taken place since.

One of these improvements is the integrated solar combined cycle system (ISCCS), which integrates a parabolic trough plant with a gas turbine combined-cycle plant. Essentially, the ISCCS uses solar heat to supplement the waste heat from a gas turbine in order to augment power generation in the steam turbine. This represents cost savings for project using this design. Both the incremental cost and O&M cost of the ISCCS are lower than a trough plant alone, and the solar-to-electric efficiency is improved. Studies have shown that the ISCCS configuration reduces the cost of solar power by as much as 22 percent over the cost of power from a conventional solar electric generating station (SEGS) of similar size. The ISCCS is the most efficient technology available and it has been adopted for the proposed project (see Annex 15 for an illustration). It has however been decided to exclude thermal storage as this technology has not yet been commercially proven on a large scale.

The Government, through the Ministry of Energy and Mines (MEM) and O.N.E., is committed to the proposed project and has stressed its preference for a commercially proven technology for the solar capacity. As such, it has been decided that the project design be based on the parabolic trough technology.

C. IMPLEMENTATION

1. Partnership arrangements

The project is co-financed by O.N.E., GEF and the African Development Bank (AfDB). Their respective contributions to the total project cost are 24%, 8%, and 68% respectively.

[5] GEF: Operational Program Number 7: Reducing the Long-Term Costs of Low Greenhouse Gas-Emitting Energy Technologies.

2. Institutional and implementation arrangements

Consultants partially financed under a GEF PDF C grant, now closed, assisted O.N.E. in the preparation of bidding documents, and draft EPC and O&M contracts and advised O.N.E. during the evaluation of proposals.

The construction and operation of the ISCC power plant will be implemented by an EPC cum O&M arrangement secured through international competitive bidding. The Production Department of O.N.E. will have the responsibility for overall project management. This Department will ensure the coordination and the technical and administrative management of the project. It will work in close collaboration with the Supply and Markets Department for the procurement aspects, with the Environment and Quality Department for the coordination of the studies and the monitoring of environmental measures, and with the Technical Department for the technical controls and oversight. The Financial Department will be in charge of the project financial management, and coordination with the various loan/grant providers. The production department will be assisted by a consulting engineer to be recruited under the project and financed by AfDB and O.N.E.

The World Bank will supervise and monitor the implementation of the activities through regular supervision missions (with the African Development Bank) and regular contacts with O.N.E. The power station which comprises a combined cycle and a solar component will be jointly financed by AfDB, O.N.E., and GEF because there will be a single contract signed for both. Following the pre-qualification exercise that took place in May 2004, consortia were formed each of which was composed of a combined cycle manufacturer and a solar manufacturer. This arrangement minimizes the risk to the project due to the fact that the responsibility and the risk of interface between the combined cycle and the solar component is left to the consortium and is not borne by O.N.E. Since the responsibilities are clearly defined, the arrangement also reinforces the incentives for operating the plant in the most efficient manner possible.

The implementation period will be three (3) years and is expected to take place between May 2007 and April 2010. In addition, the project will be supervised over the next three years to learn from its operation and ensure that the integrated solar combined cycle power plant is optimally operated.

The Personnel and Generation Departments of O.N.E. will oversee the training of their own staff in various aspects of ISCC technology.

3. Monitoring and evaluation of outcomes/results

Monitoring and evaluation

The project's primary purpose is to demonstrate and encourage replication of ISCC power generation technology. Consequently, an adequate project performance monitoring, evaluation, and dissemination system is a key component of the project design.

The monitoring and evaluation of results and outcomes will be the responsibility of O.N.E. Data will be collected and reported on by the EPC contractor and the consulting engineer while under contract. The successor, be it O.N.E. or a private operator, will take over this responsibility for the remaining life time of the plant. This would allow continuous monitoring of the project's key indicators.

The format, contents and frequency of implementation progress reports as well as reporting procedures have been agreed with O.N.E.. The Bank will closely supervise the project during its construction and first three years of operation to make sure that the learning from this experience has been fully captured and disseminated. A mid-term review will be carried out after the first year of operation to evaluate the achievement of the project development objective and take corrective action to ensure an efficient operation of the project, especially the solar component.

During the course of implementation, the World Bank will monitor and evaluate global benefits related to OP7 objectives (market penetration, global cost reduction of ISCC technology, etc.) for all the solar thermal projects in the portfolio.

Dissemination

O.N.E. will disseminate the results from the project both domestically and internationally, as a way to support future replication. The main components of O.N.E.'s dissemination strategy include: (a) transparency in the availability of information from monitoring and evaluation activities; (b) ease of access to relevant monitoring and evaluation information, as required by decision-makers and other users, including full disclosure of non-confidential information; (c) special initiatives to engage policy and operations decision-makers and program stakeholders in internalizing the lessons from experience and best practices; (d) use of lessons learned and best practices in the development of new policies and projects; and (e) systematic action on findings and recommendations that flow from the M&E program.

Some of the main dissemination techniques will include: preparation of reports, summaries and abstracts; management and staff review sessions; wide participation in project review processes by project staff and intended beneficiaries; special analyses of experience in project documents; country and regional seminars and workshops. O.N.E. will also make all the information about the ISCC power plant, including performance indicators, available on its external web site.

The dissemination will also be made through facilitating visits by the power industry, utilities and other interested institutions from all over the world to learn from the construction and operation of the plant and the results achieved. O.N.E. has indicated that it welcomes such visits as well as requests for information.

The primary end users of monitoring and evaluation products are: GEF Council and GEF Secretariat, the relevant Conventions, STAP, other international organizations, NGOs, country representatives, power industry, utilities and related stakeholders and interested members of the public.

Capacity building of O.N.E. for the above activities will be implemented as part of a technical assistance component to be financed by the project. A result indicator has been included in the results framework regarding the training of O.N.E.'s staff in integrated solar combined cycle power technology. The format will be a combination of formal and on-the-job training.

The dissemination of global results and outcomes will be the responsibility, as for the monitoring and evaluation of global benefits, of GEF, and the World Bank. . As part of the dissemination and replication strategy for the project, the World Bank and GEF will undertake a number of knowledge management activities, such as:

- Disseminate experience from the ISCC projects at key energy events and conferences, including those organized by the Bank's Sustainable Development Network.
- Organize international workshops on ISCC projects, once operational, to share lessons learned from early operation of the ISCC power plants.
- Identify financial resources for study tours from countries with potential interest in ISCC.
- Maintain a strong link with market initiatives for the development of the CSP technology, such as the Global Market Initiative.
- Conduct a specific portfolio assessment of the ISCC projects as part of the Bank's annual GEF Project Implementation Review, with the participation of stakeholders from power sector, industry, technology R&D institutions.

4. Sustainability

Project sustainability

The higher capital cost of the hybrid plant will be partly offset by the proposed GEF incremental cost grant and will not require significant increases in tariffs to consumers. The integration of the solar field with a CCGT is the most efficient technology available. The hybrid power plant is expected to operate sustainably as an integral part of the Moroccan power system. The incentive structure for the EPC cum O&M will ensure optimal design for integration of the solar thermal with the gas-fired plant and maximize solar output from the plant when in operation. Dissemination of information about this demonstration project will contribute to future replication in Morocco and elsewhere and help refine GEF strategy regarding this technology.

The Government is currently engaged in the implementation of policy measures that would: (i) gradually liberate the electricity market; (ii) rationalize energy pricing; and (iii) promote renewable energy and energy efficiency to reduce the country's energy dependence.

O.N.E. has devoted considerable efforts to preparing the proposed project to address growing concerns in Morocco about the adverse environmental impacts of SO_2 and CO_2 emissions from conventional power plants. The Government of Morocco (GoM) and O.N.E., which will be directly responsible for the project, are fully committed to the project's success and sustainability and have already collected a considerable volume of information and data on the construction, operation and maintenance of solar thermal power plants in the US and Europe. O.N.E. power

plant staff will be trained in the requisite skills for operating and maintaining a hybrid solar combined cycle power plant during the construction and operation of the plant.

Solar thermal power (STP) technology has made remarkable progress over the past decade. Many new STP plant technologies and component designs are now being operated successfully. Teething problems experienced during adjustment periods have been successfully addressed. Because of the important risks related to the introduction of this complex technology, governments and agencies in Europe and the US have cooperated with the private sector, sponsors and financial institutions to support demonstration projects to minimize investment risk. As expected, performance of some of the STP demonstration plants was lower than expected and appreciable adjustments and operational modifications were made to ensure trouble-free operation. After the initial teething problems, the performance characteristics of the plants have approached design targets and even exceeded them in a few cases.

For the proposed project, a large part of the experience gained in constructing and operating new STP projects in the US and Europe will be made available through GEF support. However, implementation and operation of the technology in a developing country still carries appreciable risks. The plant availability factor may be lower during the first year or two than those achieved in overseas projects. Nevertheless, the chance of ultimate success for the project is good, and the global benefits from the dissemination of the technology in Morocco and other countries should be substantial. The success of the proposed project, which GEF support would promote, is the critical first step in Morocco's and the Northern Africa region's gradual approach for adopting and developing ISCC technology on a large scale. GEF support is also critical to strengthening and speeding up the dissemination and replication strategy.

Replicability

The general approach adopted by the project is highly replicable within Morocco, regionally and globally. The main barriers for future replication are costs and the associated learning needs, the overcoming of which this project is expected to address by providing cost reduction and operation information and disseminating it throughout the STP community. Successful construction and operation of the proposed commercial-scale ISCC project will convincingly demonstrate a cleaner and reliable way to meet growing power demand in Morocco and thus pave the way for replicating the technology elsewhere in Morocco and particularly in the Southern Mediterranean "sunbelt" (Algeria, Tunisia, Libya, and Egypt). The project would also promote replication of the technology in Morocco and elsewhere by: (a) transferring experience in the design, construction, and operation of ISCC plants in a developing country context; (b) facilitating the manufacture of some ISCC components in Morocco, which will reduce their cost and make the technology more cost-effective; and (c) training personnel of neighboring countries' utilities to operate ISCC power plants.

Furthermore and most importantly for replicability, there are no countervailing reductions in international prices of competing fuels (particularly fossil fuels) and competing technologies. Quite the contrary is currently happening in international markets, particularly for fossil fuels where the high price levels achieved are widely believed to be a long-run trend that is likely to be sustained.

The legal and regulatory framework currently being put in place under the Bank's energy Development Policy Loan (DPL), now under preparation, supports the development of renewable energy and its integration into the grid and lays the ground for replication of the solar combined cycle power technology in Morocco. Furthermore, the project's potential for replicability in Morocco alone is large because the country has one of the world's best solar resources. The success of the proposed project, with GEF support, is the critical first step in Morocco's gradual approach for adopting and developing ISCC technology on a large scale. GEF support is also critical to strengthening and speeding up the dissemination and replication process. After the replication of the proposed ISCC project on a larger scale in Morocco and elsewhere, it is expected that the production cost of the ISCC power plants will fall significantly and that the levelized electricity generation cost will be about the same or even less than that of conventional power plants. The cost reductions will result from three factors: reduced component costs due to increased manufacturing volume, economies of scale from increased plant size, and technological improvements.

5. Critical risks and possible controversial aspects

Risk	Risk Rating	Risk Mitigation Measure
From Outputs to Objective		
The continued commitment to innovative approaches to clean energy production (especially renewables) is not maintained	M	Continued engagement with the GoM for the success of the project through sectoral policy dialogue.
The level-playing field between renewables and other sources of energy is not established / maintained	M	1. Develop an energy strategy (including renewables) as part of the Energy DPL 2. GEF grant and competitive bidding provide safeguards
From Components to Outputs		
Technological or design problems are encountered	M	Only pre-qualified firms were allowed to bid. However, those "problems" would in themselves constitute learning, and hence would contribute to project objectives.
There is no incentive to ensure that the solar contribution is maximized / the incentive is not working properly?	M	Ensure that incentives are properly designed and included in the contractual arrangements, particularly in the O&M contract
O.N.E. does not have experience with hybrid solar combined cycle power plants.	M	O.N.E. staff will be trained in the requisite skills during the construction and operation of the plant.
O.N.E. does not place a high priority on disseminating learning.	M	1.A monitoring and evaluation plan has already been agreed with O.N.E., including dissemination indicators to be monitored during the operation of the plant 2. O.N.E. has taken "ownership" of GEF program objectives, and committed substantial funds to their pursuit in this project.
Overall Risk Rating	**M**	

6. Grant conditions and covenants

Effectiveness conditions

The following events are specified as additional conditions of effectiveness of the Grant Agreement:

- Engineering consultant recruited.
- EPC/O&M signed.

Disbursement Conditions

- Effectively compensate the people affected by the land acquisition for the ISCC power plant.
- Effectively compensate the people affected by the land acquisition for the gas spur.

Other covenants: Project Execution and Environmental and social safeguard measures

1. In carrying out the Project, the O.N.E. shall ensure that:

(a) all land acquisition required for the purposes of carrying out any works under the Project, and activities related to the resettlement, rehabilitation and compensation of project affected person in connection with such works, will be completed prior to the carrying out of such works and in accordance with the provisions set forth in the EA, EMP, the RPF and the relevant RAPs in a manner satisfactory to the World Bank; and

(b) the RPF and related safeguard policies shall uniformly apply to all components of the Project that result in involuntary resettlement and/or land acquisition, regardless of the source of financing.

2. (a) The Environmental Assessment, the EMP, the RPF and the RAPs shall not be amended, revised, or abrogated without the prior approval of the World Bank;

(b) Prior to the carrying out of any Project activities not identified, assessed, nor included in the EA or EMP, such activities shall be subject to an environmental assessment, under terms of reference and in form and substance satisfactory to the World Bank; and

(c) Land acquisition activities under the Project which have not been identified, assessed, nor included in a RAP or RPF shall be subject to an environmental and social assessment under terms of reference and in form and substance satisfactory to the World Bank.

3 O.N.E shall provide biannual project reports in accordance with Section 2/06 of the Standard Conditions and on the basis of indicators agreed with the Bank.

D. APPRAISAL SUMMARY

1. Economic and financial analysis

The economic benefits of the proposed project include increased availability and improved quality of power supply. Furthermore, the project would assist ONE to develop institutional and technical capabilities in solar thermal combined cycle technology.

The project is expected to play an important role in the optimal development and operation of the power subsector. The capital costs of project, *reduced by the amount of the grant*, together with incremental fuel and operating and maintenance costs associated with it are shown in Annex 9. All costs are expressed in terms of their equivalent border values. The minimum measure of the economic benefits associated with the project is represented by incremental sales revenue. On this basis, the net present value is estimated at USD 48 million at 10% discount rate and the rate of return is 11.4%.

The foregoing revenue based measure of the net present value is, by its nature, more a measure of the adequacy of tariffs than of the true economic merit of the project. A better measure of economic benefits could have been obtained by estimating consumers' willingness to pay (WTP) for the incremental electricity sales. However, since domestic consumers are subsidized, the WTP is likely to be much higher than the average 2006 tariff used in the calculations. If, therefore, the project is justified with the average tariff used as proxy for economic benefits, it is *a fortiori* justified if one were to use WTP.

The switching values[6] of critical variables (investment cost, fuel cost, and sales) calculated in Annex 9, show that the project is sensitive to variations in these variables. Fuels costs should be kept under constant review over the life of the project and measures to adjust tariffs taken in a timely manner.

Incremental Cost Analysis

An incremental cost analysis based on intertemporal comparisons of the baseline and likely plant and the proposed GEF alternative is shown in Annex 16. This incremental cost analysis shows that the incremental cost of the Ain Beni Mathar ISCC plant is $63.16 million (of which $62.5 million is incremental capital costs). US$43.2 million will be contributed by GEF and the remaining US$ 20 million will be financed from O.N.E's resources (equity and AfDB borrowings).[7] See Annex 16 for details of the incremental costs (particularly Table 16.4).

Financial analysis

1. Historical analysis (2003-2005) :

O.N.E.'s financial position during the last three years (2003-2005) was sound. This is supported by the following: (i) adequate tariff (average of USD 0.08 per KWh in 2006, second highest in the MENA region after Lebanon) compared with O.N.E.'s operating cost excluding depreciations of USD 0.065 per KWh; (ii) new client arrears, which were substantially reduced from 9 months in 1994 to 4 months in 1997. According to the 2005 financial data, last year arrears have represented about 4 months and half of turn over. Table 1 (Annex 9) provides a summary of O.N.E. financial statements and performance during the last three years[8]. The historical analysis shows that:

- O.N.E. operating revenues increased by more than 16% in 2005. Half of the growth was due to the quantity of energy sold which increased by about 9 %, confirming the tendency of the last three years in terms of growth in electricity demand in Morocco. The

[6] A switching value indicates by how much the variable has to change to reduce the net present value to zero.

[7] For ease of presentation. the O.N.E. contribution is given here as a portion of the incremental cost of the solar component. Elsewhere in the report, O.N.E.'s contribution is given as a portion of the total capital cost of the solar component.

[8] The audit report for 2005 is still due. The financial data used however is considered as final by the ONE finance department.

remaining change in operating revenue was due to other operating revenues which doubled in 2005.

- However, the increase in operating revenues was more than offset by a sharp increase in production costs due to: (i) increase in fuel costs which almost doubled between 2003 and 2005 and (ii) 14 % increase in the cost of power purchased and imported by O.N.E. mainly from Jorf Lasfar IPP and Spain. Consequently, the operating income was negative in 2005 for the first time in three years. In order to preserve its financial autonomy, O.N.E. obtained the government approval for a 7% average increase in tariff. The change in prices was made effective in two stages during 2006 (in February for industrials and in July for households). This was the first increase in O.N.E. electricity prices since 1997.
- Arrears over a year old owed by former publicly-owned and operated regional utilities companies remain an issue. Their total amount is MAD 1,072 million (USD 123 million equivalents). Most of the arrears, 900 MAD, are due to the former public water and electricity utility of Casablanca which is now operated by Suez under a concession contract. Under the contract the private operator is not responsible for the liabilities of the previous public entity. Therefore, unless an agreement with the Municipality of Casablanca is reached O.N.E. will have to write them off as part of the extensive balance sheet cleaning exercise currently underway. These arrears are expected to have minimal impact on O.N.E.'s future financial viability.

Projections and scenarios analysis (2006-2011)

Financial projections for 2006-2011 (Table 2, Annex 9) are largely based on the assumptions summarized in Table 1. These assumptions were discussed with O.N.E. and are based on the utility least cost plan for production and expectations in terms of coal, fuel and natural gas prices. The base case scenario takes into account conservative expectation for hydropower production; succession of low and medium years in terms of water flows.

Table 1 : Base case scenario assumptions

Assumptions	2006	2007	2008	2009	2010	2011
Hydropower production expectation	Low	Medium	low	Medium	Low	Medium
Sales growth rate (%)	8.0%	7.0%	7.0%	6.8%	6.8%	6.8%
Sales in GWh	19,114	20,452	21,883	23,372	24,961	26,658
Increase in average price	7%	0%	0%	0%	0%	0%
Average price (Cts MAD)	72.54	72.50	72.55	72.74	72.93	73.12
Power production growth(%)	7.9%	7.0%	7.0%	6.5%	6.5%	6.5%
Technical losses rates(%)	9.2%	9.2%	9.2%	9.0%	8.7%	8.5%
Power production in GWh	21,050	22,525	24,100	25,675	27,350	29,134
Electricity purchased by O.N.E. in GWh	14,385	15,750	15,680	18,825	20,970	23,115
Average price for power purchased Cts MAD/kwh	38.23	40.48	37.68	34.55	30.26	30.26
Imported Coal cost (US$/Tonne)	71	67	67	67	67	67
Fuel costs (US$/Tonne)	273	274	273	273	308	308
Natural gas (US$/1000m3)	5.3	5.3	5.3	5.3	5.3	5.3
MAD/ US Dollar exchange rate	9	9	9	9	9	9
MAD/ Euro exchange rate	11	11	11	11	11	11
Investment program (Millions MAD)[9]	7,035	5,400	5,640	8,330	8,660	3,410
Debt service (Millions MAD)	1,087	1,171	7,163	2,207	2,463	2,680

The planned investments for the period 2006-2011 will total approximately MAD 36 billion (USD 4 billion equivalent). These represent the expansion and upgrading of more than 70 percent of O.N.E.'s fixed assets.

The base case scenario includes also O.N.E. planned externalization of its pension fund which will require about 11 billion MAD (USD 1.2 billion equivalent) of additional debt to be financed through the issuance of two bonds in 2006 and 2008. Note that 2006 losses in terms of net income are mainly due to O.N.E. write off of the pension fund assets. The write off should not affect O.N.E. cash position.

Overall under the base case scenario and taking into account the 2006 tariff increase, O.N.E.'s financial situation should remain sound during the next five years as perceived from its cash position, earning before interest and taxes (EBITA) and debt service ratio.

Nevertheless, given that O.N.E. is currently undertaking an update of its investment master plan in order to be able to respond to the recent upward change in terms of growth in electricity demand, it is likely that capital expenditure will be higher than currently planned. While the financing of any additional capital expenditures would be financed through PSP/IPP schemes, O.N.E. might need further tariff revisions in order to be able to raise additional capital (see scenario analysis below).

[9] Including the investments implemented by the private sector under concessions contracts with ONE.

A sensitivity analysis was carried out to assess O.N.E.'s financial situation under different scenarios for fuel, coal and natural gas prices as well as the price of power purchased. The analysis included two scenarios: (i) 5% annual increase in the cost of fuel, coal and natural gas and 5% annual increase in the price of power purchased and (ii) same as scenario 1 but with 10% annual increase instead of 5%. The table below summarizes the impacts of both scenarios on O.N.E.'s EBITA and Debt coverage.

Scenarios summary	2005	2006	2007	2008	2009	2010	2011
Base case							
EBITA	2,583	3,789	3,770	4,963	6,173	6,291	6,739
Debt coverage ratio	6.6	3.5	3.2	1.5	2.8	2.6	3
Scenario 1							
EBITA	2,583	3,330	3,747	4,222	4,744	5,316	5,695
Debt coverage ratio	6.6	3.1	3.2	1.4	2.1	2.2	2
Scenario 2							
EBITA	2,583	2,876	2,772	2,650	2,490	2,286	2,449
Debt coverage ratio	6.6	2.6	2.4	1.1	1.1	0.9	1

O.N.E.'s financial position remains sound under the first scenario. However, as shown by the results from scenario 2, an increase of more than 5% will require a further increase in O.N.E.'s tariff. Should the second scenario materialize the lengthy process for public utility tariff revision in Morocco might have a further negative impact on O.N.E.'s financial performance.

2. Technical

The main technical issue to be addressed is the specification of the performance required from the plant in terms of its capacity, output, fuel consumption, and efficiency and how these are to be divided between the conventional and solar portions of the plant. In addition to minimum qualifications for the solar trough technology, these performance specifications will ensure effective integration of the steam systems for the solar field and the gas-fired combined cycle plant. The contractor selection process reviewed plant designs to ensure that the plant will operate effectively in all modes. In particular, integration and control of the system should be flexible enough to allow the solar contribution to be consistently maximized, while under other circumstances allow power to be efficiently generated on natural gas only (e.g., during night time or if, for some reason, the solar field is not operational). Creating an incentive structure to maximize solar output from the field for the whole life of the plant and a bid evaluation mechanism, which is transparent but does not inadvertently introduce a bias for or against a particular technology or cause bidders to 'game' the evaluation is a significant task. The bid evaluation criteria and the determination of the levelized electricity cost (LEC) include incentives for the maximization of the solar output. This is reflected in the EPC and O&M contracts.

3. Fiduciary

The financial management system was appraised to determine if it complies with the requirements of the Bank in respect to OP/BP10.02. The evaluation of the O.N.E. covered the areas of accounting and financial management, as well as the reporting and auditing process of the project. The financial management system, including necessary arrangements to respond to the needs of the financial monitoring of the project, satisfies the requirements of the Bank.

The financial management system presents a low fiduciary risk. The project will be carried out while being based on the procedures and the accounting and financial organization of the O.N.E., which has a financial management system considered to be satisfactory. As an autonomous public entity with commercial and industrial characteristics, the O.N.E. has financial autonomy and is subjected to the financial control of the State. Its accounting system is based on the rules applicable to the state owned enterprises and its financial statements are submitted to an annual external audit. In addition, the O.N.E. has acquired a substantial experience in financed project management.

The financial management will be ensured by the finance and treasury divisions within the financial department of the O.N.E., in coordination with the concerned technical departments. Specific arrangements for the needs for financial reporting were approved during the evaluation. Financial monitoring reports (FMR), which will cover all the activities and sources of funds of the project, will be prepared quarterly by the O.N.E. and transmitted to the World Bank and the other donors of the project 45 days after the end of each period. The final format of these reports has been transmitted to the O.N.E. during appraisal. An annual audit report of the project accounts, transmitted to the Bank no later than six months after the end of each exercise, will be carried out in accordance with the Bank guidelines by an acceptable auditor and according to acceptable terms of references by the Bank.

The project is co-financed by GEF, AfDB, and O.N.E. Financial flows will come from the funds of the GEF via the Bank, loan funds from the AfDB, and counterpart funds financed by the O.N.E. Flows of funds between the World Bank, the O.N.E., and the recipients will be organized according to traditional disbursement procedures of the Bank. In order to facilitate the disbursement of the eligible expenditures, the O.N.E. will open separate accounts individualized for each donor in the name of the project in a commercial bank. The opened account for the funds will be managed in accordance with the procedures of the Bank as regards to disbursement.

4. Social

The development of the power plant is expected to have a positive social impact on the local population and the local economy (i) providing both direct (and indirect) sources of employment during the construction and production phases (500 direct jobs during the former and 50 during the latter phase) - the majority of workers will be locally recruited; (ii) leading to improvements in local infrastructure including the rehabilitation of local roads; and (iii) improving access to electricity particularly for poor rural families who are currently not connected.

During project preparation, the World Bank's team and a representative of the *Office Nationale d'Électricité* (O.N.E.) conducted a series of informal consultations with pastoralists in the immediate vicinity of the proposed plant. The local pastoralists viewed the plant as an asset to the region given its employment generation potential and improved availability of electricity.

The project site is situated 10 kilometers to the West of the national route P19 linking Oujda (90 km to the North) and the town of Ain Beni Mathar. The entrance to the access road for the project site is about 5km to the north of the town of Ain Beni Mathar. The project site itself and its immediate vicinity are sparsely populated. The main economic activities of the inhabitants are extensive agriculture and extensive livestock grazing. The site itself is used by local nomadic pastoralists for grazing purposes. However, given the large tracts of land available in the vicinity it has been determined that the livelihoods of the pastoralists will not be unduly compromised by the presence of the power plant, or the access roads, power lines or gas lines.

A potential negative social impact of the project is the spontaneous development of a shanty town community in the vicinity of the project site drawn to the increased employment opportunities in the area. The presence of a sizeable town in the area, Ain Beni Mathar, may mean however, that immigrants to the area may relocate there. Local authorities and O.N.E. will have to be aware of the potentially negative impacts and monitor the development of the area.

5. Environment

An initial environmental assessment was undertaken by a consultancy firm and completed in mid-2004. The project was designated as Category B project on the basis of this first report and the subsequent Environmental Assessment Study performed by a consortium composed of another international and a local consultancy firm; as the O.N.E. decided to undertake a complementary study in order to cover the aspects related to the construction of the two 225 kV and the 60 kV transmission lines, and to cover some of the missing aspects related to the World Bank policies and requirements.

The new assessment, undertaken for the totality of the project, with both components integrating the solar trough collector field and the traditional natural gas-based power generating unit, confirmed that the project has minimal negligible impacts on the environment as the plant utilizes solar and natural gas. The use of solar power does not produce any pollutants, and the combustion of natural gas generates the lowest level of CO_2 emissions compared to any other fossil fuel. In addition, the combustion of natural gas does not entail SO_2 emissions, and has significantly lower emissions of NO_2 than other fossil fuels. In that respect, the project has an overall direct environmental benefit as it will lead also to an increase in the share of renewable energies in the country's energy sector, and a reduction of green house gases emissions. The report also confirmed the potential very positive socio-economic fallouts due to the creation of employment.

The key environmental issues raised and properly addressed in the environmental assessment and the EMP are the main risks that could exist due to an accidental contamination of the site by the heating fluids during operation as well as during transportation to the site in the construction phase. Such risks will be largely reduced and properly managed through the inclusion of a retention and treatment system and by following the safety measures for proper handling and transportation of hazardous substances.

The volumes of cooling water to be pumped from the aquifer, in the selected proposal presented in the international competitive bidding, should not exceed the maximum amounts, as determined in the environmental assessment in order to maintain the current balance of the resource.

The most important impacts expected during the construction phase are due to the large volumes of construction and solid wastes that will be generated.

The Environmental Management Plan has included the potential environmental impacts associated with the construction of the Power Plant, the substations, the access road to the Plant and the transmission lines; in addition to the proposed mitigation measures, and a proper monitoring program. A capacity building program to strengthen the capacities of the O.N.E. for the follow-up on the implementation of the overall EMP, as well as the implementation of the parts of the EMP under the direct mandate of the O.N.E., has also been built in into the project.

In addition and given the special nature of the project as a GEF project aiming at disseminating the results and the lessons learned to increase the overall global benefits, a comprehensive monitoring and evaluation program that goes beyond the environmental safeguards requirements of the Bank has been included in the Environmental and Social Development and Management Component.

6. Safeguard policies

Environmental
The project has triggered the Environmental Assessment Policy (OP 4.01), which requires a partial assessment to be conducted for the project, and the preparation of an Environmental Management Plan. The Borrower has contracted out an independent consultant to undertake this assessment and prepare the EMP. The review of the first drafts of the EMP revealed an obvious lack of details and specific mitigation measures, which did however exist in the Impact Assessment Report. The Borrower was accordingly requested to amend the EMP with the support of the consultant, to integrate the specific mitigation measures. The potential environmental impacts of the power plant are confined to the site and appropriate mitigation measures have been identified and included in the Environmental Management Plan (EMP), which follows the World Bank's guidelines, notably OP 4.01.

Social
The Social Safeguards policy on *Involuntary Resettlement* (OP/BP 4.12) has been triggered as it has been determined that land acquisition will be required for the construction site of

the power plant, the gas pipelines, the access road and the electric lines. Specifically, the project requires the acquisition of:

- *159 ha 97 are 50 ca for the power plant;*
- *6 ha 17 are 11 ca where the gas pipelines will be laid and 12 ha 35 are 20 ca will be temporarily occupied/used during the construction phase; and*
- *For the access road and electric lines, a study is being undertaken to determine the exact land size requirements.*

A Resettlement Action Plan (RAP) and a Resettlement Policy Framework (RPF) have been prepared for the project. The RAP applies to the power plant site and the gas pipelines because the project-affected people have already been identified and land acquisition procedures have been launched. Since the exact nature and extent of land acquisition for the access roads and electric lines has not yet been determined, an RPF has been formulated, which will be followed with a Resettlement Action Plan downstream once the feasibility study has been completed.

At the time of appraisal, the project affected persons on the Power Plant site had been compensated by O.N.E. for the loss of agricultural productivity. The assets valuation of the people on the gas pipeline site has been completed and O.N.E. anticipates to proceed to the compensation due to these people prior to the start of the work. As mentioned earlier, the precise sites and lands to be acquired for the construction of the access roads and the electric lines have not yet been determined; hence the compensation procedure will be launched once the sites and the people whose land will be acquired have been determined, as stated in the RPF.

The persons and government agencies affected by the land acquisition can be classified as follows:

- **Public land**: For the power plant site, the *Office Nationale de l'Electricité* (O.N.E.) has proceeded with the purchase of land from the Ministry of Interior, the custodian of public collective land. Two land parcels for the gas pipelines will also be acquired in the same manner.
- **Collective land owned by the Commune of Beni Mathar** - *Collectivité Ethnique de Béni Mathar*: O.N.E. has compensated the collective land users who are actually farming on the site selected for the power plant for the loss of their crops/harvest.
- **Private land**: For the gas pipelines, 21 land owners will be compensated for their land and any eventual loss of crops/harvest. As for the power plant site, there are no private land owners whose land will be acquired.
- **Land owned by public Agencies** (*Office Nationale de Chemin de Fer, Direction Régionale de l'Equipement, et l'Agence du Bassin Hydraulique de Moulouya*): O.N.E. is preparing and processing a request letter for the permission of temporary occupation of these lands owned by public entity agencies during the construction phase.

In June 2006, a social assessment was conducted at the project site with all the acquisition-affected people. A series of intensive consultations were conducted with 8 persons whose land and/or assets will be affected by the power plant construction and 21 persons affected by the gas pipelines. The people were informed about the project and the compensation

procedures for their loss. In addition the consultations touched upon the implications of the project in terms of employment generation. The assessment further improved the local communities' understandings of the project and its implications, and confirmed that the populations are awaiting the employment opportunities which the project will likely offer.

Equally, elected representatives of the local commune of Béni Mathar as well as three public agencies that will be affected by the land acquisition for the gas pipeline, including *l'Office National des Chemins de Fer (ONCF) ; la Direction Régionale du Ministère de l'Equipement et l'Agence du Bassin Hydraulique du Moulouya* have been consulted in this regard.

The entity responsable for land acquisition in O.N.E. is the *Division Gestion du Patrimoine et des Affaires Immobilières.* The Division has experience in land acquisition issues and operates according to Moroccan law. However, given their unfamiliarity with Bank guidelines, a capacity building program will be conducted for the O.N.E.staff working on land acquisition in order to enhance their knowledge about the Bank's guidelines on Social safeguards, and precisely the policy on Resettlement and Land acquisition. It is further recommended that a third party (NGO or consultant) be hired to work with O.N.E. and provide additional oversight on land acquisition issues during the implementation and supervision stage of the RPF and RAP, in compliance with Bank social safeguards to ensure the timely implementation of land acquisition procedures.

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment (OP/BP/GP 4.01)	[X]	[ ]
Natural Habitats (OP/BP 4.04)	[ ]	[X]
Pest Management (OP 4.09)	[ ]	[X]
Cultural Property (OPN 11.03, being revised as OP 4.11)	[ ]	[X]
Involuntary Resettlement (OP/BP 4.12)	[X]	[ ]
Indigenous Peoples (OD 4.20, being revised as OP 4.10)	[ ]	[X]
Forests (OP/BP 4.36)	[ ]	[X]
Safety of Dams (OP/BP 4.37)	[ ]	[X]
Projects in Disputed Areas (OP/BP/GP 7.60)*	[ ]	[X]
Projects on International Waterways (OP/BP/GP 7.50)	[ ]	[X]

7. Policy Exceptions and Readiness

Not Applicable

* *By supporting the proposed project, the Bank does not intend to prejudice the final determination of the parties' claims on the disputed areas*

Annex 1: Country and Sector Background

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

The Economy

1. ***Promoting rapid growth and creating jobs:*** Morocco's population is about 30 millions and its 2005 income per capita was about $1,653. Approximately 400,000 new jobs must be created annually until 2010 to meet the goal of 6% unemployment set in 2004 by the government. The challenge for the country is therefore to promote rapid economic growth as an engine for job creation.

2. ***Maintaining macroeconomic stability:*** Morocco has maintained macroeconomic stability. Morocco's consumer price inflation rate was 1% in 2005, down from 1.5% in 2004. As a result of higher food and fuel prices, it is estimated to have been 2.5% in 2006. The challenge for Morocco is to keep the inflation rate differential between Morocco and its main trading partners in check so as to maintain the competitiveness of Moroccan exports.

3. ***Controlling fiscal expenditures:*** Controlling fiscal expenditures remains a priority for Morocco. The fiscal position of the Kingdom improved in 2005 despite important expenditures generated by the implementation of early retirement programs and higher petroleum product prices, because of the remarkable resilience of fiscal revenues. The 2005 budget deficit was about 4.2%. The public wage bill accounts for more than half of government expenditures and control is therefore a priority for the government. The purpose is to reduce its weight relative to gross domestic product (GDP) and to strengthen public savings to finance public investment. Early retirement and other measures which have benefited about 38,800 public servants have contributed to the reduction of the wage bill from 13% of GDP in 2005 to 12 % of GDP in 2006.

4. ***Fostering efficiency and trade***: Since the early 1980s, Morocco has pursued other economic liberalization efforts including a reform program supported by the World Bank and International Monetary Fund (IMF). Morocco has signed several agreements with the European Union on economic cooperation, including one establishing a free trade zone for industrial goods over a 12-year transition period. The U.S.-Morocco Free Trade Agreement (FTA), which was signed in 2004, eliminated tariffs on 95% of bilateral trade, with the remaining tariffs to be eliminated over the next nine years.

The Energy sector

5. **High level of import dependency: a source of vulnerability and of concern over security of supply:** Morocco is almost entirely dependent on imports to satisfy its energy demand, with 95% of primary energy demand (excluding non commercial forms of energy) covered by imports. The country is the largest energy importer in northern Africa with a total cost for its imports increasing from $3 billion in 2004 to $4.2 billion in 2005 because of rising oil prices.

Imports are dominated by oil, accounting for 2/3 of energy imports, and coal (1/3 of imports), while electricity is only a small proportion of imports at present. Energy imports have increased steadily since 2000 and represented 22 percent of the country's imports (US$4.6 billion) in 2005. Thus, Morocco is highly exposed to international price fluctuations,[1] which have a destabilizing effect on its balance of payments. The increase in energy prices is estimated to have reduced Morocco's GDP growth by 1 percent over the 2000–05 period.[2] In the Government's base case projections, Morocco's energy risk exposure is projected to grow, as consumption increases from 10 million tons of oil equivalent (toe) in 2005 to 17 mtoe in 2014. The energy price risk exposure also impacts the poor directly through the increase in their energy-related expenditures, which presently represents 8.7 percent of their budget.[3]

The price control policy in place since 2000 has substantially subsidized consumer prices for petroleum products. Energy subsidies represented US$1.04 billion in 2005 or 46 percent of the Government's capital investment budget, and would have further increased to US$1.26 billion in 2006 had the Government not taken measures in September 2006 to reduce subsidies.

One of the key element of Morocco's energy policy is to reduce import dependency and increase security of supply through the development of indigenous sources of energy (in particular renewable energy) and energy conservation.

6. Universal access to electricity, strong electricity demand growth and urgent need for additional power generating capacity: Access to electricity, a priority of the Moroccan government, is already high and increasing further with a rapid growth in rural electrification: from only 18% in 1995, it has increased to 72% in 2005 and 81% in 2006 and is projected to reach 100% in 2007. This rapid growth in rural electrification will contribute to boosting electricity demand growth. Growth in Moroccan electricity demand has accelerated over the last 3 years from 6% p.a. on average during 1997-2002 to 8% p.a. during 2003-2006. Even with intensified electricity conservation and demand side management (DSM) efforts, electricity demand is expected to continue growing at a similar rate. The "Office National de l'Electricité" (O.N.E.) projects that peak demand will grow from 3300MW in 2005 to between 4825MW and 5300 MW in 2010 and 7000MW and 8500MW in 2015 depending on assumptions on economic growth and energy conservation.

If the Ain Beni Mathar plant is not commissioned on schedule by 2010, then power generating capacity will be insufficient to meet the level of electricity demand, while maintaining the target reserve margin of 10%, even if capacity in the pipeline (projects under construction or committed) is fully commissioned. No large scale new plant has been commissioned in Morocco

[1] The increase of petroleum product prices from US$38.25 per bbl in 2004 to US$54.0 per bbl in 2005 increased Morocco's import bill by US$1.5 billion and imports' share in the balance of payments from 17 percent to 22 percent. Steam coal prices have also increased significantly over the same period, from US$34.9 per ton (Europe) in 2000 to US$69.6 per ton in 2005.

[2] This estimate is based on the evaluation of DEC of the impact of a $30 increase of oil prices on growth for middle-income countries.

[3] Energy expenditures at full market price represented in 2000 about 8.74 percent of household expenditures for the lowest income quintile and 7.29 percent for the highest income quintile, based on Morocco's 2000–01 household survey results.

since March 2005 when the CCGT of Tahaddart came into operation. Ain Beni Mathar will be the first large scale plant to be commissioned after Tahaddart. The proposed capacity for Ain Beni Mathar has been doubled because another CCGT project at Al Wahda, originally scheduled to be commissioned in 2008-09, has been cancelled because of lack of availability of natural gas. The project was conditioned on the signature of a new gas contract with Algeria which failed to occur.

To face this tight capacity situation, the Government of Morocco has increased the ceiling for autoproduction capacity from 10MW to 50MW, and O.N.E. is offering third party access for those generators.

7. **Increasing role for natural gas as a way to diversify the energy mix, but penetration hindered by lack of resources;** Extended use of natural gas, especially in the power sector, is a cornerstone of the country's energy policy, aiming at the diversification of the sources of energy, the provision of energy at the lowest cost and the reduction of the environmental impact. The commissioning of the Tahaddart plant has resulted in an increase in the share of natural gas in Morocco's primary energy demand to 3.5% in 2006, from less than 1% in 2004. The commissioning of Ain Beni Mathar would lift that share to 6%, but it would also absorb the remainder of the transit gas available.

Further natural gas penetration would require an agreement with Algeria on contracting additional gas volumes or the development of additional gas import infrastructure, which is unlikely to be feasible before 2012. For the moment, plans for additional gas-fired power plants have been cancelled.

8. **Regional energy market integration:** The Government recognizes that the country could benefit significantly from integrating into a regional power market. This would enable Morocco to receive back-up services and benefit from reserve capacity at a lower cost, purchase/sell electricity from/to neighboring countries on the best financial terms, and possibly, export "green electricity" from wind farms[4]. The potential gains in terms of avoided investment in reserve capacity, improved security of supply, and access to cheaper electricity contribute to lower the cost of electricity A Protocol was signed in 2003 to create a Maghreb regional energy market that would integrate gradually with the EU energy markets and the European Commission is financing a study on regional market integration.

The European Investment Bank has already been active in financing the strengthening of the interconnection between Morocco and Spain which was increased in 2005 to 1400MW. The strengthening of the interconnection with Algeria will be completed by the end of 2007.

Although Morocco is a transit country for Algerian gas exports to Spain and Portugal, a regional gas market has not yet developed in practice. The Algerian gas is transported across the Strait of Gibraltar via the 300-350 Bcf/year Maghreb-Europe Gas (MEG) pipeline. Morocco receives royalties (in cash or in kind) from the pipeline as payment for passage through its territory and is

[4] For instance the strong growth in demand in 2006 was in part met through imports as imports from Spain increased from 784 GWh in 2005 to 2003 GWh in 2006.

increasingly turning to natural gas to meet increasing energy demand, especially in the power sector. However, as discussed above, the volume of gas available is limited and may not allow the development of other power stations beyond Ain Beni Mathar.

9. ***Promotion of renewable energy and energy efficiency key to ensure security of supply and reduce import dependency:*** In this climate of strong demand growth and expensive energy, energy efficiency (EE) and renewable energy (RE) seem to be the most promising ways to reduce dependency on imports. The Government has therefore given priority to EE and RE in its energy policy, and a new program to accelerate the penetration of renewables and to promote EE was announced by the Council of Ministers on January 26th 2007. The objective is for renewables to capture 10% of primary energy demand and 20% of power generation by 2012. The DPL in preparation will ensure that the Bank provides the necessary support for this program to succeed in achieving its objectives.

Renewable energy plays a key role in O.N.E.'s capacity expansion plan. The plan calls for two new wind projects by 2008. One of the wind power facilities (60 MW) will be located in Essaouira, while the other (140 MW) will be located near Tangiers. The Essaouira facility is scheduled to come on-line in 2007. The Ain Beni Mathar project is in line with the Government's objective to increase the role of renewables and O.N.E.'s plan to increasingly rely on renewables to meet its objective of diversification.

In parallel, O.N.E. has initiated a demand side management (DSM) program to tap the large potential for energy savings which has been identified. This initiative is in line with the objectives of the Moroccan energy policy and consistent with efforts advocated by the Bank and other lenders to give priority to measures that reduce growth in energy demand. If successful, the program would reduce greatly the need for massive investment in generation and transmission/distribution infrastructure. In order to successfully implement the program, O.N.E. is setting up a DSM department, as part of its reorganization.

10. ***Electricity sector liberalization under way expected to induce a revival in private sector financing*:** Supported by the Bank DPL, reform of the Moroccan electricity sector is under way. A draft law, presently under discussion by the Government, calls for: (i) gradual liberalization of the electricity market, starting with eligibility of high-voltage customers, (ii) establishment of an electricity regulator who will advise on price revisions, attribution of licenses for new generators and distributors, supervision of existing and new concessions, setting of technical and commercial standards, supervision of calls for tenders for new capacity in the context of sector planning by the Transmission System Operator, and regulation of competition and (iii) restructuring of O.N.E. and unbundling into three commercially separated activities: generation for the regulated market, dispatch and transmission, and distribution. These lines of business will be entrusted to separate subsidiaries within a O.N.E. holding company.

The creation of a stable and clear regulatory framework should encourage private sector participation in the expansion of power generating capacity, and possibly other activities of the electricity value chain. The private sector already plays a key role in the electricity sector in Morocco, with over 50% of the power generating capacity in the hands of IPPs (contributing to

over 70% of generation) and 55% of electricity sales to end users done by private operators. Although private sector financing in Morocco has been deemed a success story[5], recent experience has been less positive, in particular with no private bidder for the Ain Beni Mathar plant. It is expected that interest will be revived once the electricity liberalization law is fully implemented and enforced. Moreover, the interest in wind energy of domestic and international investors has remained vivid. The interest of large industrial companies to further expand auto-production in units of increasing size is a sign of a dynamic market keen to experience competition.

[5] See for instance "Moroccan Independent Producers- African Pioneers", by Issac Malgas, Katharine Gratwick and Anton Eberhard, Management Program in Infrastructure Reform and Regulation, January 2007

Annex 2: Major Related Projects Financed by the Bank and/or other Agencies

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

The Bank has resumed a high-level of partnership in the Moroccan energy sector after a gap of some years. The Government of Morocco, O.N.E. and the Bank are engaged in an intensive policy dialogue in this strategic sector, and a comprehensive program of financial and technical support is being developed. Reliability and long-term involvement are the foundation of this relationship.

The first in a programmatic series of Energy Development Policy Loans (DPL) is now at an advanced stage of preparation (Board presentation is proposed in FY07). The DPL supports the Government's energy sector reform program which focuses on (i) energy security and sustainable development; (ii) increasing energy sector productivity and Morocco's competitiveness; (iii) moderating fiscal exposure in the energy sector; and (iv) enhancing monitoring, evaluation, and public communication in the sector.

The DPL is being developed in consultation with the European Commission under the auspices of the European Neighborhood Policy, and the EU and Morocco's joint objectives of closer economic integration.. The DPL preparation is also supported by a number of ESMAP-funded studies focusing on renewable energy, energy efficiency, and social protection.

There are clear synergies between the proposed Integrated Solar and Combined Cycle Power Project (ISCC) and the programmatic DPL: (i) support for sustainable development through a renewable energy technology that could prove highly efficient, if the experiment succeeds; (ii) avoidance of power blackouts in Morocco which would have serious political and economic implications, and would undermine reform; (iii) a gradual approach to electricity market liberalization which will be supportive of renewable energy development; (iv) promotion of private participation in power which would allow the eventual privatization of the ISCC; and (v) enhanced monitoring and evaluation capacity in Morocco which will be critical for global dissemination of the learning which is at the heart of the ISCC project.

The goals of the ISCC and programmatic DPL will also be underpinned by a proposed Bank investment loan to O.N.E. This is at a relatively early stage of preparation (for Board presentation in FY08), and will focus on augmenting transmission capacity to keep pace with rapid electricity demand growth and investment in generation capacity, including ISCC. The project will also include assistance to O.N.E. to restructure in order to respond better to the reformed policy framework, including in its support for renewable energy development.

Other lenders such as EIB, KfW, JBIC and AfDB support the development of the power sector in Morocco. Their most recent projects are shown below:

Agency	Project	Target Issue (s)
African Development Bank - Integrated Solar Combined Cycle Power Plant (to be co-financed with GEF) - Network Interconnection	Generation Transmission	Increase supply of electricity Increase transfer capacity and enhance security of supply
EIB, FADES, Kuwait Fund - Pumped Storage	Generation	Increase transfer capacity and enhance security of supply
KfW - Essaouira wind farm	Renewable energy	Increase the share of renewable energy in the energy mix and reduce GHG emissions
AFD, JBIC, KfW, EU and IsDB	Rural electrification	Improve access

Annex 3: Results Framework and Monitoring

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

Results Framework

PDO / Global Environmental Objective	Project Outcome Indicators	Use of Project Outcome Information
1. Increase contribution of renewable energy in Morocco's energy mix and provide more capacity to meet demand	1. More capacity and more renewable energy Solar	Lessons learned will serve in the design of future ISCC power plants
2. Reduction of CO_2 emissions, which contribute to global climate change, relative to continued reliance on fossil fuels.	2. Reduction of annual CO_2 emissions (a minimum of 20kt of CO_2/year).	Monitor CO_2 emission reduction and adjust operation/equipment as necessary to meet objective
3. The long-term costs of low greenhouse gas emitting technologies is reduced.	3. Thermal Power Plant costs in ¢ / kWh	Monitor solar generation cost and determine if change in operation of the ISCC plant is necessary to maximize solar output.
Intermediate Outcomes	**Intermediate Outcome Indicators**	**Use of Intermediate Outcome Monitoring**
Component One: The operational viability of solar thermal power generation is demonstrated in Morocco.	**Component One:** 1. Yearly global production of electricity of the ISCC plant 2. Share of ISCC energy in total energy production (%) 3. Yearly contribution of solar electricity 4. Solar output as a percentage of total energy produced by the ISCC power plant.	**Component One:** Show that solar thermal plant – a high-end technology - can be constructed and operated efficiently in a developing country context Low generation from the solar component or from the ISCC as a whole is symptomatic of management, incentives and operational problems that need immediate resolution

Arrangements for results monitoring

Outcome Indicators	Baseline	Target Values YR1	YR2	YR3	YR4	YR5	Data Collection and Reporting: Frequency and Reports	Data Collection Instruments	Responsibility for Data Collection
Reductions in main air pollutants emissions (tons/yr) for CO_2.	0	0	0	10,800	23,780	24,300	Quarterly	Continuous monitoring by O.N.E and the EPC contractor	O.N.E/EPC contractor
Solar thermal Power Plant costs in ¢/kWh	0	0	0	21.8	18.7	17.4	Quarterly		
As a % of natural gas price									
Dissemination									
• Number of visitors to and information requests about the plant	0							O.N.E.	O.N.E.
• Number of workshops and conferences in which the experience about the construction and operation of the plant is presented	0							O.N.E.	O.N.E.
• Information about the plant posted on O.N.E's external web site	None			Done				O.N.E.	.O.N.E.
Results Indicators for Each Component									
Component One :									
ISCC's yearly production of electricity (GWh)	0	0	0	1556	3360	3538	Quarterly	Continuous monitoring by O.N.E. and the EPC contractor	O.N.E/EPC contractor
ESCC's yearly generation of solar electricity (GWh)	0	0	0	17	37	40	Quarterly		
O.N.E. staff trained in various aspects of ISCC power technology									
Solar output as a percentage of total energy produced by the ISCC power plan	0	0	10	4	4	2	Semester		
Share of ISCC energy in total energy production (%)	0	0	0	0.5	1.0	1.13	Quarterly		O.N.E/EPC Contractor
	0	0	0	8.7	15.6	16.8	Quarterly		O.N.E/EPC Contractor

Other qualitative indicators:

- Lessons learned during the pre-construction phase (feasibility study and bidding process, environmental and social safeguards and financing.)
- Lessons learned during the construction of the plant; and
- Lessons learned from the operation of the plant and initial assessment of the viability of the technology after three years of operation of the ISCC power plant

Annex 4: Detailed Project Description [15]

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

The main components of the proposed project are:

1. The design, construction and operation of an Integrated Solar Combined Cycle power plant;
2. The construction of 225kV and 60kV transmission lines;
3. The construction of High Voltage and Very High Voltage substations;
4. The construction of an access road;
5. The drilling of boreholes;
6. Land acquisition;
7. The construction of a gas pipeline to supply the plant;
8. Environmental and Social Development and Management; and
9. Consulting services for project management and supervision.

The project description and cost for each component, including contingencies is as follows:

Project Component 1 - Design, Construction and Operation of an Integrated Solar Combined Cycle Power Plant - US$519.27 million (including US$43.2 million from GEF)

The gross capacity of the Integrated Solar Combined Cycle (ISCC) plant will be about 472 MWe (at site conditions: temperature 15°C, 40% humidity, Atmospheric Pressure 909 mbar and solar input at 58.7 MJ/s) and will consist of gas turbine(s), a steam turbine, and a parabolic trough solar field with a capacity of about 20 MWe plus ancillary facilities for the proper operation of the power plant (backup power plant, etc.). The solar field will cover a total reflective area of 183,120 m^2. It includes the space between rows of collectors for cleaning and other maintenance (18 m between rows).

The total net energy produced by the plant would be 3,538 GWh per year, which includes the solar contribution of 40 GWh per year. This corresponds to a solar share of 1.13 percent of the total annual energy produced by the plant operating at a full load. An ISCC with aero condenser and without storage is anticipated to be the preferred choice within the technical design options. The primary fuel for the gas turbine will be natural gas supplied via a spur from the Maghreb-Europe gas pipeline.

Following the construction, a 5-year O&M contract will be put in place to ensure proper operation of the newly constructed plant. The O&M contract will be extended to the same firm in charge of the construction of the plant.

Project Component 2 – Construction of 225kV and 60kV power lines- US$17.84 million (US$15.5 million financed by the AfDB, and US$2.34 million by O.N.E.)

[15] The cost of components include physical and price contingencies. (Physical contingencies of 10% and price contingencies of 2% for foreign and 3% for local costs).

This component will cover the construction of two 225kV and one 60kV transmission lines. The electricity produced by the ISCC plant will be evacuated by two 225kV transmission lines to the Oujda (110 km) and Bourdim (70 km) substations.

The 60kV line will be constructed to provide a backup power supply to the auxiliaries of the ISCC plant in case of emergency. This line, of about 10 km, will connect the 60/225 kV substation of Ain Beni Mathar to the ISCC power plant.

Project Component 3 – Construction of a 225 kV substation - US$9.04 million (US$7.15 million AfDB, and US$1.89 million O.N.E.)

This component covers the construction of one 225 kV substation.

Project Component 4 – Construction of an access road- US$3.8 million (O.N.E.)

To link the power plant to the main road (Route principale 19), which links Oujda to Bouarfa, an access road of about 6km will be constructed. As part of the access road, two bridges over the Charef and Tabouda rivers will also constructed. The infrastructure will be designed to support the heavy equipment necessary for the construction of the ISCC power plant.

Project Component 5 – Boreholes - US$0.35 million (O.N.E.)

The operation and maintenance of the power plant, in particular the cleaning of the solar collectors and the cooling of the plant, require the drilling of at least two boreholes. Water will be pumped from the acquifer located below the site of Ain Beni Mathar. Water reserves equivalent to one day consumption will be maintained. The extracted water will be treated before use and the site wastewater will be collected and treated in a two-hectare stabilization pond.

The implementing agency for the construction of the boreholes will be the Agence de Bassin de Moulouya (the Moulouya Watershed Agency) which is legally mandated to undertake this work.

Project Component 6 – Land acquisition- US$0.87 million (O.N.E.)

203 hectares of land will be acquired by O.N.E. for the construction and operation of the plant. 160 hectares will be for the power plant (including 88 ha for the solar field), 6 hectares for the boreholes and water distribution, 31 hectares for the gas spur from the Maghreb-Europe Pipeline to supply the power plant and the transmission lines, and 6 hectares for the access road.

Project Component 7 – Gas pipeline - US$9.22 million (O.N.E.)

The gas supply will be ensured via the construction of a 13 km gas spur from the Maghreb-Europe gas pipeline.

Project Component 8 – Environmental and Social Development and Management US$2.31 million (O.N.E.)

This component will include a comprehensive monitoring and evaluation program to disseminate the results and the lessons learned from the project in all its phases (pre-construction, construction and operation) to increase the overall global benefits. It also includes: (a) the implementation of the Environmental Management Plan which mitigates the potential environmental impacts associated with the construction of the power plant, the substations, the access road, the transmission lines and the gas pipeline; (b) a capacity building program to strengthen the capacities of the O.N.E. for the follow-up and monitoring of the implementation of the overall EMP, which is the responsibility of the EPC Contractor and its sub-contractors.

The details of the environmental and social mitigation measures to be adopted during the construction and operation of the plant, as per the Bank's procedures and safeguards requirements, and as defined in the Environmental Management Plan are presented in Annex 10.

The Environment and Quality Department of the O.N.E. has responsibility for the coordination of the studies and the monitoring of the environmental and social development and management component; and for liaising with the ADB.

Project Component 9 – Consulting services for project management and supervision US$5.09 million (US$4.55 million AfDB, and US$0.54million O.N.E.)

This component will finance the services of the consulting engineer during construction, testing and operation of the plant for the two-year guarantee period. The main mission of the consulting engineer is to: (i) critically review all detailed engineering designs; (ii) supervise the construction of the plant; (iii) supervise the testing and delivery of equipment in factory and on-site; (iv); supervise the testing of the plant; and (v) provide assistance during the two-year guarantee period. The consulting engineer will make sure that the data for the monitoring of the performance indicators is collected and supplied by the EPC contractor. The consulting engineer will make these data available in his periodic report to O.N.E.

Annex 5: Project Costs

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

Project Cost By Component and/or Activity	Local US $million	Foreign US $million	Total US $million
1. Design, Construction and Operation of an Integrated Solar Combined Cycle Power Plant	23.50	439.08	462.58
- civil works	*12.99*	*18.55*	*31.54*
- solar component	*7.70*	*58.75*	*66.45*
- mechanical and electrical equipment	*2.81*	*361.78*	*364.59*
2. Transmission Lines	15.75	0.00	15.75
3. Substations	1.60	6.44	8.04
4. Access Road	2.02	1.35	3.37
5. Boreholes	0.19	0.12	0.31
6. Land acquisition	0.84	0.00	0.84
7. Gas pipeline	0.83	7.38	8.21
8. Environmental and Social Development and Management	2.24	0.00	2.24
9. Consultancy services	1.00	3.98	4.98
Total Baseline Cost	**47.96**	**458.36**	**506.32**
Physical Contingencies	4.39	45.44	49.83
Price Contingencies	1.57	10.08	11.65
Total Project Costs[1]	**53.92**	**513.88**	**567.80**

[1] Project cost excluding financial charges, customs duties and value added tax.
Price contingencies are on the base cost and physical contingencies.

Annex 6: Implementation Arrangements

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

Partnership arrangements

The project is co-financed by O.N.E., the GEF and the African Development Bank. Their respective contribution to the financing of the project is respectively of 24%, 8% and 68%.

Institutional and implementation arrangements

Consultants partially financed under a GEF PDF C grant, now closed, have assisted O.N.E. in the preparation of bidding documents, draft EPC and O&M contracts and will advise O.N.E. during the evaluation of proposals. This phase, which is still ongoing, is being carried out by O.N.E.'s Directorate of Development following an agreed timetable.

The construction and operation of the ISCC power plant will be implemented by an EPC cum O&M arrangement to be secured through international competitive bidding. The Production Department of O.N.E. will have the responsibility for overall project management. The Production Department will ensure the coordination, and the technical and administrative management of the project. It will work in close collaboration with the Supply and Markets Department of the procurement aspects, with the Environment and Quality Department for the coordination of the studies and the monitoring of environmental measures, and with the Technical Department for controls and oversight. The Financial Department will be in charge of the project financial management, and coordination with various loan/grant providers. The Production department will be assisted by the consulting engineer to be recruited under the project and financed by AfDB and O.N.E.

The World Bank will supervise and monitor the implementation of the activities through regional and specialized staff as required.

Annex 7: Financial Management and Disbursement Arrangements
MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

Assessment of the Financial Management System

1. An assessment of the financial management system in place at O.N.E. (Office National de l'Electricité), the project executing agency, was carried out to determine if it complies with the Bank requirements for the project management in respect to the OP/BP10.02.

Accounting system

2. The accounting function at O.N.E.is performed by the central accounting division in the financial department. The accounting of the office is governed by the rules applicable to the autonomous public entities (decree of November 10, 1989). O.N.E. maintains an accrual accounting system, managed on an Integrated Information System (IIS) since year 2000, and held according to rules related to the "obligations comptables des commerçants" and the Moroccan chart of accounts. The operations related to the financed projects are registered in the accounting records of O.N.E, in accordance with the accounting procedures applicable within the office.

Internal control system

3. The State financial oversight, to which O.N.E. is subject according to provisions of Dahir of April 14, 1960, guarantees the separation of the functions through several levels of independent controls involving (a) the State controller for the control a priori of the expenditure at the stage of their commitment and (b) the treasurer payer who jointly signs with the director of O.N.E. all the payment orders. In addition, the internal audit function is performed by the audit and organization department, directly attached to the general manager's office.

External audit

4. The financial statements of O.N.E. are subjected to an annual external audit. The financial statements of the last three exercises, audited by an international audit firm, were certified with qualifications. These are mainly the result of the upgrade of the accounting system and do not suggest the existence of accountability issues. The audit of a GEF Grant (Grant GEF 22942) did not raise issues likely to question the use of the funds of the grant.

5. Bank policies require that an annual external audit of the project accounts, established in accordance with acceptable accounting standards, be carried out in accordance with acceptable auditing standards and terms of reference and that the auditor is acceptable to the Bank. The project financial statements including all sources and use of funds must be audited each year in accordance with Bank guidelines. The project audited financial statements must be transmitted to the Bank no later than six months after the end of each fiscal year.

Financial reporting and information system

6. The financial monitoring of projects is ensured by the service for long and medium term financing within the finance and treasury division (financial department), in coordination with the concerned technical departments. O.N.E. acquired a substantial knowledge in management of projects financed by international donors (BIRD, BAD, EIB, INSIPID, BID, KFW...). The existing human resource capacity is adequate to carry out the financial management tasks of the project. There is no need for change in quantity and quality of the existing staff to meet Bank and O.N.E. financial reporting requirement. The integrated information system (IIS) allows a follow-up of outstanding debt in foreign currency and in Dirhams (module loan) but it does not automatically provide a sufficient level of information for the financial monitoring of the project in term of allocation and use of funds by component and category of expenditure. O.N.E. elaborates project financial statements according to the format agreed with the donors based on the existing information adapted for the needs of the project.

Project monitoring

7. O.N.E. will submit to the Bank a half yearly Financial Monitoring Report (FMR) 45 days after the end of each period. These reports will be established in accordance with Bank guidelines. The FMR will provide, for all the sources of funds for the project:

- a summary cash-flow table showing received funds by sources and expenditures by category for the past semester and the accumulated amount up to the date of the report, as well as projection for the next six months,
- a summary of the use of funds showing payments by project component/activity for the past semester and the amounts accumulated as of the date of the report,
- a summary of procurement processes and procedures,
- a summary of the physical progress by project component/activity.

8. Insofar as the existing information system of O.N.E. does not automatically provide a sufficient level of detail required by the Bank for the production of the FMR, a project financial information system will be produced in term of resources and use of funds, by component and category of project expenditures and sources of financing. The financial tables will be produced manually based on the reprocessing of the data provided by the existing information system. The formats of the reports were agreed with O.N.E. during project preparation.

Evaluation of the system in use

9. The financial management system of the project is in line with the minima conditions required by the Bank taking into account the management system of O.N.E. and the experience acquired in financial project management.

Flow of funds

10. The project is co-financed by GEF, AfDB and O.N.E. Financial flows will come from GEF funds via the Bank, the loan funds from the AfDB, and counterpart funds financed by

O.N.E. Flows of funds between the World Bank, O.N.E. and the recipients will be organized according to traditional disbursement procedures of the Bank.

Disbursement

11. ***Method of disbursements.*** The proceeds of the grant will be disbursed first and once the grant funds are fully disbursed, the AfDB loan will take over. The proceeds of the Grant would be disbursed in accordance with the traditional Disbursement procedures of the Bank and will be used to finance project activities through the disbursement procedures currently in use: i.e. Withdrawal Applications (WAs) for direct payment, for Special Commitments and/or reimbursement accompanied by appropriate supporting documentation or. The Project Management Unit (Office National de l'Electricité) will be responsible for submitting the appropriate supporting documentation for activities implemented so that payments can be made from the Special Account opened for that purpose, or to submit WAs for direct payment to the Bank accompanied by the necessary supporting documentation. As projected by Bank's standard disbursement profiles, disbursements would be completed four (4) months after Project closure.

*12. **Special account.*** To facilitate disbursement of eligible expenditures O.N.E. will open and establish at a Commercial Bank a Special Account in Dirhams with an initial authorized allocation equivalent to $5 million to cover Grant's share of eligible Project expenditures. The Authorized allocation of the SA would be the equivalent of an estimated four (4) months' of eligible expenditures financed by the Grant. O.N.E. will be responsible for submitting monthly replenishment WAs with appropriate supporting documentation for expenditures incurred and will retain and make the documents available for review by the Bank supervision mission and project auditors. The supporting documentation will include reconciled bank statements and other documents as may be required.

*13. **Use of Statement of Expenditure.*** Activities to be financed under the grant funds should not require the use of statement of expenditures as a disbursement method.

*14. **Allocation of grant proceeds.***

Category of expenditure	**Amount of the grant allocated (US$)**	**Percentage of expenditures to be financed**
1. Goods, works, including installation works and services for the EPC/O&M Contract.	43,200,000	100%
Total	**43,200,000**	

15. Planning of supervision. Financial supervision activities will include a review of half yearly FMRs, review of annual audited financial statements and management letters. There will be about two financial management supervision missions per year.

Annex 8: Procurement Arrangements

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

A. General

All procurement activities under the project will be carried out by Office National de L'Electricité (O.N.E.). Procurement for the proposed project would be carried out in accordance with the World Bank's "Guidelines: Procurement Under IBRD Loans and IDA Credits" dated May 2004; and the provisions stipulated in the Legal Agreement. The Grant will finance a single contract, which is jointly financed with O.N.E. and the African Development Bank. Consequently, no Procurement Plan is required. A general procurement notice was published in UN Development Business and on d-g Market on April 6, 2004. Such contract consists in the supply and installation (single responsibility contract) of the ISCC Power Plant at Ain Beni Mathar estimated at about US$519.27 million (including contingencies) of which the GEF grant will finance up to US$43.2 million. The borrower carried out a prequalification process under the Bank's supervision and no objection. Prequalified contractors were invited to submit bids for this contract. Procurement was conducted using the Bank's Standard Bidding Documents (SBD). Procurement for non-Bank financed contracts will be conducted using AfDB and national SBD satisfactory to the Bank. The supply and installation of the transmission lines and substations for the evacuation of the power from the power plant will be financed by the AfDB and O.N.E.

Selection of Consultants: Consulting services for the supervision and management of the ISCC Power Plant will be financed by AfDB and O.N.E. and consultants will be selected in accordance with AfDB procedures.

B. Assessment of the agency's capacity to implement procurement

An assessment of the capacity of O.N.E. to implement procurement actions for the project was carried out during the pre-appraisal mission in September 2005 and updated during the appraisal mission in June 2006. The assessment reviewed the organizational structure for implementing the project. The main findings are as follows:

The Direction Production of O.N.E. would be responsible for the construction of the ISCC Power Plant. A project manager within the Direction Production has been appointed. The Project Manager reports directly to the Director of Production and will liaise with and rely for support from the following Departments: *Direction Approvisionnements et Marches* for procurement matters; *Direction Technique et Ingenierie* for technical matters; and *Direction Financiere* for financial management and audit matters.

O.N.E. has substantial project management experience including familiarity with standard bidding documents for projects financed by international financial agencies, such as the EIB, AfDB, Islamic Bank and others. The Direction Production will manage the procurement, erection of equipment/materials and commissioning, and will closely coordinate with the other relevant departments. The consulting firm Fichtner (financed by the AfDB) is assisting O.N.E. in

the preparation of prequalification document and evaluation, bidding documents and evaluation of bids, and assisting in contract negotiation. A source of possible risk is that O.N.E.'s staff may not be fully updated on the Bank procurement/contract management procedures. To minimize this risk, during project t launch, training to O.N.E. procurement specialists will be provided to update the procurement skills including familiarization with new Bank procurement guidelines. **The overall project risk for procurement is Average.**

C. Procurement Plan and Advanced Procurement

Procurement Plan:

This project involves the financing of only one contract under International Competitive Bidding (ICB) which had its procurement process advanced and is nearly completed. Consequently, a procurement plan is not required. For the overall project, Attachment 1 shows the procurement actions.

Advanced Procurement:

The single contract being financed by the GEF Grant had its procurement actions advanced. It is a Two Stage bidding process with prequalification. The contract is for a combined cycle power plant jointly financed by the Bank, O.N.E., and AfDB. It includes a solar component funded by a GEF grant. The Borrower has the help of a consulting engineer (Fichtner Solar who is also working on a similar project in Egypt).

Prequalification -- The borrower issued prequalification documents, received and analyzed applications and finally prequalified four potential bidders. The Bank supervised all steps of the process and issued the corresponding no objections (OPRC cleared the no objection to the list of prequalified potential bidders). The number of bidders in this case was low because the solar component restricts the number of qualified bidders.

First Stage of Bidding -- The borrower issued bidding documents (200-250 MW plant capacity) for the first stage of bidding for the four prequalified bidders and received technical bids submitted by only 3 bidders because one excused himself[16]. The borrower carried out clarification meetings with bidders, cleared their minutes with the Bank and sent it to bidders. The borrower (with the Bank's no objection) issued final bidding documents.

Second Stage of Bidding -- The borrower received final proposals from only two bidders since the third excused himself[17]. In accordance with the bidding documents the Borrower has opened the technical proposals and has kept sealed and safeguarded the price proposals submitted by the

[16] The bidder indicated that "*In fact we are not in the condition to submit a bid for this bidding process being responsive to all the requirements included in the bidding documents because the conditions and guarantees required are very strong and we do not find interest in the contract resulting from such bidding documents.*"
[17] After having participated in the technical discussions this bidder sent a letter indicating that it would not submit a bid for this contract. This bidder was contacted again (for the higher capacity option) and reaffirmed his lack of interest in participating in this bidding process.

two bidders for both options of solar capacity (20 MW and 30MW solar) for the 200-250 MW plant capacity. Before the opening of the price proposals, O.N.E. contacted the Bank requesting approval to issue an amendment to the bidding documents asking bidders who offered commercial bids to submit additional bids for a higher plant capacity (400-450 MW) for the two options for solar component (20 MW and 30 MW). The Bank agreed to the request with the condition that O.N.E. would keep (sealed and safeguarded) the price proposals received for the lower capacity (200-250 MW). Therefore, O.N.E. evaluated the commercial proposals for the higher plant capacity for the 20MW solar component option to define the winning bidder. Then, O.N.E. opened the winning bidder's commercial proposal for the 30MW solar component option. O.N.E. analyzed this proposal and submitted to the Bank a final recommendation on the option of its choice for contract signature, namely 452MW of CCGT and 20MW of solar capacity.

D. Frequency of Procurement Supervision

In addition to the prior review supervision the Bank has been carrying out of the advanced procurement process, the capacity assessment of the Implementing Agency has recommended one field supervision mission to carry out post review of procurement actions.

2. Consulting Services

No consultant contract will be financed under this Bank project. All Consultancy services for project management for the ISCC Power Plant will be financed by the AfDB and O.N.E.

ATTACHMENT 1

Procurement schedule for the overall project including non-Bank financing

Component No	Description of Package	Number of slices (Lots)	Type of Procurement	Lending Agency and Procurement Method	Estimated Cost (million US$)	Procurement Schedule				
						Prequalification 1. Invitation 2. Opening 3. Evaluation Report	Preparation of Tender Documents	Tender 1. Invitation 2. Opening 3. Evaluation Report	Contract Signing	Contract Completion
	Financing from the IBRD/AfDB/O.N.E. loan proceeds									
	Construction of the Solar thermal Plant									
1.	Turn-key Construction Contract	1	S&I	GEF/AfDB (World Bank guidelines)	519,27 of which 43.2 from GEF O.N.E. 114.68 and AfDB 361.6	05.26.04 09.01.04 10.24.04	02.09.05	(1) 07.26.05 (2)12.21.05 (first stage) 10.05.06(second stage) (3) 01.05.07 (evaluation)	03.09.07	04.15.09
	Total GEF/AfDB loan/)NE				**519,27 of which 43.2 from GEF, 361.6 from AfDB and O.N.E. 114.68**					
	Financing from the AfDB/O.N.E. loan proceeds									
2.	Construction of 225kV and 60kV lines	1	Works	AfDB/O.N.E. (AfDB guidelines)	17,84 (including 15.5 financed by AfDB and 2.34 O.N.E.		05.05.05	(1)06/16/06 (configuration initial) 03.01.07 (ligne vers bourdim) (2) 10.26.06 (configuration initial) 05.01.07 (ligne ver bourdim) (3)02.19.07 (configuration initial) 06.01.07	03.12.07 (configuration initial) 07.01.07 (ligne vers bourdim)	12.01.08
3.	Construction of a 225kV substation	1	Works	AfDB/O.N.E. (AfDB guidelines)	9.04 of which 1.89 from O.N.E.and 7.15 AfDB		01.05.06	(1) 08.16.06 (initial) 01.05.07 (avenant grande puissance) (2) 09.30.06 (initial) 02.25.07 (avenant grande puissance) (3) 12.28.06 (initial) 04.01.07 (avenant grande puissance)	05.01.07	12.01.08
9.	Consulting Services for project management of the power plant	1	CS	AfDB/O.N.E. (AfDB guidelines)	5.09 of which 0.54 from O.N.E. and 4.55 AfDB		03.06.06	02.15.07 04.15.07 05.15.07	06.01.07	04.15.11
	Total AfDB loan/O.N.E.				**27.2 of which 4.77 from O.N.E.**					

	Financing from O.N.E. loan proceeds									
4.	Construction of access road	1	Works	O.N.E. (Moroccan Procurement Law)	3.80		08.01.06	03.01.07. 05.02.07 06.01.07	07.01.07	07.01.08
5.	Boreholes for water supply to the plant	1	Works	O.N.E. (Moroccan Procurement Law)	0.35		03.01.06	02.01.07 04.01.07 05.01.07	06.01.07	02.01.08
6.	Land acquisition for the power plant	1	Works	O.N.E.	0.87					Completed land purchased in June 06
7.	Gas pipeline connector from the power plant to the main pipeline	1	Works	O.N.E. (Moroccan procurement Law)	* 9.22		02.01.06	06.08.07 09.05.07 10.26.07	11.09.07	05.01.07
8.	Social and Environmental mitigation measures	1	CS	O.N.E.	2.31					Study Completed in December 06
	Total for O.N.E. co-financing				**16.55**					
	Total for project				**567.80**					
	Of which from AfDB				**390**					
	Of which from GEF				**43.2**					
	Of Which from O.N.E.				**134.60**					

Annex 9: Economic and Financial Analysis

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

A. Project Economic Analysis

Method

1. The proposed project forms an integral part of O.N.E.'s least-cost expansion plan. Incremental capital costs, operation and maintenance costs, and benefit streams of the project (all in 2006 prices) are shown in Table 1 of this Annex. Assumptions underlying these figures are detailed below:

Operation and Maintenance (O&M)

2. Incremental operation and maintenance costs at generation have been estimated at $14.4 million per year

Transmission and distribution costs

3. Transmission and distribution costs are estimated at 0.6 US cent/kWh

Fuel Costs

5. Fuel costs have been estimated on the basis of the economic cost of gas for Morocco of $6/MMBtu.

Economic Benefits

6. Economic benefits associated with incremental electricity supply to consumers are calculated using average tariffs. Although benefits in this case are more a reflection of the adequacy of tariffs than the true value of the benefits of the project, calculations using consumers' willingness to pay (WTP), as proxies for benefits, are unnecessary. As tariffs, particularly for domestic consumers, are subsidized, WTP is likely to be greater than average tariffs. Therefore, if the project is justified using average tariffs, it is, a fortiori, justified using WTP.

Results of the Analysis

7. The calculations show that the NPV of the project is equal to $48 million and the rate of return is equal to 11.4%.

Switching Values:

8. The switching value of a variable is that value at which the project's NPV becomes zero (or the IRR equals the discount rate). The switching values for the ISCC project are given in the table below in terms of the percentage change in the value of the variable needed to turn the project's NPV equal to zero. Switching values are useful in identifying which variables most affect project outcome and are presented below:

Switching Values

Variable	Switching value
Sales	-3%
Fuel Costs	2%
Total Investment Costs	13%

The most two critical variables are the level of sales and the fuel costs. While sales may drop, it is unlikely, given past experience and the growth of the economy that they will drop by the required level of 3% to bring down the NPV to zero. Things are, however, different for fuel costs. They can easily increase by 1%. This is also an area of concern for the future and their evolution should be kept under constant review. Beyond operating its power stations efficiently, this variable is beyond the control of O.N.E. As suggested earlier, should fuel prices increase, tariffs would have to be adjusted accordingly (if the reforms take place, the adjustment would concern the regulated market, the non-regulated or competitive market will automatically adjust). Finally, the project's worth is also sensitive to changes in total investment costs, but an 13% increase in total investment costs is considered quite unlikely since we are dealing with actual bid results.

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Fixed operating costs	14.4	**US$ million/year**
Trans. and Dis.Costs	0.6	**UScent/kWh**
Gross Generation	3538	**GWh/year** (this excludes the solar generation of 40.5 GWh/year as there are
Fuel Cost	6	**US$/MMB** no fuel costs)
Average Tariff	0.08	**US$/kWh (at the consumer level)**
Average T and D losses	12%	
Life of the Plant	25	**years**
Discount rate	10%	

US$ Million

	Invest Cost	Fixed O&M Cost	Trans. And Dist. Costs	Fuel Cost	Total Costs	Energy Sales (GWh)	Total Revenues	Net Revenues
2007	250	0	0	0	250	0	0	-250
2008	250	0	0	0	250	0	0	-250
2009	56	14	21	141	233	3,159	253	20
2010		14	21	141	177	3,159	253	76
2011		14	21	141	177	3,159	253	76
2012		14	21	141	177	3,159	253	76
2013		14	21	141	177	3,159	253	76
2014		14	21	141	177	3,159	253	76
2015		14	21	141	177	3,159	253	76
2016		14	21	141	177	3,159	253	76
2017		14	21	141	177	3,159	253	76
2018		14	21	141	177	3,159	253	76
2019		14	21	141	177	3,159	253	76
2020		14	21	141	177	3,159	253	76
2021		14	21	141	177	3,159	253	76
2022		14	21	141	177	3,159	253	76
2023		14	21	141	177	3,159	253	76
2024		14	21	141	177	3,159	253	76
2025		14	21	141	177	3,159	253	76
2026		14	21	141	177	3,159	253	76
2027		14	21	141	177	3,159	253	76
2028		14	21	141	177	3,159	253	76
2029		14	21	141	177	3,159	253	76
2030		14	21	141	177	3,159	253	76
2031		14	21	141	177	3,159	253	76
2032		14	21	141	177	3,159	253	76

GEF Grant of $43.2 million has been deducted from total costs. Equivalently, it could have been put on the benefit side while maintining total costs on the cost side.

NPV (US$ Million)	**48**
IRR	**11.41%**

B. Financial Analysis:

Table 1 : O.N.E. financial performance (2003-2005)

	2003 Actual	2004 Actual	2005 Actual
Income Statement Items			
Unit Volume (GWh)	15,215	16,295	17,698
Revenues (operating)	12,339	12,442	14,478
Operating Income	598	599	(68)
Fuel, Coal and Gaz	1,666	1,849	3,198
Power purchase	5,034	5,003	5,760
Labor costs	1,462	1,571	1,672
EBITA	1,374	3,242	2,975
Net Income	**69**	(39)	(241)
Funds Statement Items			
Internal Sources	2,934	2,802	5,400
Borrowings	1,448	2,023	1,956
Equity Investments	797	694	482
Total Sources	**5,179**	**5,518**	**7,838**
Capital Expenditures	3,442	4,662	7,130
Working Capital Increase (Decrease)	1,028	(1,525)	(170)
Debt Service	1,275	1,055	821
Cash Variation	(565)	1,326	57
Total Uses	**5,179**	**5,518**	**7,838**
Balance Sheet Items			
Current Assets	8,132	9,409	11,376
Net Fixed Assets	40,370	42,690	46,736
Total Assets	48,502	52,098	58,112
Current Liabilities	7,701	9,337	11,533
Long-term Liabilities	21,872	24,916	26,687
Equity	18,929	17,846	19,893
Total Liabilities and Equity	48,502	52,098	58,112
Financial Ratios			
Operating Income as a % of Revenue	4.8	4.8	-0.5
Net Income as a % of Revenue	0.56	-0.32	-1.66
Return on Net Fixed Assets	0.2	-0.1	-0.5
Debt Service Coverage	2.3	2.7	6.6
% Investment self financed	44%	36%	33%
Current Ratio	1.1	1.0	1.0
Debt as a % of Total Capitalization	53.6	58.3	57.3

Table 2 Summary of O.N.E. financial performance under the Base case scenario

	2006	2007	2008	2009	2010	2011	Growth (%)
Income Statement Items							
Unit Volume (GWh)	19,114	20,452	21,883	23,372	24,961	26,738	7.12%
Revenues (operating)	15,505	16,482	17,485	18,304	19,523	20,913	6.16%
Operating Income	970	711	1,237	1,472	1,252	1,341	6.58%
Fuel, Coal and Gas	3,562	3,597	3,846	3,088	4,251	4,553	5.85%
Power purchase	5,499	6,375	5,909	6,504	6,346	6,798	1.96%
Labor costs	1,566	1,637	1,710	1,787	1,868	2,001	2.24%
EBITA	2,478	3,682	3,663	4,855	6,066	6,220	15.32%
Net Income	*(4,696)*	*483*	*497*	*859*	*682*	*720*	
Cash flow Statement Items							
Internal Sources	3,272	3,247	3,975	4,863	5,040	6,611	
Borrowings	13,181	2,506	7,283	1,200	1,029	1,200	
Equity Investments	804	1,036	908	965	897	600	
Total Sources	*17,257*	*6,789*	*12,166*	*7,028*	*6,967*	*8,411*	
Capital Expenditures	5,483	5,794	8,484	8,743	3,410	3,910	
Working Capital Increase (Decrease)	1,431	(445)	344	631	462	530	
Debt Service	1,087	1,171	7,163	2,207	2,463	2,680	
Cash Variation	9,257	269	(3,824)	(4,552)	632	1,290	
Total Uses	*17,257*	*6,789*	*12,166*	*7,028*	*6,967*	*8,411*	
Balance Sheet Items							
Current Assets	7,915	7,703	7,970	8,256	8,560	8,730	
Net Fixed Assets	44,730	47,111	49,291	48,500	46,874	47,427	
Total Assets	*52,645*	*54,813*	*57,262*	*56,756*	*55,435*	*56,155*	
Current Liabilities	7,425	7,365	8,723	8,095	7,315	7,288	
Long-term Liabilities	29,050	30,503	30,835	29,921	28,584	28,469	
Equity	16,170	16,945	17,703	18,740	19,536	20,398	
Total Liabilities and Equity	*52,645*	*54,813*	*57,262*	*56,756*	*55,435*	*56,155*	
Financial Ratios							
Operating Income as a % of Revenue	6.3	4.3	7.1	8.0	6.4	6.4	
Net Income as a % of Revenue	-30.29	2.93	2.84	4.69	3.49	3.44	
Return on Net Fixed Assets	-10.5	1.0	1.0	1.8	1.5	1.5	
Debt Service Coverage	3.0	2.8	1.3	2.2	2.0	2.3	
% Investment self financed	40%	36%	27%	30%	75%	74%	
Current Ratio	1.1	1.0	0.9	1.0	1.2	1.2	
Debt as a % of Total Capitalization	64.2	64.3	63.5	61.5	59.4		

Annex 10: Safeguard Policy Issues

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

In accordance with the World Bank Safeguards policies on environment, the project has been classified as a "Category B" Project. The project has also been classified under the "Environmental Category II" of the African Development Bank, which means the impacts are site specific and that measures to minimize or mitigate these impacts can easily be identified and recommended. The rating is based on the conclusions of the preliminary assessment at the concept stage and reconfirmed after the Environmental Impact Assessment was done. The two safeguard policies to be triggered under this project are OP 4.01: Environmental Assessment and OP 4.12: Involuntary Resettlement.

The Bank's Safeguard Policies have been made available to the implementing agency, O.N.E., which on its side shared it with the consultancy consortium, Burgéap and Phénixa, which conducted the EIA. The first draft presented to the Bank did not follow the directives and the operational procedures of the Bank with respect to environmental and social assessment, and O.N.E. was asked to re-submit a revised EIA, which was found to be acceptable to the team and the Environmental and Social Safeguards reviewers.

In addition to the Bank's guidelines, the assessment took into consideration the requirements of various national environmental laws and regulation of direct relevance to the project, namely Law 11-03 on the protection of the Environment, Law 12-03 on EIA, Law 13-03 on Air Pollution, despite the fact that no Executive Regulations have been issued to-date to operationalize the enforcement of these laws. Other regulation of relevance, such as Law 10-95 on Water and the 1914 Decree governing the establishment of hazardous, unsanitary and disagreeable establishments.

Environmental Aspects

Several alternatives were considered as part of the Environmental Impact Assessment, including siting and technology alternatives. A pre-feasibility study conducted in 1994 has considered 2 alternative sites for the solar–thermal power plant: Ouarzazzate and Taroudant. In 1996, the search for a more suitable site on the basis of various environmental factors, the proximity to the water resources needed for the cooling system, and the proximity to the Maghreb-Europe natural gas network led to the selection of the Beni-Mathar site, in Jerada, because of its proximity to the transmission and distribution network and the land availability.

The electricity produced by the proposed plant will be evacuated through two 225kV transmission lines and one 60 kV transmission line. The two 225 kV lines will go to the Oujda substation (110 km) and to the Bourdim substation (70 km) while the 60kV line will be constructed to provide a backup power supply to the auxiliaries of the plant in case of emergency. This line, of about 10 km, will connect the 60/22 kV substation of Ain Beni Mathar to the power plant.

In its identification of the path of the high voltage transmission lines, the Office National de l'Electricite has taken into consideration to generally avoid inhabited areas and protected areas of ecological importance.

The operation of the solar thermal power plant does not lead to negative impacts with respect to its air emissions , as CO_2 and NO_2 emissions associated with the use of natural gas are much less than in the case of any other fossil fuel, and there are no SO_2 emissions. The main risks that could exist would be due to accidental contamination of the site by a spill of the heat transfer fluid during operation as well as during transportation to the site in the construction phase. Such risks will however be largely reduced and properly managed through the inclusion of a retention and biological treatment system to be included in the detailed design of the project, and by following the safety measures for proper handling and transportation of hazardous substances.

Due consideration should also be given to avoid exceeding the allowable volumes of cooling water to be pumped from the aquifer in order to maintain the current balance of the resource.

Other important impacts, for which mitigation measures have been identified, and that should be included in the terms of reference (TORs) and contracts of the construction firms are related to solid waste and the final disposal of such waste in pre-identified controlled landfills, in case they cannot be re-used or recycled on site.

Environmental Management Plan

Following the guidelines of the Bank and the Pollution Prevention and Abatement Handbook, an Environmental Management and Monitoring Plan has been developed. The Government of Morocco is in general familiar with the Bank's safeguard policies and its requirements, and specifically the Quality and Environment Division of O.N.E. has acquired very important experience during the preparation of the TORs for the EIA and the supervision of the EIA consultant's work, in close collaboration with the project's environmental and social safeguards team.

The implementation of the Environmental Management Plan will be the responsibility of the EPC Contractor and its sub-contractors, as clearly specified in bidding documents that should take into consideration the recommended mitigation measures. Monitoring the implementation of the Environmental Management Plan will be the responsibility of the Quality and Environment Division of O.N.E. The cost of implementation and monitoring of the EMP is covered in the cost of the project.

Public Consultation and Disclosure

A day of public consultations was organized by O.N.E. on December 29, 2005 in the Municipality of Ain Beni Mathar. The objective was to provide information to the general public on the power plant, to raise awareness among the invited participants, and to answer their questions and concerns while sharing the results of the Environmental Impact Assessment. The

participants comprised of over 120 individuals, included the local residents, elected officials, NGO representatives from the region and economic operators.

Social Aspects

Background

The project triggered the Involuntary Resettlement Policy (OP/BP 4.12) as it has been determined that land acquisition will be required for the construction site of the power plant, the gas pipelines, the access road and the electric lines. Specifically, the project requires the acquisition of:

- *159 ha 97 are 50 ca for the power plant;*
- *6 ha 17 are 11 ca where the gas pipelines will be laid and 12 ha 35 are 20 ca will be temporarily occupied/used during the construction phase;*
- *As for the access road and the electric lines, a study is being undertaken to determine the exact land size requirements.*

This Annex presents the summaries of (i) the Resettlement Action Plan and (ii) the Resettlement Policy Framework (RPF) that have been prepared under the project. The Resettlement Action Plan applies to the power plant site and the gas pipelines because the project-affected people have been identified and land acquisition procedures have been launched. Since the exact nature and extent of land acquisition for the access roads and electric lines has not yet been determined, a Resettlement Policy Framework has been formulated, which will be followed with a Resettlement Action Plan downstream once the feasibility study has been completed. Both the RPF and RAP documents have been based on the findings of the project feasibility study, the Environmental and Social Impact Assessments, the site visits conducted and consultations held with the project-affected people.

The RPF and RAP have been disclosed at the World Bank's Infoshop and made available at the local commune level, a place accessible to the public concerned in Morocco (i.e. relevant municipalities) prior to project appraisal.

I. Summary of the Resettlement Action Plan

A. Potential Impacts of Land Acquisition

The land acquisition for the power plant site and the gas pipelines does not lead to involuntary resettlement, either residential or commercial, of local inhabitants, nor does it pose any threats to incomes or livelihoods, or create/intensify poverty or vulnerability.
The acquisition, which directly affects 8 and 21 persons, respectively, involves minor reduction in agricultural plot area, none of which would require the physical relocation of these persons.

B. Census Survey & Social Assessment

A social assessment was conducted at the project site with all the acquisition-affected people in June 2006. A series of intensive consultations were conducted with 8 persons whose land and/or assets will be affected by the power plant construction and 21 persons affected by the gas

pipelines. The people were informed about the project and the compensation procedures for their loss. In addition the consultations touched upon the implications of the project in terms of employment generation. The assessment further improved the local communities' understandings of the project and its implications, and confirmed that the populations are awaiting the employment opportunities which the project will likely offer.

Equally, elected representatives of the local commune of Béni Mathar as well as three public agencies that will be affected by the land acquisition for the gas pipeline, including *l'Office National des Chemins de Fer (ONCF) ; la Direction Régionale du Ministère de l'Equipement et l'Agence du Bassin Hydraulique du Moulouya* have been consulted in this regard.

C. Legal Framework Governing Land Acquisition

The compensation for the land acquisition can be done either on mutually agreed terms or through expropriation in the public interest, which is stipulated in law n°7-81 issued by *dahir* n°1-81-254 dated 6 May 1982.

This law supersedes previous dahirs dated April 3, 1951, June 25 1929, and August 22, 1938 respectively as well as the vizirial order dated October 20, 1954. (Refer to RAP for details).

D. Eligibility Criteria

The persons and government agencies affected by the land acquisition can be classified as follows:

- **Public land**: For the power plant site, the *Office Nationale de l'Electricité* (O.N.E.) has proceeded with the purchase of land from the Ministry of Interior, the custodian of public collective land. Two land parcels for the gas pipelines will also be acquired in the same manner.

- **Collective land owned by the Commune of Beni Mathar** - *Collectivité Ethnique de Béni Mathar*: O.N.E. has compensated the collective land users who are actually farming on the site selected for the power plant for the loss of their crops/harvest.

- **Private land**: For the gas pipelines, 21 land owners will be compensated for their land and any eventual loss of crops/harvest. As for the power plant site, there are no private land owners whose land will be acquired.

- **Land owned by public Agencies** (*Office Nationale de Chemin de Fer, Direction Régionale de l'Equipement, et l'Agence du Bassin Hydraulique de Moulouya*): O.N.E. is preparing and processing a request letter for the permission of temporary occupation of these lands owned by public entity agencies during the construction phase of the gas pipelines.

E. Valuation and Compensation for Losses

Description of the compensation

The compensation levels are determined by a Commission of Experts comprised of the following members:

- Representative of the local authority of Ain Béni Mathar ;
- President of the Rural Commune of Béni Mathar ;
- Two community representatives of the *Collectivité Ethnique* of Béni Mathar;
- The representative of the *Service de l'Enregistrement de la Direction Régionale des Impôts ;*
- A representative of the *Direction Régionale des Domaines.*

This Commission has fixed the compensation based on the current land value in the region and also on the basis of negotiations between its members among whom are local community representatives: the President of the Rural Commune and the representatives of the Locla Commune - *Collectivité Ethnique of Béni Mathar.*

Land acquisition procedure

The taking of land and related assets/crops may take place only after full compensation has been made to all affected people.

The procedures applied by O.N.E. for land acquisition are as follows:

- Address a letter to the Governor of the concerned Province to call for a meeting with the Commission of Experts;

- Participate as observers in the two meetings of the Commission of Experts, who are in charge of validating the list of affected persons and agencies as well as fixing the land value;

- Undertake Social Assessment and census;

- Compensate the land users and/or land owners, in conformity with the validated list and agreed prices.

F. Community Participation

In June 2006, a series of intensive consultations were conducted with local project affected people as part of the social and land acquisition assessment. The assessment was conducted by a local consultant. The study consulted with individuals whose land and/or assets will be affected by the construction of the power plant and the gas pipelines and they were informed about the project and the land compensation procedures. In addition, the consultations touched upon the implications of the project in terms of employment generation. The assessment further improved

the local communities understandings of the project and its implications and confirmed that the populations are awaiting the employment opportunities which the project will likely offer.

Equally, elected representatives of the local commune of Béni Mathar as well as three public agencies that will be affected by the land acquisition for the gas pipeline, including *l'Office National des Chemins de Fer (ONCF) ; la Direction Régionale du Ministère de l'Equipement et l'Agence du Bassin Hydraulique du Moulouya* have been consulted on this regards.

Additionally,

- In October 2005 the project team conducted a series of informal consultations with pastoralists in the immediate vicinity of the proposed plant. The local pastoralists viewed the plant as an asset to the region given its employment generation potential and improved availability of electricity.

- On December 29, 2005 and as part of the Environmental Management Plan (EMP), a day of public consultations was organized by O.N.E. in the Municipality of Ain Beni Mathar. The objective was to provide information to the general public on the power plant and to raise awareness, among the participants, and to answer their questions and concerns while sharing the results of the Environmental Impact Assessment (EIA). The participants, over 120 individuals, included: the local population, elected officials, NGO representatives from the region and economic operators.

G. Grievance Procedures

In case of litigation or conflict, the concerned populations can directly address their complaints and concerns to the two local representatives of the *Collectivité Ethnique* and the *Commune Rurale.*

Additionally, the land owners and/or land users who would like to contest the proposed/fixed compensation can call upon the tribunal for a revised valuation of the land/assets. Any affected person may appeal to the court for redress. The court has the power to hear submissions, review the process, and make such provisions as it deems necessary. These include ordering compensation to be paid, halting works, etc.

H. Organizational Responsibilities

O.N.E., which is the grant recipient for the project, will be responsible for ensuring that the land acquisition procedures will be undertaken in compliance with the Moroccan law on Expropriation and Land Acquisition as well as the World Bank's operational policy OP 4.12. The main Unit in O.N.E. who will be in charge of the implementation of these procedures is the *Division de la Gestion du Patrimoine et des Affaires Immobilières.*

I. Implementation Schedule

In June 2004, the land acquisition for the Power Plant site was finalized: the list of affected people and /or entities and the compensations for their loss were validated and approved by the

Commission of Experts. The required public land has been purchased, and the compensations to the communal land users for the loss of use of the land and/or loss of crops have been granted by O.N.E.

In February 2006, the Commission of Experts completed validating the list of land owners/users, the size of the land and other characteristics and valuated the land/assets to fix the compensations for the land acquisition entailed by the construction of the gas pipelines. Due compensation will be granted to the affected people prior to the start of the work on the gas pipeline.

O.N.E. is officially requesting authorization from the concerned parties/agencies for the temporary occupation/usage of their lands for the construction of the gas pipeline. O.N.E. expects to obtain the official permission by November 2006.

J. Cost and Budget

For the power plant site:

- 7 998 750,00 Dhs has been transferred/paid to the Ministry of Interior for the acquisition of communal land; and
- 192 877,08 Dhs has been paid to the 7 communal land users for their loss of crops/assets.

For the gas pipelines,

- 687895,00 Dhs has been allocated for the private and public land acquisitions; and
- 19 024,00 Dhs for the temporary occupation/ of land parcels.

The land acquisition costs (including compensation, land purchase, etc.) are being financed from O.N.E.'s budget. This cost remains negligible/much lower in comparison with the overall project cost.

K. Monitoring and Evaluation

O.N.E. will be in charge of monitoring the implementation of this RAP to ensure that the project-affected people are adequately compensated. For every operation and any type of land acquisition (private, public or communal land), the table in annex 3 will be filled out and submitted to the Bank for non-objection. This table will allow O.N.E. to inform the Bank of the progress made on the Plan and will be used as a monitoring and evaluation tool to document accomplishments, identify the dates for specific activities, delays, if any etc.

In addition to the internal supervision by O.N.E., the implementation of the Resettlement Action Plan should be followed up by a third party entity such as a local NGO/ consultant who is specialized in Land acquisition and Social Development related issues. Performance indicators should be used to measure progress.

II. Summary of the Resettlement Policy Framework

A. Principles and Objectives Governing Resettlement

Minimization of expropriation of land. The expropriation of private land is minimized in accordance with Moroccan law, which requires public utility projects of any nature to make maximum use of public land, and only to resort to expropriation when there is no alternative. Minimal expropriation of private land also serves the interest of O.N.E. and the concerned municipalities which are obliged to pay compensation awarded by independent assessment as explained below. Preference is always given to transfer of government or public land from other agencies where this is available, but even in this case compensation is payable. Also provisions will be taken by O.N.E. to avoid disturbing existing structures, in particular residences, farms, areas of religious or cultural heritage value, parks or other areas of public value.

Legal process is obligatory. All expropriations must be carried out according to the provisions of Moroccan law. The law of expropriation defines the procedures to be followed and protects the rights of all parties involved. Wrongs committed during expropriation may be redressed by the courts with provision for payment of damages and punishment of offenders.

Compensation and eligibility principles. Whenever expropriation of private land is unavoidable, Moroccan law clearly indicates that land should be expropriated through full compensation at market value, independently determined, with advance public notice, negotiation and right of appeal. Rights to compensation extend to owners, tenants, workers, or any person who can demonstrate any interest lost as a result of expropriation.

B. Description of Procedures for Preparing and Approving A Resettlement Action Plan

The procedure for the land acquisition for the access road and the electric lines is as follows:

- Address a letter to the Governor of the concerned Province to call for a meeting with the Commission of Experts;
- The Commission of Experts meets to fix the land value and compensation ;
- The local Authorities validate the list of land owners/users to be compensated based on the Commission's valuation.

Finally, O.N.E. pays the fixed compensation according to the validated list. Compensate the land users and/or land owners, in conformity with the validated list and agreed prices.

As per the World Bank's safeguard policy on Involuntary Resettlement OP/BP 4.12, a Land Acquisition and Resettlement Plan (LARP) will be formulated and implemented by O.N.E., and will encompass the following.:

- Project description
- Potential impacts of Land Acquisition
- Objectives of the Resettlement program
- Socio-economic studies
- Legal Framework

- Institutional Framework
- Eligibility for compensation
- Valuation of, and compensation for Losses
- Resettlement measures
- Community Participation
- Grievance procedures
- Organizational responsibilities
- Implementation schedule
- Costs and Budget
- Monitoring & Evaluation

The taking of land and related assets/crops may take place only after full compensation has been made to all affected people.

C. Estimated Population Displacement

At the present state, no physical displacement of persons, residences or commercial enterprises is expected, and any such instances will be fully detailed in the RAP.

The completion of the feasibility study will determine the exact location and size of land required for the access road and the electric lines. A census will be conducted to identify the people that will be affected by this land acquisition.

D. Eligibility Criteria

The following main categories are entitled to compensation where land/assets loss is established.
(a) Owners;
(b) Tenants with and without occupancy rights;
(c) Usufruct users;
(d) Owners of trees or other permanent improvements;
(e) People who use the land for commercial purposes;
(f) People who have made or maintained improvements of any nature, including caretakers, guardians, etc.

E. Legal Framework Governing Land Acquisition

The same legal procedures will apply as in the RAP (See above).

F. Methods of Valuing Affected Assets;

The same procedures will apply as in the RAP (See above).

G. Grievance Redress Mechanisms;

The same procedures will apply as in the RAP (See above).

H. Arrangements for Funding Compensation

The land acquisition costs (including compensation, land purchase, etc.) will be financed through

O.N.E.'s budgetary provisions. This cost remains negligible in comparison to the overall project cost.

I. Mechanisms for Consultations with, and Participation of, Project Affected Persons

A Census and a Social Assessment to inform and consult with the persons that will be affected by the project, and specifically by land acquisition for the access road and electric lines construction, will be undertaken once the feasibility study is completed and all relevant information on the land size to be acquired and ownership of the land have been obtained.

J. Monitoring of Implementation

O.N.E. will be responsible for the formulation and monitoring of a Resettlement Action Plan which will need to be prepared following the procedures described in section C.

In each case, when any type of land acquisition and compensation is involved the following timetable is prepared. This timetable serves as a monitoring device showing all actions involved, the responsible agency, expected completion date, the reason(s) for any delay and new expected completion date. This table shall be submitted to the Bank for non objection.

Action (full description)	Agency(s) involved	Expected completion date	Reason(s) for delay and new expected completion date

Morocco Solar Power Project - Status of land Acquisition

Land to be acquired	Amount of land to be acquired	Land Ownership Status	State of advancement / Timeline	Instrument Developed
***Site of Solar Thermal Power Plant**	• 159 ha 97 ares 50 ca purchased.	• *Collective land (terres collectives) owned by the Ministry of the Interior and conferred to the Commune/ Municipality of Ain Beni Mathar.* • *8 persons (members of the collectivité ethnique) who have been exploiting the land are directly affected by this land acquisition.*	• Land size and ownership status determined. • Purchase of land completed in June 2005. O.N.E purchased 160 ha from the Ministry of the Interior for 7 998 750, 00 DH. (Copy of said contract sent to the Bank). • Compensation for loss of crops paid by O.N.E to 8 'exploitants' /members of the "collectivitie ethnique" - 5.000 dh/ha for loss of agricultural land. • In June 2004, the land acquisition for the Power Plant site was finalized: the list of affected people and /or entities and the compensation for their loss were validated and approved by the Commission of Experts in charge of land/asset valuation. The required public land has been purchased, and the compensation to the communal land users for the loss of land usage right and/or loss of crops have been granted by O.N.E.	**RAP** Resettlement Action Plan / Land Acquisition Plan

			• "Bank has asked for certificates of the said compensation certifying that the people affected by the land acquisition for the power plant have received full compensation, that they are leaving voluntarily and are satisfied with the compensation granted by O.N.E. (i.e.have no other claim). • Bank has asked for proof of land title to reconfirm ownership of land.	
***Gas Pipelines**	• *6 ha 17 ares 11 ca will be purchased* • *12 ha 35 ares 20 will be rented for the duration of construction.*	• Land is owned by both private and public entities: a) PRIVATE - 21 private individuals will have land acquired from them.; b) PUBLIC - 3 agencies are affected by land acquisition : l'Office National des Chemins de Fer (ONCF) ; la Direction Régionale du Ministère de l'Equipement et l'Agence du Bassin Hydraulique du Moulouya. La Collectivité Ethnique de Béni Mathar.	• Land size and ownership status determined in February 2006. • Land price fixed by the Commission of expertise (Terre Bour : 10 dh/m^2 = sale price and et 0,15 dh/m^2 for temporary rent during construction phase: Terre irriguée : 35 dh/m^2 = sale price and 0,35 dh/m^2 for rent during construction phase. • By Bank's request, O.N.E. is in the process of preparing a request letter of temporary occupation authorization from the three public agencies. • During consultation the agencies have confirmed that they have agreed, in principle, to the temporary use of their land by O.N.E. during the construction phase. • O.N.E. anticipates finalizing	**RAP** Resettlement Action Plan / Land Acquisition Plan

			compensation to all concerned parties by October 2006.	
Name/location of site/land to be acquired	**Amount of land to be acquired (if known)**	**Land Ownership Status**	**State of advancement / Timeline**	**Instrument Developed**
****Access Road**	*Studies are underway to determine the:* • *Surface area to be acquired* • *Ownership status of the land* • *Number of persons requiring compensation*	• Ownership status to be determined by ongoing study.	• Study to determine the exact surface area and number of affected persons expected to be completed by end of November 2006.	**RPF** Resettlement policy Framework developed. RAP will be developed when studies finalized
****Electricity lines**	*Studies are underway to determine the:* • *Surface area to be acquired* • *Ownership status of the land* • *Number of persons requiring compensation*	• Ownership status to be determined by ongoing study.	• Study to determine the exact surface area and number of affected persons launched in February 2006 for a duration of 16 months (expected in June 2007).	**RPF** Resettlement policy Framework RAP will be developed when studies finalized

All land parcels to be acquired are relatively small and uninhabited and none of the land constitutes the sole source of revenue for the affected persons. No population displacement is entailed.

✱ Les terres objet de vente ou de location pour le projet sont des terres collectives, c'est-à-dire des terres données par l'Etat en exploitation à des ayants droits qui font partie de la Collectivité Ethnique ou à la Collectivité Ethnique dans sa globalité. Ces terres sont utilisées pour la céréaliculture, la luzerne et/ou l'élevage, aucune parcelle n'est habitée.

** Le choix du site pour la route d'accès et les lignes électriques sera basé sur une étude de faisabilité qui prendra en compte le niveau d'ensoleillement, la proximité du gazoduc, la disponibilité de l'eau, la proximité du réseau électrique ainsi que l'aspect social à la suite de la fermeture de la mine de Jerada.

Annex 11: Project Preparation and Supervision

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

	Planned	Actual
PCN review	07/30/1998	08/05/1998
Initial PID to PIC	06/01/1999	04/14/1999
Initial ISDS to PIC	09/25/2003	09/25/2003
GEF Council Approval	10/15/2004	10/15/2004
Appraisal	June 2006	06/30/2006
Negotiations	July 2006	09/11/2006
GEF CEO Endorsement	February 2007	
Board Approval	March 13, 2007	
Planned date of effectiveness	May 2007	
Planned date of mid-term review	December 2009	
Planned closing date	December 2012	

Key institution responsible for preparation of the project:
Office National de l'Electricite (O.N.E.)

Bank staff and consultants who worked on the project included:

Name	Title	Unit
Noureddine Bouzaher	Task Leader	MNSSD
Rachid Bouhamidi/Charles Sterling/Lizmara Kirchner	Financial Analysts	MNSSD
Rene Mendonca	Power Engineer (Consultant)	Consultant/MNSSD
Meryem Benchemsi/Siaka Bakayoko/Moez Makhlouf/Samia Msadek	Financial Management Specialists	MNACS
Armando Araujo Ribeiro	Procurement Specialist (Consultant)	Consultant/MNSSD
Dominique Bichara	Senior Counsel	LEGMS
Khalid Boukantar	Program Assistant	MNSSD
Sophie Jablonski	Junior Professional (JPA)	MNSIF
Dahlia Lotayef	Environmental Specialist	MNSSD
Yaa Oppong and Tiguist Fisseha	Social Safeguards Specialists	MNSSD
Fanny Missfeldt-Ringius	Environmental Economist	AFTEG
Jonathan D. Walters	Sector Manager, Energy and Economics Support Unit/Overall coordination and quality control	MNSSD
Rohit Khanna/ Chandrasekar Govindarajalu/	Bank GEF Coordination/ advisers/reviewers	ENVGC
Silvia Pariente-David	Sr. Economist/reviewer	MNSSD

Estimated Approval and Supervision costs:

1. Remaining costs to approval: $40,000
2. Estimated annual supervision cost: $80,000

Annex 12: Documents in the Project File

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

References:

- Description sommaire de la centrale de Ain Béni Mathar .

- Evaluation de la capacité d'un organisme à procéder à la passation de marchés pour les projets, fixation des seuils d'examen préalable et plan de supervision de la passation des marchés.

- Bilan énergétique 2004.

- Evolution de la puissance installée 2004 – 2012.

- Satisfaction de l'énergie appelée nette (GWh) – Scénario fort et scénario faible.

- Satisfaction de la puissance appelée à la pointe (MW).

- Projections de la demande 2004 – 2012 (Scénarios moyen, fort et faible).

- Bilan, compte d'exploitation, compte de gestion et tableau de financement 2004.

- Perspectives financières 2005 – 2010.

- Projections 2004 - 2010: (i) Indicateurs financiers ; (ii) Comptes charges et produits ; (iii) état des soldes de gestion ; (iv) tableau de financement ; (v) emplois et ressources.

- Coûts estimatifs du projet du projet d'Ain Béni Mathar.

- Calendrier prévisionnel d'exécution.

- Etat d'avancement des composantes.

- WASP computer output for generation planning 2004 – 2033.

- Draft procurement plan.

- Lettre du Premier Ministre au Ministre de l'Energie marquant son accord pour l'approvisionnement de la centrale de Ain Béni Mathar en gaz naturel à prélever sur la redevance perçue par le Maroc au titre du transit par le Gazoduc Maghreb Europe.

- WASP computer simulations on least-cost generation (October 2005).

- International Energy Agency (IEA) (2003). Renewables for Power Generation: Status and Prospects. 2003 Edition, Paris.

Annex 13: Statement of Loans and Credits

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

Operation Portfolio (IBRD, IDA, and Grants) as of 01/26/2007

Operations Portfolio (IBRD/IDA and Grants)
As Of Date 01/26/2007

Closed Projects 133

IBRD/IDA *

Total Disbursed (Active)	349.98
of which has been repaid	0.00
Total Disbursed (Closed)	7,479.77
of which has been repaid	6,284.33
Total Disbursed (Active + Closed)	7,729.75
of which has been repaid	6,284.33
Total Undisbursed (Active)	511.92
Total Undisbursed (Closed)	13.51
Total Undisbursed (Active + Closed)	525.43

Active Projects

Project ID	Project Name	Last PSR Supervision Rating: Development Objectives	Last PSR Supervision Rating: Implementation Progress	Fiscal Year	Original Amount In US$ Millions: IBRD	IDA	GRANT	Cancel.	Undisb.	Difference Between Expected and Actual Disbursements *: Orig.	Frm Rev'd
P075808	MA-Adult Literacy (Alpha Ma	MS	MS	2003	4.1			1.804875	2.341571	3.0540739	-0.016727
P043412	MA-Basic Education Reform	S	S	2005	80				61.38571	30.92119	
P088243	MA-FINANCIAL SECTOR D	S	S	2006	200				74.19079	71.393437	
P083746	MA-HOUSING SECTOR DP	MS	MS	2005	150				57.62475	4.3644659	
P056978	MA-IRRIGATION BASED C	MS	MU	2001	32.67			6.1546244	16.72209	21.435529	1.318679
P100026	MA-NATIONAL INITIATIVE	S	S	2007	100				104.0336		
P046314	MA-PROTECTED AREAS M	MU	U	2000			10.5		4.898496	4.8964951	-0.291717
P082754	MA-RURAL ROADS	S	S	2004	36.86				34.81023	8.0249536	7.456332
P094007	MA-RURAL ROADS II	S	S	2006	60				65.75253	5.9651313	
P069134	MA-Rainfed Agriculture Dev	MS	MS	2003	26.8				29.81505	8.1711177	0.537764
P086877	MA-Rural Water Supply and	S	S	2005	60				62.04373	4.5616468	
P073531	MA-Social Development Ag	S	S	2002	5				3.271055	0.9084416	0.908442
Overall Result					755.33		10.5	7.9594994	516.8207	163.71648	9.914793

CAS Annex B8 (IFC) for Morocco

Morocco
Statement of IFC's
Held and Disbursed Portfolio
As of 07/31/2006
(In US Dollars Millions)

	Held				Disbursed			
FY Approval Company	Loan	Equity	Quasi	Partic	Loan	Equity	Quasi	Partic
2006 FONDEP	3.45	0	0	0	0	0	0	0
2000 Maghreb Inv. Mgt	0	0.02	0	0	0	0.02	0	0
2000 Maghreb Invest P	0	2.3	0	0	0	2.3	0	0
Total Portfolio:	3.45	2.32	0	0	0	2.32	0	0

Approvals Pending Commitment

	Loan	Equity	Quasi	Partic
2005 BMCE	0	30	0	0
2002 SGRI	0	0.9	0	0
2004 Medtel Restruct	0	0	0	0
Total Pending Commitment	0	30.9	0	0

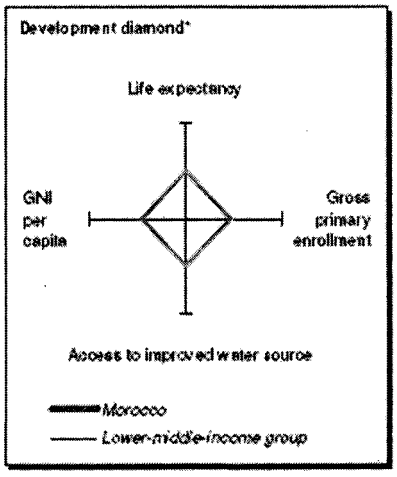
Annex 14: Country at a glance

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

Morocco at a glance

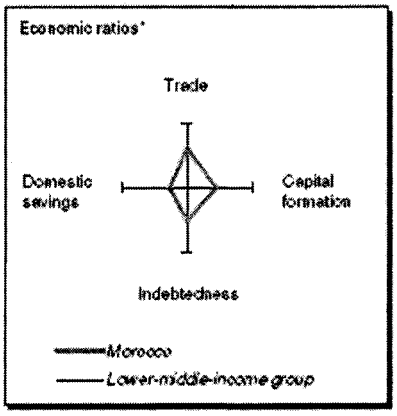
8/13/06

POVERTY and SOCIAL	Morocco	M. East & North Africa	Lower-middle-income
2005			
Population, mid-year *(millions)*	30.2	305	2,475
GNI per capita *(Atlas method, US$)*	1,730	2,241	1,918
GNI *(Atlas method, US$ billions)*	52.2	685	4,747
Average annual growth, 1999-05			
Population *(%)*	1.5	1.9	1.0
Labor force *(%)*	1.8	3.5	1.4
Most recent estimate (latest year available, 1999-05)			
Poverty *(% of population below national poverty line)*	19	..	..
Urban population *(% of total population)*	59	57	50
Life expectancy at birth *(years)*	70	69	70
Infant mortality *(per 1,000 live births)*	38	44	33
Child malnutrition *(% of children under 5)*	10	13	12
Access to an improved water source *(% of population)*	81	89	82
Literacy *(% of population age 15+)*	52	72	89
Gross primary enrollment *(% of school-age population)*	106	103	114
Male	111	106	115
Female	100	100	113



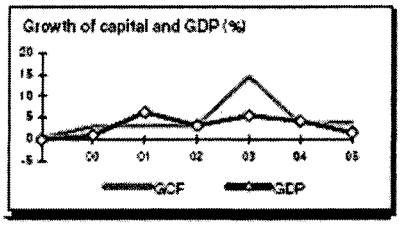
KEY ECONOMIC RATIOS and LONG-TERM TRENDS	1985	1995	2004	2005
GDP *(US$ billions)*	12.8	33.1	50.0	51.7
Gross capital formation/GDP	25.1	20.7	25.0	25.6
Exports of goods and services/GDP	25.4	27.3	33.1	34.4
Gross domestic savings/GDP	16.1	14.0	18.8	16.8
Gross national savings/GDP	19.3	17.1	27.6	26.4
Current account balance/GDP	-6.7	-3.6	2.2	0.1
Interest payments/GDP	4.3	4.1	1.2	..
Total debt/GDP	125.0	71.9	36.3	..
Total debt service/exports	33.7	33.4	14.1	..
Present value of debt/GDP	..	..	33.3	..
Present value of debt/exports	..	..	78.4	..

	1985-95	1995-05	2004	2005	2005-09
(average annual growth)					
GDP	2.9	3.6	4.2	1.6	4.3
GDP per capita	0.8	2.2	0.7	0.4	2.6
Exports of goods and services	7.5	5.0	4.7	3.4	5.4



STRUCTURE of the ECONOMY	1985	1995	2004	2005
(% of GDP)				
Agriculture	16.6	14.6	15.9	13.3
Industry	33.4	32.9	30.4	31.2
Manufacturing	18.6	18.3	16.5	16.8
Services	49.9	52.5	53.8	55.5
Household final consumption expenditure	68.0	68.6	60.2	62.8
General gov't final consumption expenditure	15.9	17.3	21.0	20.4
Imports of goods and services	34.4	34.0	39.3	43.1

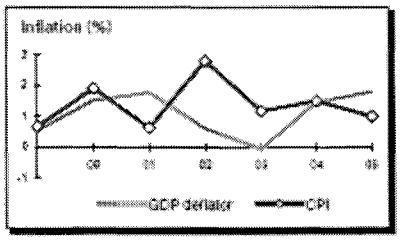
	1985-95	1995-05	2004	2005



Morocco

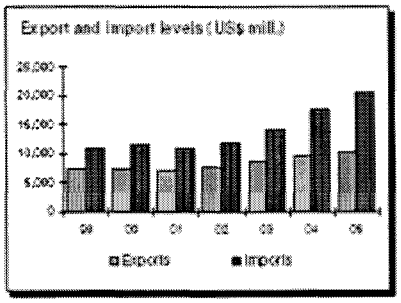
PRICES and GOVERNMENT FINANCE

	1985	1995	2004	2005
Domestic prices				
(% change)				
Consumer prices	7.7	6.1	1.5	1.0
Implicit GDP deflator	8.2	8.1	1.5	1.8
Government finance				
(% of GDP, includes current grants)				
Current revenue	16.0	23.8	25.1	27.1
Current budget balance	-6.6	0.1	-0.3	-1.2
Overall surplus/deficit	-8.8	..	-2.3	-3.3



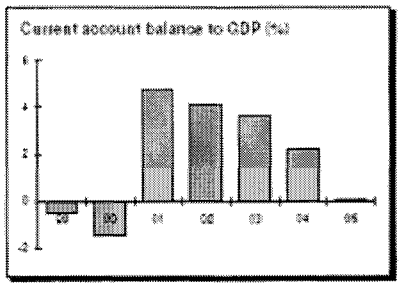
TRADE

	1985	1995	2004	2005
(US$ millions)				
Total exports (fob)	2,268	6,871	9,739	10,288
Agriculture	546	1,469	1,532	1,528
Phosphorus rock	479	284	451	546
Manufactures	477	3,754	5,832	6,211
Total imports (cif)	3,921	10,011	17,625	20,582
Food	507	1,373	1,534	1,470
Fuel and energy	1,074	1,177	2,938	5,054
Capital goods	649	2,186	3,881	4,190
Export price index *(2000=100)*	61	100	119	126
Import price index *(2000=100)*	82	122	126	138
Terms of trade *(2000=100)*	75	82	95	91



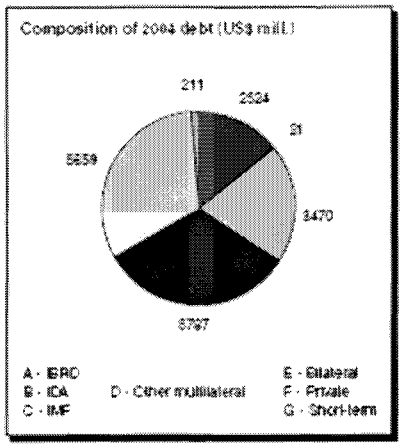
BALANCE of PAYMENTS

	1985	1995	2004	2005
(US$ millions)				
Exports of goods and services	3,263	9,045	16,568	18,142
Imports of goods and services	4,419	11,243	19,669	22,761
Resource balance	-1,157	-2,199	-3,101	-4,619
Net income	-766	-1,318	-651	-909
Net current transfers	1,064	2,330	4,861	5,590
Current account balance	-859	-1,186	1,109	41
Financing items (net)	976	204	726	1,923
Changes in net reserves	-117	982	-1,835	-1,964
Memo:				
Reserves including gold *(US$ millions)*	115	3,870	17,577	18,671
Conversion rate *(DEC, local/US$)*	10.1	8.5	8.9	8.9



EXTERNAL DEBT and RESOURCE FLOWS

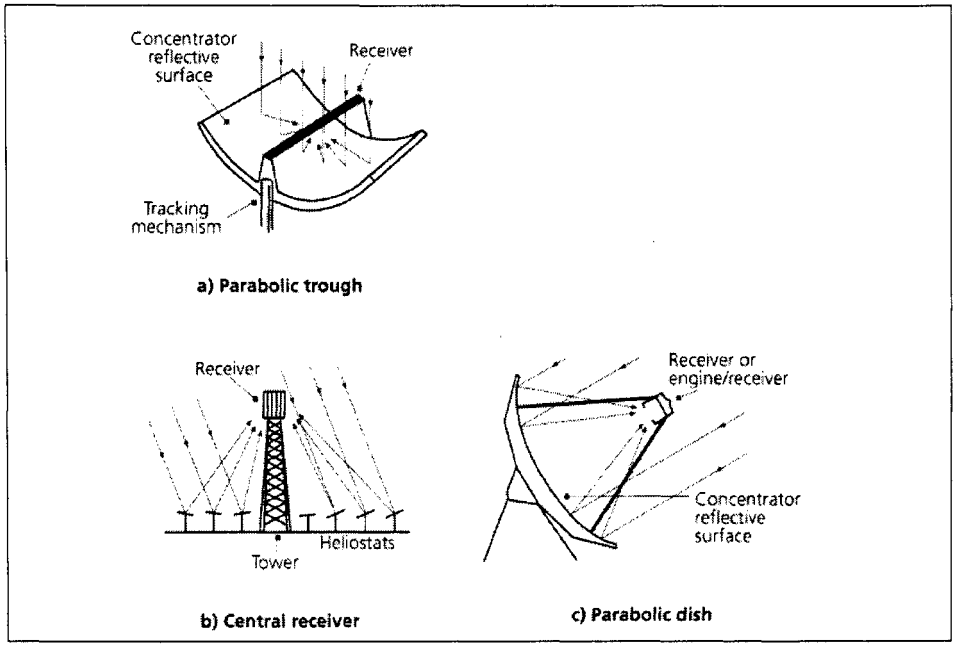
	1985	1995	2004	2005
(US$ millions)				
Total debt outstanding and disbursed	16,056	23,771	17,672	..
IBRD	1,288	3,966	2,524	2,258
IDA	43	33	21	20
Total debt service	1,429	3,759	2,996	..
IBRD	167	630	572	396
IDA	1	2	2	2
Composition of net resource flows				
Official grants	416	100	413	..
Official creditors	391	-117	-597	..
Private creditors	216	158	-573	..
Foreign direct investment (net inflows)	20	92	769	..
Portfolio equity (net inflows)	0	20	572	..
World Bank program				
Commitments	379	433	127	..
Disbursements	307	426	129	262
Principal repayments	87	350	469	310
Net flows	220	76	-340	-48
Interest payments	81	282	106	87
Net transfers	139	-206	-444	-135



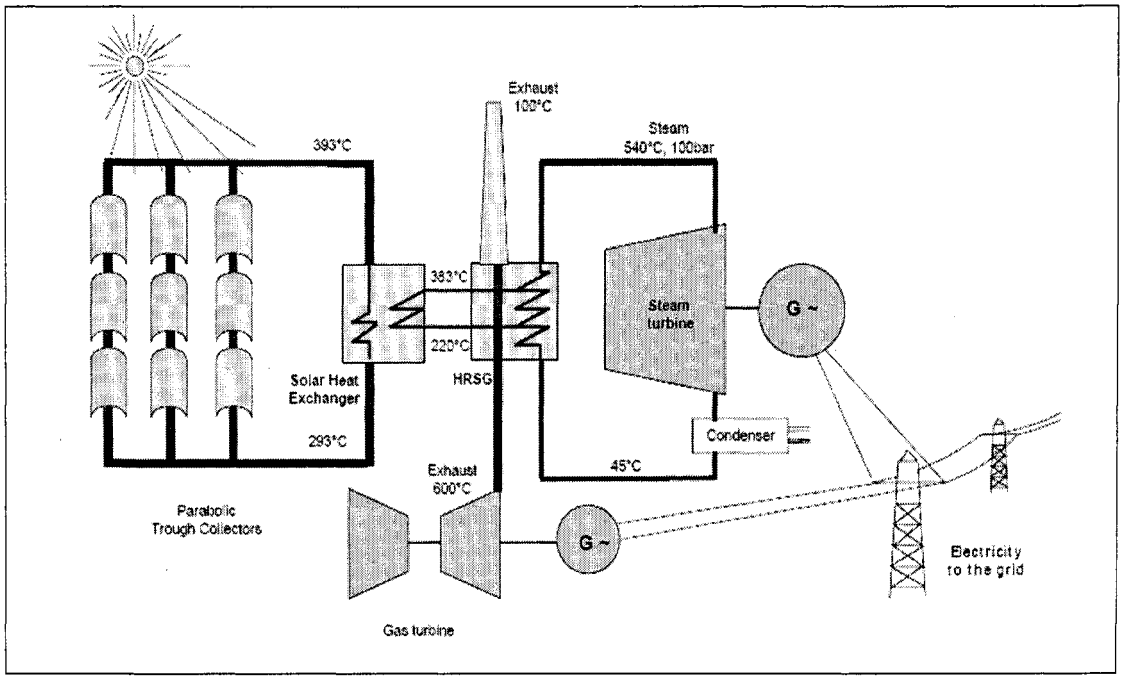
Note: This table was produced from the Development Economics LDB database.

8/13/06

ANNEX 15 – Solar Thermal Technologies and Integration
MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT



Source: Fichtner Solar GmbH



Source: Fichtner Solar GbmH

Annex 16: Incremental Cost

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

Incremental Cost Analysis

1. Total incremental costs of the Morocco Integrated Solar Combined Cycle (ISCC) project (472 MW with 20 MW solar) are US$63.16 million. The GEF will cover an amount of US$43.2 million, corresponding to 68% of the total incremental costs.

Global Environmental Objective

2. The Global Environment Facility (GEF) has identified "solar thermal-electric technologies in high insulation regions, initially emphasizing the proven parabolic trough variant for electric power generation"[18], as one of the renewable energy technologies it supports through its operational program number 7 (OP 7). The project, with other thermal power projects now being developed worldwide (e.g. Algeria, Spain, etc.) including two planned GEF solar thermal projects in Egypt and Mexico, will contribute to building a critical mass to bring down the production costs of the ISCC technology.

3. The demonstration of the use of parabolic trough for electric power generation as per OP 7 is at the heart of the support of the GEF for this project. In accordance with the findings for renewable energy technology development for power generation, the IEA (2002) report emphasizes that "the highest potential for cost reduction among the renewable electricity technologies are (a) expensive and (b) recent in development. They tend to have a steep learning curve with a progress ratio of about 80%".[19] ISCC technology fits in this category. The construction of the projects in Egypt, Morocco, and Mexico are intended to set the stage for future developments. In 2002, about 354 MW of parabolic trough solar concentrating power plants were installed. The addition of 20 MW in Morocco would increase the installed capacity by 6%. An addition of 30 MW solar would increase the installed capacity by 8%. Parabolic trough technology, as used for ISCC power plants, is the leading concentrating power technology. The other two types of technologies (power tower and parabolic dish) are at a more experimental stage.

4. Among the countries in Africa, Morocco has led the application of renewable energy together with Egypt. Because of its strong dependence on fossil fuel from imports, Morocco has targeted its energy policy towards the diversification of the sources of supply and the valorization of the national resources, in particular through the promotion of all the useable forms of renewable energies (hydraulic, wind and solar), which use domestic resources.

5. Morocco has a large potential of renewable energy, as reflected in solar radiation of 5 kWh/m²/day, and in wind with a potential of 6,000 MW (in particular on the 3,500 km of coastal areas). In recognition of this importance, Morocco has adopted a renewable energy strategy, which prescribes that the share of Renewable Energies (including hydraulics) reaches 10% in the national energy balance

[18] GEF: Operational Program Number 7: Reducing the Long-Term Costs of Low Greenhouse Gas-Emitting Energy Technologies.
[19] International Energy Agency (IEA) (2002). Renewables for Power Generation. Paris.p.18.

by 2012, compared to 3.9% at present.[20] While Morocco has accessed her significant wind energy potential with the commissioning of the 50MW wind farm at Koudia Al Baida (2001) and a number of additional wind farms have been posted for submission of tender, Morocco still has not found a way of tapping its significant solar resources.

6. In early 2007 - and despite large progress made in the area of solar technologies - no competitive solar technologies exist. Solar photovoltaics have become increasingly popular for off-grid applications or applications dedicated to a specific type of use (lamps, hifi equipment, navigation equipment, mobile phone network equipment). At a cost of UScents 25 - 80/kWh, the technology is still far away from being competitive for large-scale electricity production. As identified by IEA (2002)[21], which reviewed the future potential of different solar technologies, solar trough technology has the most important technological development potential for large-scale solar applications. IEA (2002) estimate solar trough technology to be in the range of UScents 20 - 25/kWh. Consequently, the possibility of a grant from the GEF towards the incremental costs of the solar trough technology constitutes a unique opportunity for the GoM to become a driver in the development of technology.

7. A direct global benefit of the project is the carbon abatement achieved by substituting solar energy for fossil fuels. Assuming the 20 MW solar field will be operating about 35% of the time (compared to 67% for the gas turbine), the solar contribution to the overall generation of the power plant will be about 1.1% or about 40 GWh per year. This translates into carbon savings of about 24,300 tons of CO_2 per year or 610,000 tons of CO_2 over the 25 year lifetime of the plant. These values are based on the actual bids received and represent an increase in carbon savings compared to the original estimates of 22,500 tons of CO_2 per year. The incremental cost per ton of CO_2 avoided is US$ 104/ton of CO_2.

Sector Background

8. Morocco's energy sector faces serious constraints due to its dependence for more than 95 percent on energy imports and its remaining substantial use of traditional energy (firewood and charcoal). The energy sector in Morocco is also characterized by the preponderance of the petroleum products, even if their share in the power sector were reduced from 83% in 1980 to 62% in 2005. Total consumption, though, remains relatively low (0.4 TEP/capita/year). Morocco's total energy expenditure increased from 27 billion DH (US$3 billion) in 2004 to 37.7 billion DH (US$4.2 billion) in 2005 due to the rise in the prices of oil and coal. In order to counter this dependence, Morocco has actively sought to increase the diversity of energy resources used in the electricity sector in the last 15 years. In early 2007, the primary fuels used in the production of electricity include coal, heavy fuel oil, natural gas, hydraulics, wind and solar photovoltaics.

9. Moroccan **electricity demand** grew about 5 to 7 % per year on average over the last decade, and it is expected to continue growing at this pace for the foreseeable future. In 2006, total sales of electricity amounted to 21,104 GWh, an increase of 10% compared to 2005. The total number of customers is at 2,654,222 up by 10.6% due to the ongoing rural electrification program. Under the rural electrification program some 3,610 villages were connected to the grid, and some 363 villages received individual solar

[20] The Moroccan Government states in their 2007 Energy Sector note that "The importance of our local potential, the considerable evolution of technologies and the strong growth of the world market, accompanied by a significant and continuous fall of the costs, constitute for Morocco, essential opportunities which will result in these new resources representing a significant share in the national energy balance in the years to come."
[21] IEA (2002), p.18. ibd.

systems. The rate of electrification in rural areas increased from 62% in 2003 to 85% in 2005 and 89% in 2006. The average tariff in 2004 was 0.678 MAD/kWh corresponding to about US¢ 8/kWh. To meet the growing demand, additional generation capacity of between 200 - 300 MW per year will be needed. The connection to the grid of the solar thermal power plant in the Moroccan expansion plan is scheduled for the middle of 2009.

10. **Institutional Framework:** since 1963, the National office of Electricity (ONE) is the principal actor of the electricity sector. As a publicly-owned commercial and industrial entity, it was created by dahir it n° 163-226 of August 5 1963 which: [22]

- entrusts ONE with the public service responsibility for the generation, transmission and the distribution of electricity;
- obliges ONE to ensure the service of the distribution of electricity in the absence of service supplied by the communes ("Regies") or by concessions;
- gives ONE exclusive right for the setting up of generation capacity exceeding 10MW.

11. The Government of Morocco (GOM) has embarked on a power sector reform program and has undertaken important steps to secure private investors to operate the sector's power generating and distribution facilities. As early as 1994 the electricity law was amended to permit the operation of Independent Power Producers (IPPs). By Order in Council n° 2-94-503 of September 23, 1994, the ONE was entitled to enter in agreements with private entities, for the generation of electricity by entities with generating units larger than 10 MW, provided that the generation is intended exclusively for the needs of ONE. Since this law was passed, three concession contracts for the generation of electricity with off-take by ONE through dedicated Purchasing Power Agreements were concluded with Jorf Lasfar Energy Company (JLEC); the Wind company of Strait (CED); and Electric power of Tahaddart (EET). [23]

12. As a single buyer established by the Order in Council of September 1994, ONE ensures the supply of electricity to all the customers of the Moroccan market through its own generation, the purchase from concessionaires, and imports. ONE is the most important distribution company in Morocco, covering 95% of the national territory, serving 1.466 communes and supplying 56% of the customers.

13. **Energy supply:** in early 2007 a total of 5.2 GW capacity was installed in Morocco, of which 3.5 GW was thermal power (of which 1.6 GW are coal-fired), 1,265 hydropower, 54 MW wind power, and 464 MW pumped storage. Several IPPs are operating in Morocco, including the coal-fired power plant of Jorf Lasfar. The latter contributes about 10,000 GWh or almost 55% of Morocco's electricity demand.

[22] The rights and obligations of ONE are defined in a schedule of conditions, approved by the decree n° 2-73-533 of November 29, 1973, which defines the technical, administrative and financial terms relating to the operation of installations for generation, transmission and distribution of electricity.

[23] More details on these concessions as follows:

- Jorf Lasfar Energy Company concluded on September 12, 1997 a contract with ONE for the exploitation of the two existing generation units in Jorf Lasfar and for the construction and operation of two other units in this same power station. The total capacity of these four units is 1.356 MW. The generation of this power station accounted for 55.4% of the demand at the end of 2004.
- Wind company of the Strait which signed a contract with the ONE on October 2, 1998, and designed, built and operates the wind farm Abdelkhalek Torres (Koudia Al Baïda), with a capacity of 50 MW.
- Electric power of Tahaddart, with 48% of capital held by the ONE, 32% by ENDESA and 20% by SIEMENS. The purpose of the company is the construction and the operation of a combined cycle power plant at Tahaddart, with a capacity of 384 MW and using transit natural gas. The power station was brought into service on March 26, 2005.

Substantial amounts of electricity are also being imported from Spain. In 2006, the net import from Spain amounted to 2,003 GWh or nearly 10% of electricity generation.

14. In 2004, electricity generated from coal accounted for about 70% of generation. The second major fuel was HFO with 1,881 GWh produced in 2004. In February 2005, natural gas became the second major fuel with the completion of the 385 MW combined cycle power plant at Taharddart. Morocco is beneficiary of a natural gas wheeling arrangement whereby the country can extract up to 7% of all gas wheeled from Algeria via Morocco to Spain through the Euro-Maghreb gas pipeline. The consumption of Tahaddart was 348 million m3 in 2005, producing nearly 11.6% of Morocco's electricity or a share of 3.1% of the country's total energy balance.

15. The GOM is committed to developing renewable energy resources such as mini-hydro, solar, and wind. The most visible sign of the GOM's commitment to renewables is the construction of the 50 MW wind farm at Koudia Al Baïda. The addition of further capacity is planned for April 2007 at Cap Sim (60 MW) and for 2008 at an area near Tangiers (140 MW). Power generated from wind is around 200 GWh annually or 1% of power generated.

16. Due to the availability of GEF funds, the solar thermal power plant planned at Aïn Beni Mathar has figured in Morocco's power expansion plan. The inclusion of full incremental costs allows the plant to enter the least cost expansion plan. The GoM fully recognizes in its recent Energy Sector Letter the importance of such funding to access the significant solar resources in the country: "In the last few years, the renewable energy sector benefited from a favorable national and international environment supportive to durable forms of energy".

Baseline

17. An analysis of Morocco's system expansion plan, fuel supply and availability, and potential candidate plants suggests that the least-cost baseline course of action would be the commissioning of further gas-fired combined cycle capacity, if natural gas was available. The baseline plant is therefore assumed to be a combined cycle gas turbine (CCGT) fueled with natural gas capable of producing the same output as the proposed GEF alternative.

GEF Alternative

18. The GEF alternative is a combined CCGT and solar field power plant of the parabolic solar trough concentrating solar power design. As opposed to photovoltaic technology, the Integrated Solar Combined Cycle Power Plant (ISCC) technology uses direct insolation. Due to Morocco's high levels of direct insolation, it makes the country an ideal location for the setting up of such plant. The plant is to be located in Aîn Beni Mathar, which is about 86 km south of Oujda. In the context of Morocco, Aîn Beni Mathar is a least cost site with excellent levels of solar insolation 2,290 kWh/m2/year, direct access to natural gas (close vicinity to the Euro-Maghreb pipeline), water supply, and close access to the national grid. The plant is directly implemented by ONE through a combined Engineering, Procurement, Construction (EPC) and O&M (Operation and Maintenance) contract.

19. The preferred proposed alternative foresees the construction of a solar thermal - fossil fuel hybrid power plant of a total net capacity of 472 MW, with 20 MW solar. The bids for power plant were made for different options. The originally planned 227 MW plant was substituted in favor of a larger plant, as

another gas-fired thermal power plant for the Moroccan grid was canceled. Thus the need arose for the power plant at Ain Beni Mathar to be increased in size.

CGGT	Solar Field	
	20 MW	30 MW
452 MW	Option A	Option B

20. Based on a feasibility study prepared by Fichtner Solar (2005) the proposed solar thermal power station would have the characteristics as shown in table 16-1. The lowest cost bid for option A, which is the preferred option of the GoM, is presented in table 16-1.

Table 16-1: Characteristics of the Solar Thermal Power Plant

Plant type	**Integrated Solar Combined Cycle System (ISCC), Fichtner (2005)***	**Lowest priced bid (Option A, 20 MW)**
Gross Plant Capacity (MW)	227	472
of which solar field	23	20
Electricity output (GWh/yr)	1,572	3,538
Solar output (GWh/yr)	37.5	40
Solar share (% of energy output)	2.4	1.1
Investment/Total Installed Costs (US$ million)	187	476[24]
Levelized electricity costs without grant (US¢/kWh)	5.6	6.2
* Original estimate		

Scope of the Analysis

System boundary

21. The analysis is based on the direct comparison of the proposed solar thermal plant with the least-cost conventional solution, assuming the same load factor.

Additional domestic benefits

22. The GEF alternative will result in improvements in domestic air quality. Morocco has already initiated and implemented important actions dealing with local air pollution, including measures on promoting renewable energy (e.g. the Koudia Al Baïda windfarm), utilizing cleaner fuels (in particular natural gas), and improving efficiency in energy production and usage (e.g. at Jorf Lasfar I and II, which are under private management).

[24] The total of $476 million includes project components 1, 7 and 9 – all without contingencies (see Annexes 4 and 5 for details).

Key Assumptions

23. The incremental cost analysis uses assumptions common for economic analysis at the World Bank. The economic cost of gas is assumed at US$ 6/mm BTU. This is the price of gas throughout most of Europe and can be assumed the market price for transit gas, as if this gas was not consumed in Morocco it could be sold in Spain at about that price. Key assumptions are summarized in Table 16-2 below.

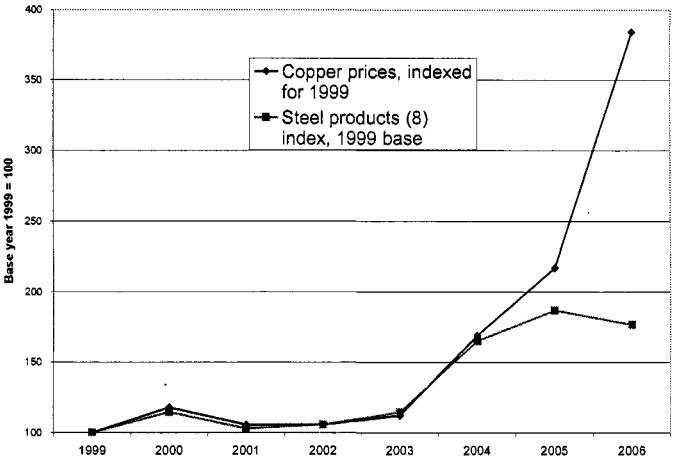
Table 16-2: Key Assumptions

Parameter	Value
Technical:	
Plant lifetime	25 years
Construction time	25 months
Economics:	
Economic cost of gas	$6/mmBTU
Overall discount rate	10%

Costs

This incremental cost analysis benefits from the availability of the actual bid data. For the purposes of comparability, both initial cost estimates and actual bid data are compared. It is noteworthy that the bid prices for both the CCGT and the solar component are higher than anticipated. Equally, the incremental cost estimates are higher than originally estimated, by a total of nearly US$14 million. Difference of estimates in capital costs are due to:

(a) **the decline of the US Dollar with respect to the Euro:** since 2003 the US$ has declined by 33% with respect to the Euro. As the market is dominated by European suppliers, this would fully convert into a price increase of plant;
(b) **the increase of metal and other commodity prices in world markets:** as the solar part of the plant is particularly heavy in equipment (steel), changes in the metal markets affect the plant price significantly. Since 1999, when the GEF adopted the strategy of pursuing concentrating solar technology, the price of steel has increased by 77% (in real terms). Similarly, the copper price has increased by 284% (in real terms). See also graph below.
(c) **the winning bid's plant size:** although rated at 20 MW, the winning bid has a solar field that is 32,000 m2 larger than the estimated value. This indicates that the estimates had underestimated the required size for guaranteeing a rating at 20 MW. Against this background, the increase in incremental costs at 28% appears relatively modest.



24. Nevertheless, there are a number of factors due to modifications undertaken in the scope of the project and the project design, which have contributed to limiting the price increase with respect to the cost estimate. Most noteworthy is the increase in size of power plant from originally 227 MW to 472 MW, and the shift from an IPP to an EPC contract. The larger size of gas fired power plant allows for economies of scale. Moreover, production of larger-scale turbines is more common, and technology developments will focus on those. Equally, an IPP will be more expensive, as the private investor has higher expectation of financial rates of return than the public sector. Finally, the project configuration and arrangements have been optimized in the selection process for the EPC cum O&M contract through the utilization of open competitive bidding.

Capital costs

25. The cost for the baseline CCGT was estimated at US$632/kW and that of the GEF alternative at $826/kW. The actual costs of the least cost offer for the CCGT part of the ISCC was US$ 918. Solar power entails substantially higher capital costs than conventional generation and the kW installed costs an estimated $2,160/kW for the solar field. The actual costs as per bid amounted to US$3,289. The overall estimated cost of the ISCC was US$826/kW, but the actual price was higher at US$997.4. A more detailed cost breakdown - based on the findings of the feasibility study and project appraisal- is shown in table 16-3 below, and a technical breakdown is provided in Table 16-6 below. Capital costs include physical contingencies. The comparison of cost estimates between the baseline and the GEF alternative focuses on the costs of design, construction, and operation alone as the costs for the required transmission lines, substation, access road, boreholes, gas pipeline connection, environmental mitigation and consultancy services are assumed to be roughly the same in both cases. A detailed breakdown of Project costs is included in Annex 5 above.

Recurrent costs

26. The main recurrent cost elements concern fuel purchases and operation and maintenance (O&M). The original estimates for O&M data for the ISCC plant were based on the experience in this area collected from the nine solar thermal plants that have been operating in California since the 1990s. Over the years, operators have succeeded in substantially reducing O&M costs by increasing the efficiency and lifetime of solar field components, improving the effectiveness of the solar field - power block interface and other measures. Nevertheless, the ISCC envisaged under the GEF funding is technologically substantially different to those plant constructed in California. Most importantly, the plants in California are significantly smaller in size. This introduced a significant level of uncertainty into the estimate for O&M costs. The fixed annual O&M costs had been estimated at a total of US$2,750,000. The actual fixed O&M price as per lowest evaluated bidder amounted to US$5,210,000. This indicates that the operating experience from plant in California may not be readily converted into cost for ISCC.

Table 16-3: Cost Estimates and Actual Costs

	Estimate at Project Appraisal	Bid price "A"	% change
Capital Cost (US$/kW)			
ISCC	826	997	+21
CCGT	632	898	+42
Solar field	2,160	3,289	+52
Solar field (US$/m^2)	203	363	+79
O&M Costs (US$)			
ISCC fossil part, fixed O&M (US$)	1,980,000	5,210,000	+89
ISCC solar field, fixed O&M costs (US$)	770,000		
ISCC, variable O&M costs (¢/kWh)	0.05	0.03	-40
CCGT, fixed O&M costs	$1,840,000	Not applicable	Not applicable
CCGT, variable O&M costs (¢/kWh)	0.05	Not applicable	Not applicable
Incremental costs	49.6	63.16	28
Incremental costs covered by GEF	43.2	43.2	0
Share of incremental costs covered by GEF	88%	68%	-22

Incremental costs

27. The above considerations result in an incremental cost estimate of US$ 63.16 million for the 472 MW ISCC with 20MW of solar field. Table 16-4 presents baseline costs and the costs of the ISCC alternative broken down in capital, fuel and O&M costs over the plant lifetime. The incremental cost is equally broken down in incremental capital, fuel and O&M costs. It is assumed that the baseline plant would generate the same GWh of electricity as the ISCC alternative. Due to the high actual O&M costs compared to the somewhat lower fuel cost savings, the overall operational costs of the ISCC plant are somewhat higher than of the baseline plant. More detailed technical data are provided in table 16-7.

Table 16-4: Investment, O&M and Incremental Costs for 472 MW ISCC, with 20 MW solar trough (US$ million unless otherwise stated)			
	NPV (discounted)	Capital	Recurrent
Baseline (CCGT) [costs scaled to ISCC estimates]			
Capital costs	414	414	
Fuel costs	1,171		1,171
O&M costs	93		93
Total	1,678		1,264
Levelized electricity costs ($/MWh)	57.5	14.2	43.3
Alternative (ISCC)			
Capital costs	476	476	
Fuel costs (gas turbine)	1,158		1,158
O&M costs	107		107
Total	1,741		1,265
Levelized electricity costs ($/MWh)	59.6	16.3	43.3
Increment			
Incremental capital costs[25]	62.51	62.51	
Incremental fuel costs	-13.39		-13.39
Incremental O&M costs	14.04		14.04
Total incremental costs	**63.16**	62.51	0.65
Incremental levelized costs ($/MWh)	2.1	2.1	0.0
Note: Figure may not add up due to rounding. * Discounted at 10% over the 25 year plant life.			

Sensitivity Analysis

28. In order to assess the robustness of results, a sensitivity analysis is conducted to verify the impact of changing underlying assumptions on the level of incremental costs. The results of the sensitivity analysis are summarized in table 16-5. They indicate that the results are highly robust to changes in the underlying assumptions.

Table 16-5: Sensitivity Analysis for Incremental Cost Estimate			
		Total Incremental Costs (US$ million)	Percentage change wrt base case (%)
Gas price	$7/mmBTU	60.83	-3.7
	$6/mmBTU	63.16	Base case
	$5/mmBTU	65.32	3.4
Discount rate	15%	62.95	-0.3
	10%	63.16	Base case
	5%	63.57	0.6
Plant lifetime (years)	30	63.18	0.0
	25	63.16	Base case
	20	63.12	-0.1

[25] The incremental capital costs of the solar component equal the total capital cost of that component minus the voided capital cost of 20MW of combined cycle capacity (which would have been needed in the absence of the solar component).

Summary: Incremental Cost Matrix

29. The results of the incremental cost analysis can be summarized in the incremental cost matrix shown in table 16-6.

Table 16-6: Incremental Cost Matrix

	Baseline	Alternative	Increment
Domestic Benefit			
a) physical	3,497 GWh per year of electricity	3,538 GWh per year of electricity (40 GWh are produced through the solar field	40 GWh
b) programmatic	Limited institutional capacity to develop complex renewable-based generation projects at ONE.	Demonstrated practical viability of utility-based solar-thermal technology. Participating in planning, preliminary design of technical and financial requirements, preparation of bidding documents for hybrid plant.	Reduction of perceived risks in renewable-based power; gain in operational experience. Up to 20 O.N.E..staff at various levels trained in solar/hybrid technology.
Global Benefits			
a) environmental			610,000 tons of CO_2 abated over 25 years of project life.
b) programmatic	No hybrid solar thermal power plant in operation; high risk perceived by investors. Solar thermal industry dormant with little future prospects; high costs.	20 MW(e) solar thermal capacity (or an increase of global capacity by 6%) installed and operating. Demonstration effect. Revived interest/market opportunities for solar thermal industry.	20 MW(e) of solar thermal capacity (or an increase of global capacity by 6%) installed and operating. More countries and investors globally willing to consider solar thermal power options. Creation of new opportunities for solar thermal power industry as a result of demonstrated large-scale component and system integration; optimization of components relevant for up-scaling power plant.
Costs ($M)			
Capital Costs	414	476	62.51
Fuel Costs	1,171	1,158	-13.39
O&M	93	107	14.04
	---	---	---
Total	1,678	1,741	**63.16**

Table 16-7: Incremental Costs Calculations - Technical Data

Available Grant (mln $)	43.2
LEC of total generation ($/MWh)	62.16
Solar Generation (GWh/a)	40
Solar Generation as percent of design value	1.1
LEC of solar generation ($/MWh)	247
Solar field Size (1,000 m2)	183.12
DNI (Annual direct normal irradiation, kWh/m2/a)	2,290
Power plant gross capacity (av. temp., max solar heat, MW)	478
Power plant net capacity (day, av. temp., max solar heat, MW)	472
Power plant net capacity (night, av. temp., max solar heat, MW)	450
Specific CO_2 emissions of comparable generation (kg CO_2/kWhe)	0.60
Annual CO_2 emission reduction (kt/CO_2/a)	24.3
Total CO_2 emission reduction (mln t/CO_2/25 years)	0.61
Incremental cost per ton of CO_2 avoided (US$/ton)	104

Annex 17: Scientific and Technical Advisory Panel (STAP) Review

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

Independent Technical Review

1. Introduction

This project will assist the Government of Morocco, through its state-owned Office National de l'Electricité (O.N.E.), to finance and construct an integrated solar thermal combined cycle (ISCC) power plant through an Engineer, Procure and Construct (EPC) cum Operation and Maintenance (O&M) contract. O.N.E. will finance the plant through an African Development Bank (AfDB) loan (already secured for about 64% of the project cost), their own contribution of about 16%, and a grant from the Global Environment Facility (GEF), which will be used to finance the incremental cost of the solar thermal portion of the ISCC power plant (about 20% of total investment costs.) The O&M contract will last 5 years and include appropriate incentives to ensure an efficient operation of the plant, particularly the solar field.

Selection of the EPC/O&M contractor will be through an international bidding process, and details of the plant design and the contractual arrangements can only be defined after the winning bid is selected. As a result, the Project Appraisal Document (PAD) has been written with a limited amount of technical details, based primarily on the feasibility study carried out by Fichtner Solar in 2005. Therefore, this technical review can only address the details provided regarding the project approach, site selection, conceptual design, bidding process, and expected contractual arrangements. It cannot comment on the adequacy of the final plant design or contracts.

The gross capacity of the ISCC power plant is expected to be between 200-250 MWe and the solar thermal parabolic trough collector field is expected to have an equivalent capacity of between 20-30 MWe. Based on the feasibility study, the annual net electricity produced by the plant is expected to be about 1,590 GWh, which includes the solar field contribution of about 56 GWh per year. This corresponds to a solar share of 3.5 percent of the total plant output when operating at a full load. The primary fuel for the gas turbine will be natural gas supplied via a spur from the Maghreb-Europe gas pipeline.

2. GEF Context

The proposed project addresses GEF Operational Program 7 (OP7): reducing the long-term cost of low greenhouse gas-emitting technologies. OP7 aims to accelerate market penetration of several large-scale backstop technologies that are constrained by high capital costs and high commercial risks. The strategy is to identify projects that address national priorities and then finance the incremental costs of investments, capacity building and other activities that reduce market barriers and perceived risks by investors.

Based on the technical success of the 354 MW of solar thermal power plants still operating in California after more than 15 years, this technology can be considered an important large-scale

non-carbon emitting backstop technology. Many of these plants currently operate at solar outputs that exceed their initial design specifications. Also, this reviewer agrees that significant cost reductions and eventual commercial acceptance of this technology can only begin to occur with the implementation of several demonstration projects in carefully selected countries and sites. The proposed project is one of four similar projects (the others being in India, Mexico and Egypt), which have been approved by GEF as part its program to accelerate cost reduction and commercial adoption of this large-scale non-carbon emitting generation technology. In addition, the timing of this project fits well with new installations of solar thermal power technology taking place in industrialized countries. These projects include a 1 MWE solar parabolic trough organic Rankine cycle power plant undergoing start-up in Arizona, a 64 MWe solar thermal power plant under construction in Nevada, and two 50 MWe solar thermal power plants with thermal storage under construction in Spain.

3. Key Issues

a. Project Approach

The reviewer agrees with the Project implementation approach of constructing the plant on the basis of a turnkey EPC contract and a 5-year O&M agreement with the same contractor. First, the ISCCS design integration and the technology selection risks will be borne by the contractor, who will have the expertise to manage those risks. Second, competition among the EPC bidders will help ensure that the most cost-effective combination of technology and local component manufacturing will be selected. Third, the O&M contract should contain appropriate incentive structure for both maximizing the total plant reliability as well as maximizing the utilization of the solar field over the long term. The PAD only discusses the latter issue, but the O&M contract will need to address both issues. As O.N.E .owns the plant, it is assumed that they will control the dispatch of the gas-fired portion of the plant. Finally, the use of only pre-qualified bidders is likely to allow the selected EPC contractor and key suppliers to capture technology and organizational learning effects that are essential to achieving long-term cost reductions for solar thermal power.

One question that this reviewer could not assess from the PAD is whether the bidder prequalification includes the potential manufacturers of the solar collectors and heat collection elements.

3.2 Scientific and Technical Soundness

Nine solar thermal power plants that raise steam to generate power have been successfully operating for over 15 years. The basic concept of integrating a solar thermal steam raising facility with a natural gas combined cycle power plant is sound and has been extensively studied. While such a project has yet to be implemented, a project employing this concept should be completely feasible, as the technical basis for such an integrated system is quite straightforward and both aspects of the plant are technically proven. The reviewer concurs with the decision not to include thermal storage within the plant configuration.

The technical and economic effectiveness of the ISCC power plant will depend on the detailed design and selection of equipment, which will be made at a later stage of project development. Therefore, this review will only list the most important technical issues that will need critical analysis when the detailed design is available.

As the technology selection will be left to the EPC Bidders, who will all be pre-qualified, the bid documents must establish minimum requirements for the solar thermal steam raising component to ensure that the minimum solar share target can be met. Effective integration of the steam systems for the solar thermal field and the gas-fired combined cycle plant is essential to achieving significant cost reductions and proper performance of the power plant. The selection process should review plant designs to ensure that the plant operates effectively in all modes. In particular, integration and control of the system should allow the solar contribution to be consistently maximized. In addition, the system should allow power to be efficiently generated on natural gas only, if required (during nighttime or if the solar field is not operational).

3.3 Adequacy of the Financing Mechanism

The financing approach to this Project is much simpler than the IPP approaches that have been attempted on other GEF solar thermal power projects. In particular, this financing approach avoids the complicated negotiation for power purchase, fuel supply and implementation agreements that can be problematic for IPP projects.
O.N.E.'s funds appear to be available, the AfDB loan is reported as secured, and with approval of the GEF grant, all Project funds will be in hand. In addition to the EPC/O&M contract, the Project includes funds to enable transmission of the power to load centers, provision of natural gas from the Maghreb-Europe pipeline, and supply of water for cooling and collector field washing.

3.4 Identification of Global Environmental Benefits

The project's principal global environment objectives are to contribute to improving the economic attractiveness of non-carbon emitting solar thermal generation technology globally and to demonstrate the operational viability of this hybrid solar thermal power generation system in a developing country. The Project will contribute to the global learning effects that will lead to a reduction in costs for solar thermal technology over the long term. In addition, this Project could be the first solar thermal power plant constructed in a developing country, and will be critical to demonstrating that the technology capacity can be developed to manage these type plants.

With the new solar thermal power plants being constructed in the US and Europe, and the other GEF solar thermal power projects moving towards implementation, the technology has the potential to provide a significant proportion of new electricity generating capacity in the next century on a non-carbon emitting basis. Major markets exist for this technology in other high sunlight regions of the world, many of which are in developing nations.

This project will build an ISCC power plant designed to minimize the cost of buying down the solar technology. As a result, the global benefit from reducing carbon emissions from power

generation, estimated at 570,000 tons of CO_2 over the 25-year lifetime of the plant, are relatively small. They represent only 3.5% reduction of the conventional gas combined cycle power plant emissions. As solar thermal costs decrease the solar fraction of future plants will increase, and so will the global environmental benefits from reducing carbon emissions.

3.5 Fit with GEF Goals

The project has a good fit with the GEF Operational Program #7. The plant itself will have lower CO_2 emissions than a combined cycle power plant of the same annual output. More importantly, it will help revitalize the solar thermal industry, and it will facilitate the technological and organizational learning that are critical to achieving long-term cost reductions.

3.6 Regional Context

The project is a good fit to Morocco's growing electricity demand, its existing commitment to private sector development of new power projects, its excellent solar resource and its current availability of natural gas. The project also meets Morocco's commitment to develop renewable sources of energy.

3.7 Replicability

This project and its companions in Mexico, India and Egypt are not likely to result in immediate cost-competitiveness for solar thermal power plants. However, they are very important steps in that direction. A comprehensive study by Sargent and Lundy[26], which assessed the viability of long term cost reductions for solar thermal technology, concluded that with cumulative installations of about 1000 MWe, the cost for the technology can be reduced from today's cost of 10 - 11 cents per kWh to a range of 5 - 6 cents per kWh. This report confirms the study[27], commissioned in collaboration with the GEF Secretariat, which concluded that a phased approach should be adopted to support long term cost reductions for solar thermal technology.

These four projects represent the first of three phases, and they will provide an initial opportunity for cost reduction. Achieving the cost reductions identified in the Sargent and Lundy report would create very important opportunities for replication of solar thermal power plants, not only in Morocco, but also throughout the Mediterranean Region, South Asia, and other parts of the world with similar climates. The need for future GEF buydown will most strongly depend on the cost of conventional power, the future benefits that can be achieved through CDM and the valuation (if any) of environmental externalities.

3.8 Sustainability

From the GEF perspective, the main sustainability issue will be to ensure that the plant is operated in a manner that maximizes output from its solar thermal field throughout the lifetime of the plant. As already discussed in Section 3.1, the O&M contract should contain appropriate incentive structure for both maximizing the total plant reliability as well as maximizing the utilization of the solar field over the long term. However, as the owner, O.N.E. will be directly

[26] Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts, Prepared for the Department of Energy and National Renewable Energy Laboratory, SL-5641, October 2002.
[27] Cost Reduction Study for Solar Thermal Power Plants, Enermodal Engineering, May 1999.

responsible for the Project's long-term success. In addition to data collection on the construction, operation and maintenance of solar thermal power plants in the US and Europe, strong importance needs to be placed on training of O.N.E. power plant staff in the requisite skills for operating and maintaining an ISCC power plant during the construction and initial operation of the plant.

4. SECONDARY ISSUES

4.1 Linkages to Other Focal Areas

No comment.

4.2 Linkages to Other Programs

As already mentioned, this project has linkages to other similar projects in Mexico, India and Egypt, and it forms part of the GEF program on Greenhouse Gas Reduction.

4.3 Degree of Involvement of Stakeholders

According to the Project Brief, there is a high degree of involvement of all the key stakeholders, including the GoM, O.N.E. and the Centre de Développement des Energies Renouvelables (CDER). In addition, local stakeholders, including the elected officials from the Municipality of Ain Beni Mathar, NGO representatives from the region, and the local residents have been consulted regarding the Project.

4.4 Capacity Building Aspects

The proposed project contains specific elements of capacity building that will involve technical, managerial and financial departments within O.N.E. These are necessary and appropriate. In addition, successful implementation of the Project should provide local manufacturing and job opportunities within the region, and support essential capacity expansion within the international solar thermal component manufacturing sector.

4.5 Innovativeness

No comment.

5. CONCLUSION

This reviewer's overall assessment is that the project is technically feasible, that the proposed approach to project development is sound, and that the project has significant long-term potential to meet GEF goals.

6. SUBSTANTIVE EDITORIAL COMMENTS

Minor editorial comments are provided in a marked-up version of the PAD. However, a few items were significant enough to warrant discussion, and are summarized below.

6.1 GHG Calculation

If the annual production from the solar field is 35 GWh, and the CO_2 emissions from a natural gas combined cycle power plant are 0.65 kg per kWh, then 23,000 tons per year of CO_2 emission reductions is correct, as given on page 24. Then, the 25 year emission reduction total should be 575,000 tons of CO_2 (as stated on page 51), not 200,000 tons of CO_2 as stated on page 5.

6.2 Annual Solar Output

The reviewer can't determine if the expected annual solar output, based on the feasibility study, is 35, 38 or 56 GWh/yr. Page 5, and Table 2 on page 51 use 56 GWh/yr, but page 24 used 35 GWh/yr, and page 51 at the top uses 38 GWh/yr. Correcting this output value will also impact the CO_2 calculation.

6.3 Solar Thermal Power Plant Costs

The second data row of the table on page 24 gives what appear to be costs for the solar thermal portion of the ISCC power plant. There is no basis for these numbers. If the method of calculation is the annualized capital investment in the solar field plus the solar field O&M costs divided by the equivalent solar output, then the initial operating year value appears too high, and the reduction in this value for the second and third years appears too great. Some explanation is needed.

Annex 17: STAP Review

MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

Responses to STAP Technical Review

The STAP Reviewer, Mr. Pascal DeLaquil, commented on the project document in March 2006. The following are the responses/comments to the issues raised.

Issue/Comment	Reference in Project Document/Response
"**3.1** ....., the O&M contract should contain appropriate incentive structure for both maximizing the total plan reliability as well as maximizing the utilization of the solar field over the long term. The PAD only discusses the latter issue, but the O&M contract will need to address both issues..."	Section B. Para. 4 and 5
"**3.1** .....Finally, the use of only pre-qualified bidders is likely to allow the selected EPC contractor and key suppliers to capture technology and organizational learning effects that are essential to achieving long-term cost reductions for solar thermal power."	Section C. Replicability. Long-term cost reductions in solar thermal power will result from three factors: reduced component costs due to increased manufacturing volume, economies of scale from increased plant size, and technological improvements. The experience gained by one EPC contractor has a minor effect on cost reduction over the long term.
"**3.1**.....One question that this reviewer could not assess from the PAD is whether the bidder prequalification includes the potential manufacturers of the solar collectors and heat collection elements."	Section A. Para 2
"**3.2**....As the technology selection will be left to the EPC Bidders, who will all be pre-qualified, the bid documents must establish minimum requirements for the solar thermal steam raising component to ensure that the minimum solar share target can be met. Effective integration of the steam systems for the solar thermal field and the gas-fired combined cycle plant is essential to achieving significant cost reductions and proper performance of the power plant."	Section B. Para. 4

"**3.2.** ..... The selection process should review plant designs to ensure that the plant operates effectively in all modes. In particular, integration and control of the system should allow the solar contribution to be consistently maximized. In addition, the system should allow power to be efficiently generated on natural gas only, if required (during nighttime or if the solar field is not operational). "	Included in the bidding documents and will be included in the EPC and O&M contracts. There are in particular penalties for not meeting minimum solar contribution target<
"**3.3** ...The financing approach to this Project is much simpler than the IPP approaches that have been attempted on other GEF solar thermal power projects. In particular, this financing approach avoids the complicated negotiation for power purchase, fuel supply and implementation agreements that can be problematic for IPP projects.	Agree
"**3.4**. ..... In addition, this Project could be the first solar thermal power plant constructed in a developing country, and will be critical to demonstrating that the technology capacity can be developed to manage these type plants."	Agree
"**3.4**..... As solar thermal costs decrease the solar fraction of future plants will increase, and so will the global environmental benefits from reducing carbon emissions."	Agree
"**3.5**..... The plant itself will have lower CO_2 emissions than a combined cycle power plant of the same annual output. More importantly, it will help revitalize the solar thermal industry, and it will facilitate the technological and organizational learning that are critical to achieving long-term cost reductions."	Agree

"**3.6.** … The project is a good fit to Morocco's growing electricity demand, its existing commitment to private sector development of new power projects, its excellent solar resource and its current availability of natural gas. The project also meets Morocco's commitment to develop renewable sources of energy."	Agree
"**3.8.**…… the O&M contract should contain appropriate incentive structure for both maximizing the total plant reliability as well as maximizing the utilization of the solar field over the long term. "	Section B. Para. 4 and 5
"**3.8.**……..strong importance needs to be placed on training of O.N.E. power plant staff in the requisite skills for operating and maintaining an ISCC power plant during the construction and initial operation of the plant."	Section B. Para. 4 and 5 An indicator for O.N.E.'s staff training in various aspects of the ISCC technology has been included in the monitoring and evaluation (M&E) plan
"**4.4.**…… In addition, successful implementation of the Project should provide local manufacturing and job opportunities within the region,"	The project provides jobs and economic activities in the region. The development of local manufacturing should be left to the private sector and is likely to evolve over time.
"**6.1.** If the annual production from the solar field is 35 GWh, and the CO_2 emissions from a natural gas combined cycle power plant are 0.65 kg per kWh, then 23,000 tons per year of CO_2 emission reductions is correct, as given on page 24. Then, the 25 year emission reduction total should be 575,000 tons of CO_2 (as stated on page 51), not 200,000 tons of CO_2 as stated on page 5."	Corrected
"**6.2.**…… The reviewer can't determine if the expected annual solar output, based on the feasibility study, is 35, 38 or 56 GWh/yr. Page 5, and Table 2 on page 51 use 56 GWh/yr, but page 24 used 35 GWh/yr, and page 51 at the top uses 38 GWh/yr. Correcting this output value will also impact the CO_2 calculation."	Corrected

Annex 18: Cost Reduction of Solar Thermal Power Technology[1]

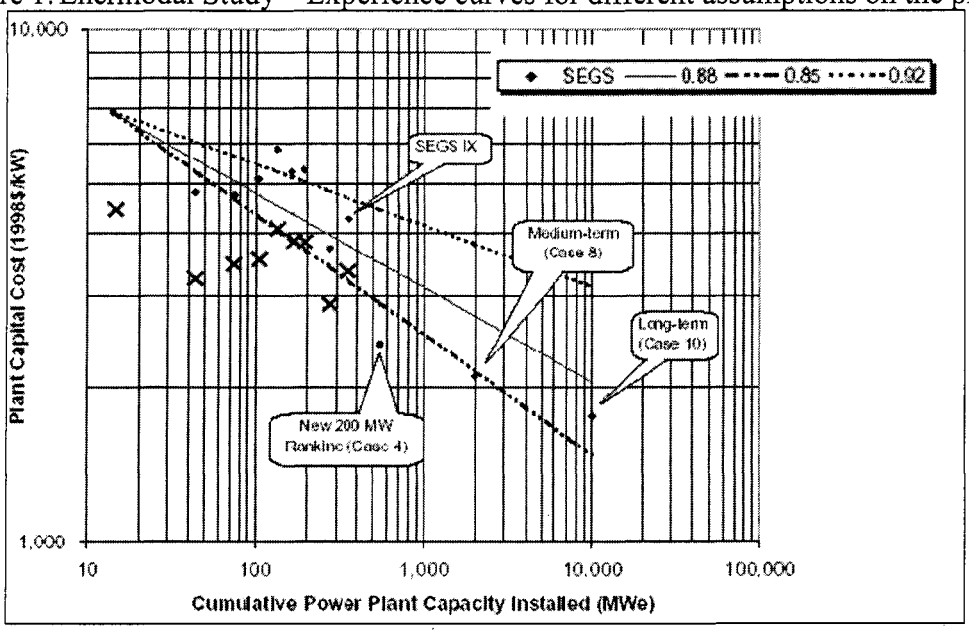
MOROCCO: INTEGRATED SOLAR COMBINED CYCLE POWER PROJECT

The aim of any electricity producing technology must be to realize competitive electricity generation costs. Several studies have examined the future cost reduction potentials for solar thermal power generation technology. The most important studies in this context are Enermodal (1999), and DLR (2004) which are briefly reviewed below:

Enermodal (1999): Cost Reduction Study for Solar Thermal Power Plants

The Enermodal study uses the specific investment costs per installed capacity ($/kW) as a reference measure. This reference number does not however seem appropriate to forecast cost reduction for solar thermal power plants because larger solar fields in combination with heat storage can lead to lower levelized electricity costs due to a higher plant capacity factor, even though the specific investment costs increase. The second point of note in the approach used by the Enermodal study is the fact that it uses the cost of the first plant out of the nine existing parabolic trough plants as the starting point of the learning curve instead of using a linear regression function of all reference plants (see Figure 1). Therefore the cost of the first plant determines strongly the cost forecast for future technology deployment.

Figure 1: Enermodal Study – Experience curves for different assumptions on the progress ratio



DLR (2004): Scenario model "Athene"

[1] World Bank: *Assessment of the World Bank/GEF Strategy for the Market Development of Concentrating Solar Thermal Power* - Global Environment Facility Program – The World Bank 2006

This study assumes as a starting point the empirical values from the existing parabolic trough plants. But for the future cost reductions, it is explicitly mentioned that all solar thermal power technologies are included. Technological variants and improvements as well as competition are essential preconditions of the experience curve model.
Cost reduction in this study is split into four categories:

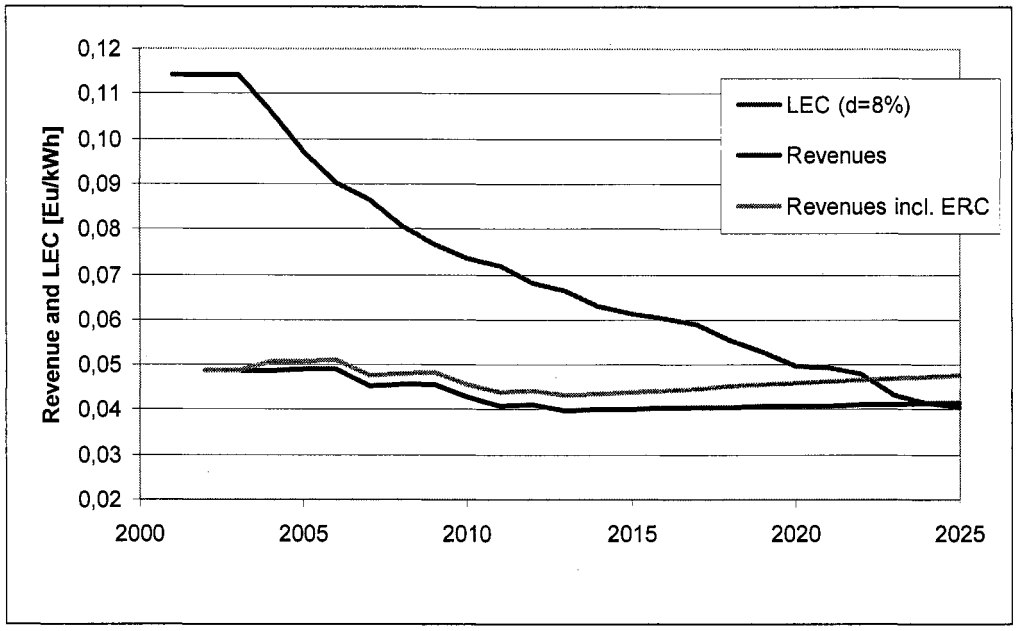
- Improving efficiency (from 13.2 percent today to 17.0 percent in 2025)
- Learning effects due to volume production
  - collector costs, surface-specific progress ration (PR) is 0.9
  - thermal energy storage (up to 12 hrs), capacity-specific PR=0.88
  - steam cycle components from 850 €/kW down to today's conventional plant costs of 740 €/kW, PR=0.94
- Economies of scale due to larger units (up to 200 MW_e): doubling capacity leads to 15 percent cost reduction
- The annual operation and maintenance costs will decrease proportionally to the reduction of investment costs (2.5 percent of investment).

Further assumptions of this model are:

- No CO_2-allowances considered, respectively carbon price increasing from initially 7.5 Euro/t CO_2 to 30 Euro/t CO_2 in 2050
- Plant life time: 25 years
- Internal plant project interest rate: 8 percent (in real terms)
- Solar Resource DNI=2350 kWh/(m^2a) (favorable sites for solar thermal power generation range between 1800 and 2900 kWh/(m^2a).
- Market growth of 23 percent p.a. (IEA references: wind (1971-2000) 52 percent p.a., PV 32 percent), (implementation of 5000 MW till 2015 corresponds to GMI goal).
- Fossil Reference LEC (IEA) with same number of annual operating hours as STPPs
- Fuel prices increasing by 0.52 percent p.a. (IEA)

As a result of the assumptions given above, the cost reduction forecasts of the Athene study are given in the following graph:

Figure 2: Development of levelized electricity costs and revenues from the power exchange market referred to by LEC of fossil power plants (plant project interest rate 8 percent), the bright blue line includes Emission Reduction Credits (ERC) of initially 7.5 Euro/t CO_2 increasing to 30 Euro/t CO_2 in 2050



Source: DLR (2004)

According to the Athene study, the cost competitiveness of solar thermal power generation will be reached in 2025. The total necessary subsidies account to 12 billion €, which corresponds to a total installed capacity of 42 GW_e, not taking into account CO_2 trading. If the above-mentioned carbon prices are included, cost competitiveness will be reached in 2023. The total necessary investment will thereby be significantly reduced to 2.5 billion €, respectively 22 GW_e.

The implicit assumption is that the number of full-load hours is constantly increased due to larger thermal energy storages up to 6500 hrs/a (12 hrs thermal storage). However, in some cases it may be more economical to aim at producing only peaking to mid-load-power for the period when power tariffs on the electricity market are highest (smaller energy storage), which in turn could justify lower thermal storage.

The Athene model is a very thorough assessment using many validation points from experienced facts and developments. The assumptions used are generally conservative. In this context, the Athene scenario may be considered as a very conservative scenario for solar thermal power cost and market development.

Cost Reduction – Summary

All studies referenced assumed a conservative global solar thermal power market development. It has also to be stated that many of the countries in the world's sunbelts lack the financial resources to finance solar energy. With present global solar thermal power market movements re-emerging, there is no fundamental reason why technology growth similar to wind energy is not feasible.

The main messages from the comparison of cost projection studies are:

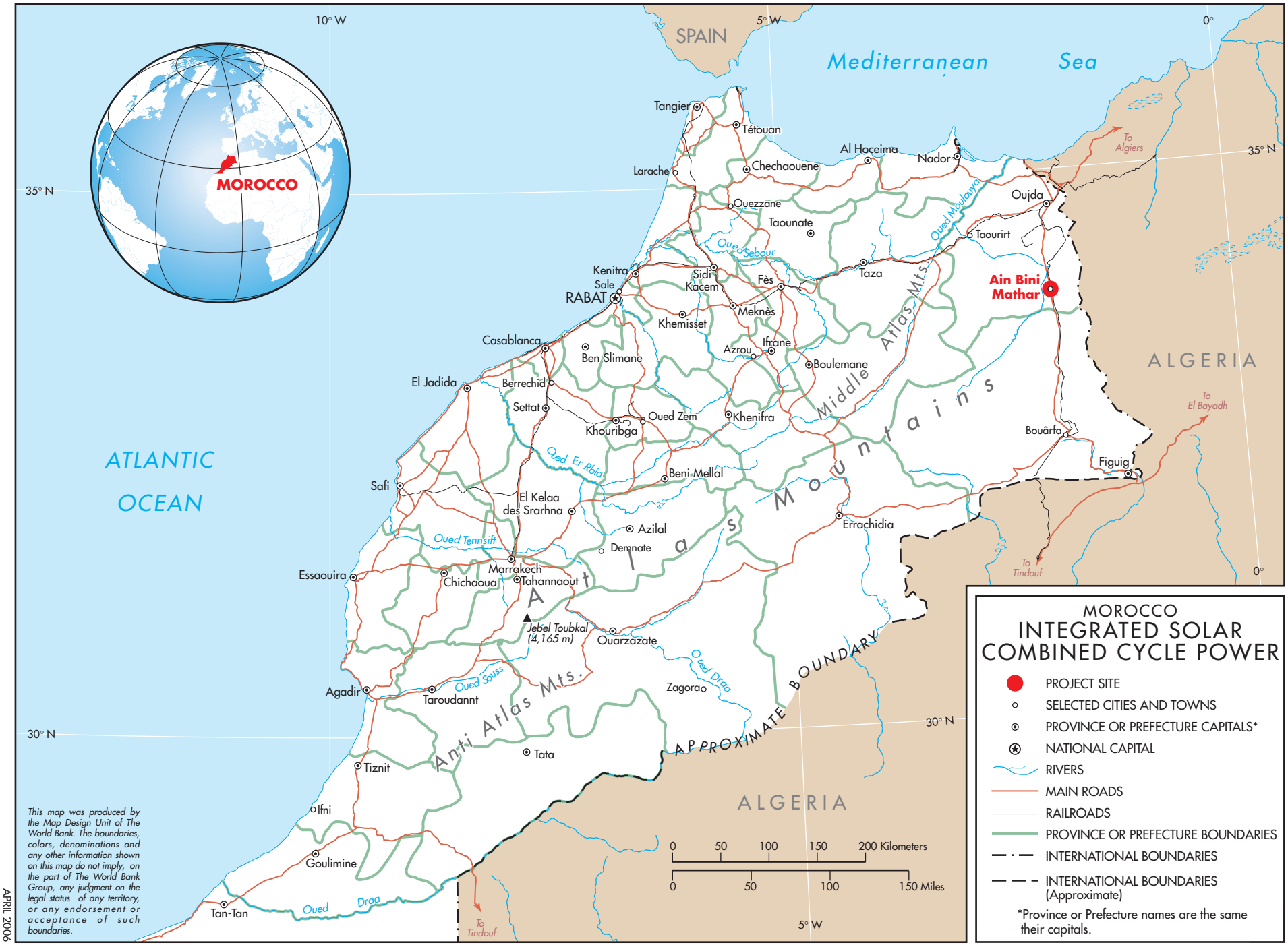
- The technology has the potential to be cost-competitive within 10 to 25 years, and has the potential to be a significant electrical power option for developing countries, which often have abundant solar resources. With hybridization and thermal energy storage, solar thermal power is dispatchable power that helps to support grid stability.
- Should GEF promote solar thermal investments now in developing countries and not once the technology has moved further down the learning curve?

  The GEF projects will contribute to OP7's goal of "reducing the long-term costs of low greenhouse gas-emitting energy technologies" if at least two or three are successfully deployed and operated. However, the projects in the current portfolio will not have a significant cost-reduction impact on the underlying cost of the technology. It is difficult to quantify the cost reduction effect of the four projects: In the beginning of the portfolio's history, it seemed that it would be one of the GEF plants that would be the first to be built after the California SEGS plants. However today, with other commercial solar thermal power activities evolving, other projects may perhaps come in first. Therefore the question is, which part of the cost reduction curve will the GEF projects influence? In theory, the cost reduction effect will be largest for the first plants built. In practice, much of the early cost reduction will result from a reduction of the risk premium as design, construction, and O&M experience is gained. The developing countries in particular experience an additional premium due to the perceived added difficulties of carrying out large projects using new technology. This is another cost reduction area that the GEF projects can impact in a positive manner.

Affordable technology and climate protection are goals officially supported by many developing countries with good solar resources. In order to meet these goals, GEF should support the implementation of climate-protecting renewable energy in developing countries. Whereas the OECD countries can afford subsidizing power technologies on a large scale, developing countries usually are not able to do so. By supporting the implementation of the first solar thermal power pilot plants, GEF will help create technology trust and institutional learning and thereby reduce the hurdle for subsequent market entry. The solar fields of solar thermal power plants contain many components that can be locally manufactured, such as concrete foundations or standard steel components or, depending on the solar technology and the project, country, mirrors.

Enermodal. 1999. *Cost Reduction Study for Solar Thermal Power Plants*. Kitchener, Ontario: Enermodal Engineering Limited.

DLR (German Aerospace Center). 2004. "Financing Instruments for the Market Introduction of STTPs – Scenario Model 'Athene.'" BMU-funded study SOKRATES, December 2001–December 2003, Final Report 2004.


MOROCCO
INTEGRATED SOLAR COMBINED CYCLE POWER
PROJECT SITE
SELECTED CITIES AND TOWNS
PROVINCE OR PREFECTURE CAPITALS*
NATIONAL CAPITAL
RIVERS
MAIN ROADS
RAILROADS
PROVINCE OR PREFECTURE BOUNDARIES
INTERNATIONAL BOUNDARIES
INTERNATIONAL BOUNDARIES (Approximate)
*Province or Prefecture names are the same their capitals.
Mediterranean Sea
ATLANTIC OCEAN
SPAIN
ALGERIA
ALGERIA
Ain Bini Mathar
RABAT
Tangier
Tétouan
Al Hoceima
Nador
Larache
Chechaouene
Ouezzane
Taounate
Oujda
Taourirt
Taza
Kenitra
Sale
Sidi Kacem
Fès
Meknès
Khemisset
Casablanca
Ben Slimane
Azrou
Ifrane
Boulemane
El Jadida
Berrechid
Settat
Oued Zem
Khouribga
Khenifra
Bouârfa
Figuig
Safi
Beni Mellal
El Kelaa des Srarhna
Azilal
Demnate
Errachidia
Essaouira
Marrakech
Chichaoua
Tahannaout
Jebel Toubkal (4,165 m)
Ouarzazate
Agadir
Taroudannt
Zagora
Tiznit
Tata
Ifni
Goulimine
Tan-Tan
Middle Atlas Mts.
High Atlas Mts.
Anti Atlas Mts.
Oued Sebou
Oued Moulouya
Oued Er Rbia
Oued Tennsift
Oued Souss
Oued Draa
Oued Draa
APPROXIMATE BOUNDARY
To Algiers
To El Bayadh
To Tindouf
To Tindouf
10° W
5° W
0°
35° N
30° N
0 50 100 150 200 Kilometers
0 50 100 150 Miles
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