Global Environment Facility

GEF

Monique Barbut
Chief Executive Officer
and Chairperson

1818 H Street, NW
Washington, DC 20433 USA
Tel: 202.473.3202
Fax: 202.522.3240/3245
E-mail: mbarbut@TheGEF.org

August 3, 2006

Dear Council Member:

I am writing to notify you that World Bank, the Implementing Agency for the project entitled, ***Mexico: Hybrid Solar Thermal Power Plant***, has submitted the proposed project document for CEO endorsement prior to final approval of the project in accordance with World Bank procedures.

Over the next four weeks, the Secretariat will be reviewing the project document to ascertain that it is consistent with the proposal included in the work program approved by the Council in December 1999, and with GEF policies and procedures. The Secretariat will also ascertain whether the proposed level of GEF financing is appropriate in light of the project's objectives.

If by August 31, 2006, I have not received requests from at least four Council Members to have the proposed project reviewed at a Council meeting because in the Member's view the project is not consistent with the Instrument or GEF policies and procedures, I will complete the Secretariat's assessment with a view to endorsing the proposed project document.

We have today posted the proposed project document on the GEF website at www.theGEF.org. If you do not have access to the Web, you may request the local field office of UNDP or the World Bank to download the document for you. Alternatively, you may request a copy of the document from the Secretariat. If you make such a request, please confirm for us your current mailing address.

Sincerely,

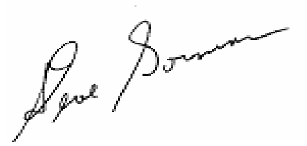
cc: Alternates, Implementing Agencies, STAP

THE WORLD BANK/IFC/M.I.G.A.

OFFICE MEMORANDUM

DATE: July 28, 2006

TO: Ms. Monique Barbut, CEO/Chairman, GEF



FROM: Steve Gorman, GEF Executive Coordinator

EXTENSION: 35865

SUBJECT: **MEXICO: Hybrid Solar Thermal Power Plant Project**
Submission for Final CEO Endorsement

1. Please find attached the electronic file of the GEF Project Document for the above-mentioned project for your final review, prior to circulation to Council and your final endorsement. This project was approved for Work Program entry at the December 1999 Council Meeting. The scheduled Board Date for this Project is October 3, 2006. We would appreciate receiving your response, so that we may finalize the Bank Board submission, by September 5, 2006.

2. The GEF Project Document is fully consistent with the objectives, scope, and overall cost of the proposal approved at the December 1999 Council meeting. The Government of Mexico has confirmed its approval, in the minutes of negotiations, of the Project Appraisal Document, including the financing plan, counterpart contributions and legal documents.

3. In accordance with the objectives of GEF Operational Program 7, the main global environmental goal of this project is to demonstrate and encourage replication of ISCCS power generation technology in Mexico and elsewhere, thereby contributing to the reduction of global GHG emissions. The project would integrate a 31 MW solar field with a 535 MW combined cycle gas turbine. In conjunction with other planned GEF solar thermal projects in Egypt and Morocco, the project will contribute to building critical mass and bringing down the worldwide production costs of this technology.

4. Three adjustments have been made during project preparation concerning:

   - *A change in project location*. The original project site located in the State of Baja California was moved to the Municipality of Agua Prieta in the State of Sonora, also in northern Mexico for the following reasons: i) there is a considerable reserve margin in terms of capacity operating in the Baja California region; the transmission system of the region, which is not connected to the national interconnected system, has exhibited signs of saturation , ii) an increase in the national electricity demand growth rate required the construction of additional capacity in the State of Sonora. The new site exhibits solar insolations of the same magnitude exhibited in the original site and presents additional advantages including an isolated site with no human settlements within or surrounding the project area and a natural gas pipeline to supply the project needs within 2 Km from the site. The change in project site does not alter the objective, scope nor the cost of the project.

- *An increase in the capacity of the thermal component from about 280 MW to 535 MW with no changes in the size of the solar component (31 MW):* With the high electricity demand growth rates in northern Mexico, in 2005 the Federal Commission of Electricity (CFE) decided to increase the size of the thermal component to 535 MW. This change required an assessment to evaluate the impacts on the project development and global objectives. A technical and economic study by the consultant firm Sargent & Lundy conducted in March – May 2006 concluded that the larger capacity of the combined cycle gas turbine (CCGT) would allow a higher output and efficiency from the solar field. The change in thermal capacity would enrich the operational experience associated with the installation of ISCCs. The project development and global environmental objectives, indicators and incremental costs are not affected by the change. For an in-depth discussion of the incremental cost implications, please see the Project Document (p.13) and Annex IV.

- *The decision to bid the project under a public sector ownership modality as opposed to under the scheme of independent power production (IPP).* The four projects in the GEF portfolio worldwide were originally programmed to operate under the scheme of Independent Power Production (IPP). They switched to a different modality with a more limited participation of the private sector. In the case of Morocco and Egypt, the scheme switched to the Engineer Procure Construct (EPC) model with contracts for operation and maintenance. In Mexico, the project will be bid as a Finance Build Transfer (known as *Obra Pública Financiada* or OPF) where the project is ultimately State owned, operated and maintained by the CFE.

The above described changes do not change the technical design and economic analysis of the original proposal; and project objectives are unchanged.

5. All STAP comments have already been addressed at the time of work program entry.

6. At the work program review, Switzerland expressed its support for the Mexico project, commenting that the country's ability to manufacture parts of the system is an argument in its favor. *It asked whether this and the other STP projects could generate enough interest for the industry to compete and lower the cost of such systems. It recommended that dissemination strategies be developed further to ensure maximum impact of the projects.*

On the first point, observations on cost reduction trends in the wind power industry suggest that similar cost reductions for STP will require substantially more installations to be built in the next 10 years than has occurred in the past. Fortunately, the GEF/WB portfolio is not evolving in isolation but is part of interconnected global developments that are expected to trigger the take-off of the technology. On the second point, we fully agree on the importance of effective dissemination. Each of the GEF projects incorporates a monitoring and evaluation plan, and a dissemination strategy directed at informing both domestic and international actors in the sector. For the Mexico project, CFE and Ministry of Energy (SENER) will have active roles in this respect.

7. Please let me know if you require any additional information to complete your review of the Project Document. We look forward to receiving your endorsement of the project for Bank Board approval

Many thanks.

Attachments

cc: Messrs./Mmes. P. Bliss-Guest, R. Ramankutty, GEF PROGRAM COORDINATION (GEFSEC); J. Albert, D. Aryal, K. Ashida, M. Isaac (LCSES); G. Elizondo Azuela, E. Terrado (LCSFE); C. Govindarajalu, R. Khanna, S. Wedderburn, E. Monier (ENV); ENVGC ISC, Regional Files

Document of
The World Bank

Report No: 36794-MX

PROJECT DOCUMENT

ON A

PROPOSED GRANT FROM THE

GLOBAL ENVIRONMENT FACILITY TRUST FUND

IN THE AMOUNT OF USD 49.35 MILLION

TO THE

UNITED MEXICAN STATES

FOR A

SOLAR THERMAL PROJECT AGUA PRIETA II

July 14, 2006

Finance, Private Sector and Infrastructure Department
Mexico and Colombia Country Management Unit
Latin America and the Caribbean Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective May 7, 2006)

Currency Unit	=	Mexican Peso (MXN)
10.9635 Mexican Pesos	=	US$1
US$	=	SDR 1

FISCAL YEAR

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

CCGT	Combined Cycle Gas Turbine
CENACE	National Dispatch Center
CFE	Federal Commission of Electricity
CO2e	Carbon Emissions (Carbon Dioxide Equivalent)
CSP	Engineer Procure Construct
GEF	Global Environmental Facility
GHGs	Greenhouse Gases
GoM	Government of Mexico
IPP	Independent Power Production
IIE	Institute of Electrical Research - Mexico
ISCCS	Integrated Solar Combined Cycle System
NAFIN	National Financial Institution
O&M	Operation and Maintenance
OPF	Finance Build Transfer Scheme (Obra Pública Financiada)
POISE	Least Cost Plan (Programa de Obras de Inversiones del Sector Eléctrico)
SEMARNAT	Ministry of Environment and Natural Resources
SENER	Ministry of Energy
SHCP	Ministry of Finance (Treasury)
SIN	National Interconnected System
SEGS	Solar Electric Generation Stations
STP	Solar Thermal Projects

Vice President:	Pamela Cox
Country Director:	Isabel Guerrero
Country Manager	Makhtar Diop
Sector Manager:	Susan G. Goldmark
Task Team Leader:	Gabriela Elizondo Azuela

MEXICO
Hybrid Solar Thermal Power Plant

CONTENTS

Page

I. STRATEGIC CONTEXT AND RATIONALE

A. Country and Sector Issues

The project proposed in this document seeks to contribute to the market development of a technology known as Integrated Solar Combined Cycle System (ISCCS) which has high potential for future replication in the developing world and for reductions in Greenhouse Gas (GHG) emissions.

Mexico is the ninth largest greenhouse gas emitter in the world. The main CO_2 emission sources (excluding land use-related emissions) are energy combustion (89 percent) and industrial processes (11 percent). The national CO_2 emissions from fuel combustion increased by 23 percent between 1990 and 2000 and are expected to increase by 69% when extending the period to 2010.

Within the next ten years the demands for electricity, natural gas and oil products are projected to rise by 75, 69 and 35 percent respectively.

The Mexican electricity system, operated primarily by *Comisión Federal de Electricidad* (CFE), serves 96 percent of the population. About 73 percent of Mexico's installed power generation capacity of 47 GW is fossil fuel-based, with oil-fired plants, including combustion turbines, responsible for the largest share of both capacities (43 percent) and generation (49 percent). Combustion turbine plants comprise less than 8 percent of total generation and are used largely for meeting demands at peak and in isolated areas. Gas-fired plants represent more than 19 percent of generation, about the same share as hydro, with just below 14 percent of total generation capacity.

Mexico has abundant renewable energy resources; however it has only a small share of generation capacity based on either wind, solar, hydro or geothermal resources. Notably, Mexico is located within the world's solar belt where high solar insolations allow for the efficient operation of grid-connected solar based power generation.

The electricity system in Mexico has 1, 365 MW of nuclear capacity (2.90 percent), 960 MW of geothermal capacity (2 percent) and about 87 MW of wind capacity (considering La Venta I and La Venta II plants, less than 1 percent).

The most important element of Mexico's power sector development is the considerable re-arrangement of the fuel mix expected by 2014 which indicates a doubling of natural gas use and a 50 percent increase in coal for generation. By 2020 the IEA expects Mexico to increase gas use in the power sector five-fold, to 44 percent of all generation.

At the Federal level, the Energy Sector Program (PROSENER) establishes the increase in the use of renewable energy resources as a sector priority and defines a number of strategic actions including i) develop programs, projects and actions to increase the use of renewables, ii) increase the capacity share of renewable energy in the electricity sector,

iii) strengthen research and technology development activities on renewable energy and iv) promote education on renewable energy.

Recently Mexico has made substantial progress in the development of policies and measures to increase the market share of renewable energy. These include: i) a provision for Accelerated Depreciation, which makes 100% investment in renewable energy technologies after January 2005 eligible for depreciation in the first year, and ii) a proposed Renewable Energy Law (passed by the lower house of Congress in late 2005; pending before the Senate) that specifies a range of methodologies and dispatch conditions to better capture the value of contributions of renewables.

In particular, the proposed Renewable Energy Law establishes the creation of a trust fund to support the development of emerging technologies based on renewable energy sources (Chapter IV, article 18). In addition, the law also proposes the implementation of a second trust fund to support research and development activities focused on those renewable energy technologies that are considered promising for the future development of the national energy and other industries (Chapter VIII).

In March 2006, the Institute of Electrical Research (IIE-Mexico) issued a report that identifies the research and technology development priorities for the Mexican energy industry in the twenty first century. The report emphasizes that given the abundant solar resources in Mexico, research and technology development activities will have to focus on: a) heat production for industrial applications using solar resources, b) concentrating solar power technology (and specifically parabolic trough technology), and c) photovoltaic panels.

Today however, there are no policies or regulatory mechanisms that explicitly support renewable energy and the development of emerging technologies in this field. In fact, total expenditures on research and technology development initiatives in the electricity sector have declined from 1-1.5% of total electricity sales in 1993 to 0.68% in 2006[1].

The demonstration of integrated solar combined cycle systems (ISCCS) using solar parabolic trough technology with the support of the Global Environmental Facility (GEF) will allow Mexico to install a technology that is considered promising for the development of the electricity industry in the twenty first century. With the first installation, Mexican engineers will learn how to integrate combined cycle gas turbines (CCGTs) with solar fields and be able to improve the thermodynamic integration based on first hand experience.

Without question, the passing of the Renewable Energy Law (expected to be passed in September 2006) and the implementation of the trust funds proposed would allow the replication and scaling up of solar thermal projects at the North of Mexico.

[1] Sources include: a) Mulas del Pozo, Pablo. 2006. Investigación y Desarrollo Tecnológico de la Industria Energética, Seminario Nacional Agenda del Desarrollo. IIE, b) CFE, 1993. El Sector Eléctrico de México, Fondo de Cultura Económica, México.

CFE has already expressed interest in exploring the possibility to integrate solar fields into existing coal-fired Rankine plants operating at the North of Mexico. Such a combination would result in higher CO_2-emission reductions by displacing coal rather than natural gas.

In addition, Mexico has a well-developed industrial base and has the potential to locally manufacture up to 40% of the plant components. Mexican companies have already manufactured parabolic collectors for the LUZ installations in California[2].

The introduction of integrated solar combined cycle systems (ISCSS) has the potential to penetrate the national energy market considering high energy demand growth rates at the North of Mexico, the need to hedge against future increases in natural gas or coal prices and the benefits associated with the reductions in greenhouse gas emissions (GHGs).

B. Rationale for Bank involvement

Global warming has been identified as a very significant poverty and security issue. The associated detrimental effects are likely to particularly manifest themselves in many developing countries.

Though most of the anthropogenic emissions thought to be contributing to the effect have historically come from the OECD countries, modeling shows that in the future other countries such as India, China and Mexico will have, although in a much lower scale, a growing contribution.

The GEF Operational Program 7 (OP 7) support technology development initiatives and aims to increase the market share of low greenhouse gas-emitting technologies that are not yet commercial, but which are promising for becoming competitive in the future.

In 1996, the GEF's Scientific and Advisory Panel (STAP) recommended high temperature solar thermal power technology as one of the renewable energy technologies with significant potential for cost reduction and the expected high demand from countries located in the world's solar belt. In 1999, the GEF launched a portfolio of four projects (to be located in India, Mexico, Morocco, Egypt) to promote the introduction of ISCCS.

Concentrating Solar Power (CSP) is viewed as the most cost-effective option for converting solar radiation into electricity, and it had been operationally proven in California since the mid-1980s.

In 2005, the World Bank-GEF sponsored an updated review of the status of the technology and its potential for replication[3]. The review concluded that i) solar thermal electricity technology is worthy of continued support, ii) the benefits of a successful

[2] Spencer Management Associates, Report 1994.
[3] Assessment of the World Bank / GEF Strategy for the Market Development of Concentrating Solar Thermal Power, May 31, 2005, prepared by a group of experts from Global Research Alliance, Fraunhofer Institute for Solar Energy Systems, CSIRO Australia and CSIR South Africa.

industry, particularly for developing countries, are significant, iii) the technology is not new and has been proven, however it is still in the process for becoming competitive, iv) the technology has the potential to follow a similar cost reduction curve as wind energy.

The World Bank and GEF, together with other bi-lateral agencies, have engaged a broad array of Mexican policy, technical, financial, and environmental agencies and actors on the topic. Discussions have aimed to building consensus on the need for energy sector diversification, the potential benefits of developing in-country renewable energy resources to achieve such diversification, and the technical assistance and program approaches required to stimulate and sustain long-term renewable energy development.

SENER, CFE and other agencies recognize the value added of the World Bank and GEF in (a) providing objective information on international experience and tailoring it to Mexican circumstances, (b) identifying and collaborating with a range of technical, financial, and policy experts within and outside of Mexico, and (c) carrying out key analyses required to inform decisions. Indeed, over the last years the Bank has contributed to strengthen the national institutional capacity to plan, integrate and develop renewable energy with the various projects supported with either carbon finance or the Global Environmental Facility.

Given the entry into force of the Kyoto Protocol in February 2005, the Bank's engagement with Mexico (both through GEF and several projects under development through the Bank's Carbon Finance Business) remains important in supporting Mexico position on emerging international accords on mitigating greenhouse gases (GHGs).

Mexico ratified the United Nations Climate Change Convention in 1993 and Kyoto Protocol on September 7, 2000. With the presentation of the Second National Communication to the UNFCCC at the end of 2006, the Mexican Government is confirming its commitment to report the progress achieved in mitigating greenhouse gas emissions.

As a non-Annex I country, Mexico is eligible for financing from the GEF through the mechanism established by the Convention. The Project has received the endorsement from the GEF Operational Focal Point and is formulated in accordance with national priorities.

The proposed project has been included by Treasury (SHCP) in the Federal Expenditures/Investments Program for 2006 (*Programa de Egresos de la Federación*, PEF) and approved by Congress.

C. Higher level objectives to which the project contributes

The proposed project is consistent with the Country Partnership Strategy (CPS, Report No. 28141-ME, March 18, 2004) which proposes to promote environmental sustainability as one of its four strategic pillars. In particular, the CPS acknowledges the threat of climate change (paragraph 54 pp 21) and agrees "to support on-going programs to address the problems of GHG emissions and promote the introduction of clean energy technologies" (paragraph 119, pp 44).

The project is consistent with GEF Operational Program Number 7 "Reducing the Long Term Costs of Low Greenhouse Gas Emitting Technologies".

The project will contribute to reduce GHG emissions from anthropogenic sources through the installation of an integrated solar combined cycle system (ISCCS) using solar parabolic trough technology. The project, known as Agua Prieta II, will be located at the North of Mexico in the State of Sonora within the world's solar belt where there is potential for replication. The Agua Prieta II will be the first of its kind penetrating the electricity market in Mexico and Latin America.

II. PROJECT DESCRIPTION

A. Lending instrument

GEF Project – No associated Bank investment.

A GEF grant will finance part of the proposed project by covering the incremental cost associated with the installation of the solar component, or <u>about 14.2 percent of the total investment costs when considering the integrated project</u>.

The costs of the thermal plant will be covered by the CFE[4]. The project will be bid under the scheme Finance-Build-Transfer (known as *Obra Pública Financiada* or OPF). The project will be ultimately a State owned initiative.

B. Project development objectives and key indicators

The project development objective is to demonstrate and encourage replication of ISCCS power generation technology in Mexico and elsewhere, thereby contributing to the reduction of global GHG emissions.

Key performance indicators associated with the project development objective include:

- Total electricity generated from the solar thermal hybrid project (GWh/year)
- Solar output as a percentage of total energy produced by the hybrid plant (GWh/year)

C. Project global environmental objectives and key indicators

[4] It is important to note that Treasury (SHCP) approves the total cost of the thermal plant in the annual budget for investments in the electricity sector. The GEF grant, to be use for the financing of the solar field is an incremental cost not considered in the Federal Expenditures Program (PEF).

The global benefits associated with the project include: i) demonstrate the operational viability and value added of integrating a solar field with a large conventional thermal facility (ISCCS using solar parabolic trough technology); ii) contribute to reduce the long-term costs of the technology; and iii) reduce global GHG emissions.

The carbon emissions reduction is estimated in 391,270 tons of CO2 over the 25 year economic life of the plant.

Key performance indicators associated with the global environmental objective include:

Cost of solar thermal power (c /KWh)

Reduction of CO2 emissions (tons/year)

D. Project components

The design, construction and operation of the proposed Integrated Solar Combined Cycle System (ISCCS) include two components:

Component 1. Design and construction of a 31 MW (peak) solar field: the solar collector field consists of a large field of single-axis tracking parabolic trough solar collectors.

Component 2. Design and, construction of a 480 MW (net) gas based thermal plant: the plant is based on a standard configuration that includes two industrial frame combustion turbines each associated with a heat recovery steam generator (HRSG) and a steam turbine.

The proposed project will only finance component 1, as indicated in the Table below.

Table 1. Design and Construction of a 485.5 MW (net) ISCCS Plant (4)

Component	Indicative Cost (US$M)	GEF Financing (US$M)	% GEF Financing	GOM Financing (US$M)	% GOM Financing
Component 1: 31 MW (peak) Solar Field					
Solar field 118,500- 120,000 m2	43.518	43.518	100	-	-
Fence (land of solar field)	0.241	0.241	100	-	-
Land purchase	1.5	-	-	1.5	100
Wastewater treatment plant	1.86	0.42 (1)	22.58	1.43	76.9
Incremental Cost due to Integration (2)	5.171	5.171	100	-	-
Total	**52.29**	**49.35**	**94.38%**	**2.93**	**5.60%**
Component 2: 480 MW Thermal Plant					
Combustion Turbine	79.9	-	-	79.9	100
HRSG (no duct firing)	36.7	-	-	36.7	100
Steam Turbine and Auxiliaries	26.5	-	-	26.5	100
Mechanical Equipment	56	-	-	56	100
Electrical Equipment	18.9	-	-	18.9	100
Civil and Structural Work	13.3	-	-	13.3	100
Construction	65	-	-	65	100

Total	**296.3 (3)**	**0**	**0**	**296.3**	**100**
TOTAL	**348.59**	**49.35**	**14.16%**	**299.23**	**85.84 %**

(1) Includes only the expansion required for the maintenance of the solar field (i.e. cleaning of mirrors, etc).
(2) The integration of solar field requires modifications in the design of the thermal components, these include: major equipment required expansion, design modifications in the power block (based on the configuration selected during the cycle optimization phase of the project) and for the addition of duct firing.
(3) This is an indicative cost, actual costs of the thermal component will be specified once the bidding has been awarded.
(4) The operation of the integrated ISCCS is responsibility of the CFE.

It is important to note that under the Finance Build Transfer scheme (known as *Obra Pública Financiada* or OPF), the bid winner will design and construct the plant and CFE will operate and maintain it.

E. Lessons learned and reflected in the project design

A portfolio of four ISCCS projects to be located in India, Morocco, Egypt and Mexico entered the GEF program in 1999 with a grant volume of US$ 194.2 Million. However, each of these projects has encountered significant delays.

A STAP review of the portfolio in 2004 concluded that low greenhouse gas emitting technologies are not only exposed to the barriers typical of innovation and technology market development, but also to the common barriers that affect conventional projects (e.g. transactional, informational, institutional and capacity-related).

The lessons learned with the GEF portfolio as indicated by the STAP review include:

The difficulty in adapting emerging technologies to the IPP scheme
The four projects in the portfolio, originally programmed to operate under the scheme of Independent Power Production (IPP) switched to a different modality with a more limited participation of the private sector. In the case of India, Morocco and Egypt, the scheme switched to the Engineer Procure Construct (EPC) model with contracts for operation and maintenance. In Mexico, the project will be bid as a Finance Build Transfer (known as *Obra Pública Financiada* or OPF) where the project is ultimately State owned, operated and maintained by the CFE.

The 2004 STAP review concluded that the lack of success with the IPP approach seemed to be the result of private sector risk aversion associated with the costs of financing the high capital investment characteristic of large solar field, coupled with the general global decline in IPP interest across the developing world.

In the case of Mexico, the CFE made the decision to change the IPP for the OPF scheme even before the bidding was launched. The reason for the change was the Mexican legal constraint for launching a bidding process that offers a grant, where the grant has not been secured. In this case the GEF CEO endorsement could not be provided before the beginning of the bidding process due to uncertainties regarding both the project design offered by the bid winner and the reputation of the bid winner. Under the OPF scheme, the GEF CEO endorsement can be provided before the bidding starts considering that the project design is already specified in the bidding document and the owner and operator of the plant is known to be CFE, a company with strong technical capacities and solid reputation.

Securing full co-financing is frequently a slow and difficult process for capital intensive projects in developing countries

Some of the projects in the portfolio have experienced delays due to the difficulty in securing full co-financing as public sector power plants (Morocco, Egypt, India). In the case of Mexico, as a Finance Build Transfer or OPF project, the bidders are responsible for the financing of the thermal facility (the combined cycle gas turbines CCGT). The OPF scheme and the transactions for CCGT projects have been successful in all cases in the past resulting in a low perception of risk by the participant bidders. For the particular case of the solar thermal hybrid project, the bid winner will not have to finance the solar component, as the grant will be provided before the construction starts or in tranches as the construction advances.

There are a limited number of consulting firms and suppliers in the solar thermal technology industry

This is evidenced by the fact that the engineering design of three of the four projects is being carried out by the same firm. In addition, consultations carried out by the four utilities, as well as their requests for interest, and the experience with the India ICB suggest that there are probably only one or two suppliers of the solar thermal power technology. In this regard, it is also worth noting that about 15% of the value of the solar thermal components is covered under intellectual property protection. In the case of the India project, the reluctance of power-plant bidders to assume the liability for under-performance of the solar thermal component resulted in no bids being received after the bidding process in 2003.

Since the solar contribution in all the projects is in the 6-10% range, the lead in all the bids for these hybrid projects would be taken by mainstream power generation firms.

The potential for ISCSS cost reductions still looks promising

While there was a strong rollout of solar thermal electricity plants in California in the 1980's, no new commercial scale solar thermal electricity plant were commissioned in the last 12 years. In that time, research and development led to improved solar field components, new thermal storage concepts, and operation and maintenance experience has continued to emerge through the existing California plants. Over the last 12 months however, the industry has been reinvigorated. Several projects are presently under construction around the world. Nonetheless, no critical mass of projects has yet been reached such that the industry would be self-sustaining[5].

The assessment to review the GEF strategy for the market development of concentrating solar thermal power technology sponsored by the GEF in 2005 concluded that:

> "This report determines that solar thermal electricity technology is worthy of continued support. The benefits of a successful industry, particularly for developing countries, are significant. The technology is not new, but stalled in its development path. All required technology elements are essentially already in place. The major outstanding issue is the need for cost reduction, and this study concludes that there is no fundamental reason why the technology could not follow a similar cost reduction curve to wind energy and eventually be cost-competitive. However robust, long term support mechanisms will be required."

F. Alternatives considered and reasons for rejection

Originally, the four ISCCS projects that entered the GEF program in 1994, considered thermal component capacities in the range 140-285 MW with corresponding solar component capacities in the range 25-35 MW.

With the high electricity demand growth rates at the North of Mexico, in 2005 the CFE decided to increase the size of the thermal component to about 480 MW (summer design conditions)[6]. Due to economic constraints, the size of the solar component would remain in the same range 25-35 MW. This change required an assessment to evaluate the new alternative's impacts on the project development and global objectives.

The assessment to review the GEF strategy for the market development of concentrating solar thermal power technology sponsored by the GEF in 2005 concluded that:

> "Mexico's new plan to equip a 560 MW CC instead of a 250 MW plant with a solar field, thereby diluting the solar share to approximately 50 % of its original contribution, should not be grounds to cancel project support. The 560 MW CC would be built anyway and, with the same solar field size, more solar electricity is actually generated. This is because during the hours when the solar field is not operating, there are thermodynamic advantages due to the solar field now representing less of an off-design imposition. High solar shares anyway are not among the advantages of the ISCC concept. ISCCS is a good concept to boost a CC that would anyway be built with a comparatively huge amount of renewable energy (compared to other forms of solar energy usage). One critical point with respect to the ISCC concept in general, but especially in combination with a larger combined cycle,

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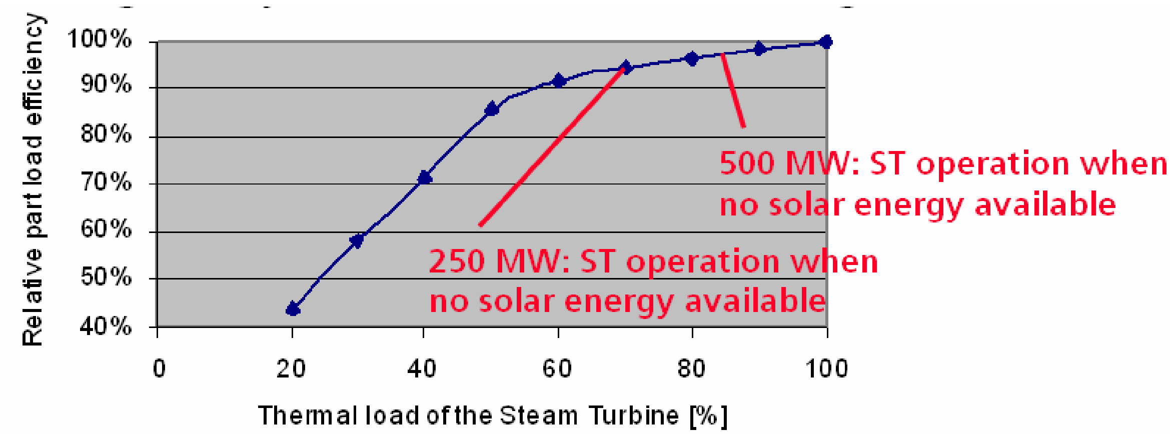
5 Assessment of the World Bank / GEF Strategy for the Market Development of Concentrating Solar Thermal Power, May 31, 2005, prepared by a group of experts from Global Research Alliance, Fraunhofer Institute for Solar Energy Systems, CSIRO Australia and CSIR South Africa.

6. At the beginning of 2005, CFE proposed a 560 MW CCGT plant, and this is the capacity quoted by the consultants in charge of the assessment to review the GEF strategy for the market development of ISCCS.

is the fact that sufficient incentives will be in place in order to ensure that the solar field will actually be operated".

The data available from previous studies suggests that a larger thermal component may have higher relative part load efficiency, as shown in Figure 1.

Figure1: Relative part load losses of the steam turbine for the daytimes when solar field is not providing solar steam for different ISCC plant sizes.[7]



A recent study by Sargent & Lundy and the results of a consultancy by Spencer Management (May 2006) concluded that "the 2x2x1 CCGT arrangement increases the contribution and efficiency of the solar component. The reason for the outstanding output is due to i) a higher solar increment due to the higher efficiency of the 2x2x1 arrangement and ii) the 500 MW thermal plant results in a lower drop in efficiency during night hours, when the solar field is not operating".

Most importantly, the larger size of the thermal component does not affect the project's contribution to reducing the long term cost of the technology or the amount of GHG emissions. In fact, the installation of the solar field in Mexico will build local technical capacity with the potential to trigger replication with either gas or coal based power facilities. The chances for this are particularly high for Mexico, given the entrepreneurship exhibited by CFE engineers with other technologies such as geothermal and the fact that Mexico has already manufactured some of the components required to assembly the solar field.

The demonstration of the Agua Prieta II project will also open the possibility for the future operation of ISCCSs under the IPP scheme, with the participation of the private sector.

[7] With data from Sargent & Lundy, 2004. Feasibility Study for an Integrated Solar Combined Cycle System (ISCCS) Mexico; Spencer Management Associates 2000. ISCCS Using Solar Parabolic Trough Technology: Feasibility Study for Mexico.

III. IMPLEMENTATION

A. Partnership arrangements (if applicable)

The project is co-financed by the Federal Commission of Electricity (86% of total project costs corresponding to the thermal component) and the Global Environmental Facility (14 % total project costs corresponding to the solar component).

B. Institutional and implementation arrangements

Main Responsible Institutions:

The Ministry of Finance and Public Credit (SHCP) is the official recipient of the grant. SHCP is the only entity of the Federal Government that has the capacity to receive donations from international financing agencies. It also assigns the financial agent for the project.

The Federal Commission of Electricity (CFE) will execute the project. CFE's investments in power generating plants is authorized by a budgetary allocation from the central government under the scheme of Projects with Deferred Impact in the Budgetary Registry (*Proyectos de Impacto Diferido en el Registro de Gasto*, PIDIREGAS), using either the Independent Power Production scheme (IPP) or the Finance Build Transfer modality (*Obra Pública Financiada*, OPF). Under the OPF scheme, the contractor is responsible for the construction phase, including its financing. CFE pays the contractor in full upon satisfactory reception of the project, at which point CFE becomes the project's owner. CFE finances the project under financing modalities authorized by Treasury (*Secretaría de Hacienda y Crédito Público*, SHCP), accessing the financial markets, or borrowing from national or international financial institutions. In some cases, the CFE buys the financial scheme already arranged by the contractor.

The Federal Commission of Electricity (CFE) through its Directorate for Financed Investment Projects (*Dirección de Proyectos de Inversion Financiada*) will assume overall GEF project implementation responsibilities, including:

i. Preparation of bidding package including general technical specifications
ii. Bidding process: bid structuring and evaluation
iii. Purchase and operation of the Agua Prieta II ISCCS Plant
iv. Project monitoring and evaluation
v. Regular reporting

The preparation of the bidding package has been completed. The CFE advertised the bidding documents last June 27th, 2006 and will award the bid next November 30th, 2006. The Agua Prieta II ISCCS plant is expected to start operations in March 31st, 2009.

Nacional Financiera (NAFIN) has been designated by SHCP as the financial agent for the Project and as such will provide overall financial management of the Project and the

Special Account. NAFIN will also be responsible for formal correspondence with the Bank.

The grant will be transferred through a special account directly to the contractor under the terms and conditions of a legal contract signed between CFE and the contractor. The grant will be disbursed in tranches as the construction of the project proceeds under the technical supervision of the CFE.

C. Monitoring and evaluation of outcomes/results

The monitoring and evaluation of outcomes and results will be mainly the responsibility of CFE.

The data on total annual generation and unit costs will be supplied by CFE and its dispatch center (*Centro Nacional de Control de Energia, CENACE*) throughout the operation of the plant. Emissions reductions will be calculated and reported also by CFE.

In addition, CFE will monitor, evaluate and disseminate performance results from the project both domestically and internationally, as a way to promote learning and support future replication.

The Ministry of Energy (SENER) through its Research, Technology Development and Environment Directorate (*Dirección General de Investigación, Desarrollo Tecnológico y Medio Ambiente)* within the Undersecretariat for Energy Planning will also support dissemination activities and the periodic evaluation of project's outcomes.

The project's primary purpose is to demonstrate and encourage replication of ISCCS power generation technology in Mexico and elsewhere. Consequently, an adequate project performance monitoring, evaluation, and dissemination system is a key component of the project design. The project will be monitored and evaluated in line with World Bank procedures and GEF guidelines. CFE will ensure that all project data are adequately recorded, documented, and disseminated. Data will be collected on all the key performance indicators and results will be used to implement corrective actions, if necessary, and serve as reference in the development of similar projects in the future.
A capacity assessment conducted during the preparation of the project indicates that CFE has the technical capacity to operate, maintain and monitor the project's performance.

The Results and Monitoring Framework (included in Annex 3) outlines the process for measuring project progress in meeting project global and development objectives, and details the intermediate indicators gauging progress toward and attainment of these objectives.

D. Sustainability and Replicability

Grant recipient commitment has been demonstrated by significant support during project preparation over the last six years: a) despite the delays and inconsistencies between Bank's and country's procurement policies, CFE has consistently supported the project and allowed - to the extent of possible - changes in its bidding process to accommodate Bank's requirements[8], b) CFE's high level management has visited Washington DC on several occasions to discuss alternative solutions and overcome obstacles to project implementation, c) given the impossibility of obtaining a GEF CEO endorsement before the launching of an IPP process, CFE accepted to change project's modality to a Finance Build Transfer scheme (OPF), d) CFE agreed to finance the cost of the land for the solar field given that GEF grants cannot cover this type of expenses, e) CFE has spend resources in the development of technical specifications for their inclusion in the bidding package and in public consultations to comply with Bank's safeguards and finally f) due to electricity growth rates at the North of Mexico CFE will launch the bidding process as a hybrid plant in June 2006 despite the fact that the GEF CEO endorsement is not expected until the end of July 2006.

The ISCCS Agua Prieta II is expected to operate sustainably as an integral part of the Mexican power system. Gas based thermal generation based on combined cycle gas turbines (CCGTs) are about the most efficient and clean thermal generation arrangements in the capacity mix. These plants are generally dispatched in based load, displacing other older, less efficient generating plants. In addition, the solar contribution hedges against future increase in natural gas prices and during the periods when temperature and humidity conditions affect the performance of the thermal plant.

As mentioned before, Mexico has made substantial progress in the development of policies and measures to increase the market share of renewable energy. These include: i) a provision for Accelerated Depreciation, which makes 100% investment in renewable energy technologies after January 2005 eligible for depreciation in the first year, and ii) a proposed Renewable Energy Law (passed by the lower house of Congress in late 2005; pending before the Senate) that specifies a range of methodologies and dispatch conditions to better capture the value of contributions of renewables.

In particular, the proposed Renewable Energy Law establishes the creation of a trust fund to support the development of emerging technologies based on renewable energy sources (Chapter IV, article 18). The law also proposes the implementation of a second trust fund to support research and development activities focused on those renewable energy technologies that are considered promising for the future development of the national energy and other industries (Chapter VIII).

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[8] An internal review of the case by Bank's Operational Procurement Review Committee in 2003 required one alteration to CFE's procurement process in order for the process to be accepted by the Bank: the intervention of an independent third party auditor proposed by CFE and acceptable to the Bank to safeguard the integrity of the two envelope system. CFE accepted this condition in 2003. Recently, CFE allowed the Bank's review of the bid evaluation report of the power plant ensuring the Bank's fiduciary obligation under certain workable arrangements.

CFE has already recognized the potential to replicate the integration of solar fields with coal based power generating facilities already operating at the North of Mexico; a technological arrangement with higher potential for reductions in GHG emissions and with the characteristics to hedge against future high natural gas prices.

Another aspect that support the argument of potential replication at the national levels is the fact that Mexico has well-developed industrial base and has the potential to locally manufacture up to 40% of the plant components (Spencer Management Associates 1994). Mexican companies have already manufactured parabolic collectors for the LUZ installations in California. The manufacturing of some of the ISCCS component in the country would lower the overall capital costs of the technology, facilitating its replication.

Ultimately, it is expected that the ISCCS Agua Prieta II Project will contribute globally to knowledge dissemination and the adoption of the technology in other developed and developing countries located within the world's solar belt.

E. Critical risks and possible controversial aspects

Table 2: Risk Mitigation Measures

Risk to Project Development Objective	Risk Mitigation Measure	Risk Rating
Insufficient and/or non-competitive bid responses	The GEF grant will be disbursed in tranches during before and construction to lower the volume and costs of financing The Finance Build Transfer (OPF) scheme represents lower risks for the bid winner considering that CFE will be the owner and operator of the plant	M
Failed bid	Existing track record of CFE in IPPs and OPFs is solid and internationally recognized. The biddings have always attracted a good number of participant bidders The size of the thermal component is large and considered an attractive project by itself. A number of international consortiums have already expressed interest in the bidding.	M
Insufficient experience with CSP technology	Solar trough technology has a good operating record, parabolic reflectors have been tracing the sun for 20 years at the California SEGS plants and generated nearly 13 TWh in the period 1986-2005 Secure valid warranties from manufacturers (in practice one of the most critical points in real project development)	M
Technological or design problems during operation	CFE qualified technical employees will learn during the construction of the solar field and taught by the contractor how to operate the field in the most optimal way. This is also in the best interest of the	M

	equipment supplier and/or contractor since they want to build a good reputation with the installation and appropriate operation of their equipment. CFE will provide continuous training to plant operators and employees in charge of maintenance.	
Poor maintenance of solar field due to constraints in budgetary resources approved by Hacienda for O&M	This is one of the first renewable source based facilities in the country. The plant will have international and national exposure putting extra pressure on CFE to properly operate and maintain this demonstrative facility.	M
Risk due to change in government and potential changes in the Ministry of Energy (SENER)	In this case, CFE is the project's counterpart. The change in government does not imply a change in CFE personnel (e.g. our focal points have worked at CFE for more than 10-15 years). Over the last 10 years (at least) SENER policies have supported renewable energy and technology development. This is not expected to change with the introduction of the new Energy Sector Program in 2007. By the time the new administration arrives, the project will have been already awarded.	N

Risk Rating - H (High Risk), S (Substantial Risk), M (Modest Risk), N (Negligible or Low Risk)

Overall Risk Rating: M

F. Loan/credit conditions and covenants

Non applicable

IV. APPRAISAL SUMMARY

A. Economic and financial analyses

An Incremental Cost analysis was prepared in order to compare the investment and operating costs of incorporating a solar component into a gas-fueled combined cycle plant in Agua Prieta. This analysis is presented in Annex 15.

Results of the economic and financial analyses are summarized as follows:

- The project will have a clear positive impact on the Mexican power system; it will help reducing fuel costs through its higher thermal efficiency displacing older and less efficient plants and will offer firm capacity in an environment characterized by a declining reserve margin.
- Total project costs amount to approximately US$350 million for a net capacity of approximately 485.5 MW. The incremental cost stemming from the incorporation of a solar component is in the order of US$ 49.35 million.
- While gas-fueled combined cycle plants constitute the main component of CFE's least cost expansion plan, the proposed solar thermal project implies a variation in the least-cost plan adding a solar component that increases capital investment and operation and maintenance costs, while increasing the overall efficiency of the plant and thus reducing fuel costs. The proposed GEF grant will help achieving a sustainable development consistent with the least cost objective –

ensuring the maximization of benefits- while bringing the environmental benefits of the solar component.

- The project's Economic Internal Rate of Return is 14.4%, for avoided cost of 52 $/MWh and gas prices of 4.9 $/mmBtu. The sensitivity analysis concludes that the project economic returns are not sensitive to an increase in fuel prices since this variable would have an impact in both the stream of costs and benefits (the latter estimated as avoided costs).
- Economic indicators are sensitive to variations in capital costs. The project will break even at capital cost increase of 14.9%.
- The project will yield a financial return of 22%.

Scenarios of Natural Gas Prices

The economic and financial analysis is based on the official scenarios of natural gas prices issued the last quarter of 2005 by the Ministry of Energy SENER. These scenarios are consistent with cost-benefit analysis of the project prepared by CFE and presented to Treasury (SHCP) for inclusion in the Federal Expenditures Program (PEF) and Congress approval[9].

The economic and financial analysis is detailed in Annex 9.

B. Technical

The project will be located in the Municipality of Agua Prieta, State of Sonora, 6.2 Km from the Agua Prieta City and 2 Km from the US border. The Northern States of Mexico, and particularly Sonora are located in the world's solar belt, where the direct normal insolation (DNI) is the highest and the potential to develop solar energy is the best.

The Agua Prieta II ISCCS project will have a net thermal capacity of about 485.5 MW (net) including a solar field of about 31 MW (peak).

The project is based on a configuration with two industrial frame combustion turbines each associated with a heat recovery steam generator (HRSG) and one steam turbine. This standard configuration is typically referred to as 2x2x1.

The solar component consists of large field of single-axis tracking parabolic trough solar collectors. The solar collector field is modular and is composed of many parallel rows of solar collectors aligned along a north-south horizontal axis. Each solar collector has a linear parabolic-shaped reflector that focuses the sun's direct beam radiation on a linear receiver, filled with a heat transfer fluid (HTF) located at the focus of the parabola.

Due to the low availability of water in the region, an air cooled condenser will be used in the plant. The water supply will be gray water from the Agua Prieta municipal sewage system (oxidation lagoons located about 5 Km from the site). The gray water will be

[9] The documents are referred as follows: a) Escenarios de Precios de Gas Natural 2005-2014 and b) Analisis de Costo Beneficio CCC Agua Prieta II (con campo solar) y I56 LT Red de Transmision Asociada a la CCC Agua Prieta II (con campo solar).

processed to produce boiler quality makeup water for the power plant operation as well as suitable water for cleaning of the solar trough components. The proposed project will install an 8 inch water pipeline which will run along the highway to connect the municipal wastewater treatment plant to the proposed project. At the site, a small modular wastewater treatment plant will be installed to improve the quality of the grey water in order to reach the quality level necessary for operations and maintenance.

Parabolic trough technology is currently the most proven solar thermal electric technology. This is primarily due to nine large commercial-scale Solar Electric Generating Stations (SEGS), the first of which has been operating in the California Mojave Desert since 1984. These plants, which continue to operate on a daily basis, range in size from 14 to 80 MW and represent a total of 354 MW of installed electric capacity. In addition to the Agua Prieta II project there are various parabolic trough power projects currently in the planning and development stages in Algeria, Australia, Crete, Egypt, Iran, Morocco, Spain and in the US in the States of Nevada and Arizona.

The annual average efficiency of solar output is expected to be 13.6%, which reasonable when comparing to SEGS in California, whose efficiencies are in the order of 12%. The higher efficiency is the result of the 2x2x1 CCGT configuration.

In terms of fuel supply, the plant will run on natural gas. The natural gas pipeline is already built, 2 Km from the site; the propose project will only install an extension to the site, which will run along the highway.

CFE will also build a transmission line, this is however a separate project, prepared by a different division of CFE (Gerencia de Proyectos de Líneas de Transmisión) and awarded in a different bidding process.

C. Fiduciary

Procurement Capacity Assessment: CFE is the second-largest government company in the country. Its performance in procurement was reviewed against international standards in the recent review of the federal procurement and FM systems. The experience, capacity and organization of CFE is more than adequate to carry out highly complex procurement procedures, such as that required for the Project.

Prior Review Thresholds: The Bank and CFE had agreed on a schedule of reviews including the bidding documents, advertisement and the bid evaluation report under special arrangements that will ensure confidentiality of the award until it is final.

Financial Management Assessment: The Mexico Country Financial Accountability Assessment (CFAA) was completed in October 2003. This assessment focused on the federal public sector, which was considered to have generally sound Financial Management (FM) systems and institutions. Country FM risk was rated moderate, and all individual risk factors were rated low or moderate. The results of the CFAA have an indirect impact on this project, as funds will flow into Mexico's public FM systems

(CFE) and through a third party (bid winner). The Bank has recently supported government efforts to strengthen some of the areas considered by the CFAA to be opportunities for improvement, such as the accounting processes and information systems. Specifically for the Solar Thermal Hybrid Project Agua Prieta II, the Bank has carried out a Financial Management Assessment (FMA), which concluded that the project design allows for an appropriate level of transparency that will facilitate oversight and control while also supporting smooth implementation.

Based on this analysis, the regional financial management team (LCSFM) has determined that the project risk is Moderate and has concluded the following:

(i) The CFE has an adequate internal control environment, capable people, a well-organized office, and good segregation of duties; (ii) Although the project will only involve a small number of payments (approximately three) from CFE to the bid winner, it involves a large amount so the inherent risk is moderate; (iii) Prior to project implementation certain actions will be required to strengthen program financial management, e.g. implementation of the project's Operational Manual (OM), fine-tuning of agreed audit arrangements, and the final format of the Disbursement Report; (iv) The financial agent NAFIN will provide implementation support and oversight based on its many years of experience with Bank-financed projects; (v) For disbursement purposes, the recognition of expenditures will be upon the payments from CFE to the bid winner; (vi) Considering project's characteristics at least two financial management supervision missions (FMSM) will be conducted during the first implementing year, and one FMSM during the following years; and a Bank financial management specialist will review the annual audit reports.

D. Social

The project is located in the Municipality of Agua Prieta, approximately 6.2 Km from Agua Prieta City. The 2000 National Census reported a total number of 63,942 inhabitants living in the municipality, with 99.87 percent of them residing in the Agua Prieta City. The industrial sector is the main source of economic activities in the area. During the preparation of the project, a social screening was conducted. The result of the screening showed that the construction and operation of the project will not cause any adverse social impacts.

The project is located in an isolated area, with good access via federal roads. The installation and operation of the plant requires an area of about 118-120 hectares.

The land where the project will be installed belongs to one legal private owner, and currently it does not have any productive or social use. The owner is willing to sell his property to CFE, and in accordance with the Mexican law, the value of the property will be appraised based on its commercial value.

The project is already included in the Municipal Development Plan and it will not create any conflict with other future development plans and/or proposed land uses.

A public consultation was held by CFE on May 4, 2006 with the attendance of representatives of local authorities, associations, mass media, NGOs, labor unions, and community members. The results of the consultation were positive. In general terms the participants welcomed the construction and operation of this innovative technological arrangement. Details of the consultation are provided in Annex 10.

In terms of positive impacts, the project will generate 660 jobs during the pre-construction and construction phases. Of these, 450 will be provided to non-qualified labor. CFE expects these positions to be filled with local people. The more specialized work force is generally hired from the region or State.

During the construction and operation of the project CFE will implement a number of community activities; these are described in detailed in the Environmental Management Plan[10].

Under the above-mentioned conditions, this project is not expected to have any significant social impacts, and as such is considered a Category B project.

E. Environment

The project site for the Agua Prieta II Integrated Solar Combined Cycle System (ISCCS) is located in the northern part of Mexico, between the City of Agua Prieta, State of Sonora, and the City of Douglas, Arizona (see Figure 1 in Annex 10). This is a desert zone, with very low precipitation and a high incidence of solar radiation. Though some small scale agricultural production exists, the main source of income for the region comes from industrial activities, mainly manufacturing.

The region surrounding the project site has been significantly affected by human intervention. The municipality of Agua Prieta, approximately 6 kilometers east of the project site, has a population of approximately 64,000 inhabitants. Utilities (water, electricity, sewage) cover 100% of the population in the Agua Prieta municipality. The city has been growing slowly towards the south, where most of the industries are located. The Naco-Nogales combined cycle gas power plant is 7 kilometers south-east. Oxidating lagoons for the water treatment plant for the city can be found east of the site, in the outskirts of the urban area. The construction of the plant will include an 8 inch water pipeline which will be aligned to the right of way already given by the highway that connects the site to the oxidation lagoons[11]. In addition, other industries such as quarries and assembly plants (maquiladoras) can be found in the region.

In terms of fuel supply, the plant will run on natural gas. The natural gas pipeline is already built, 2 Km from the site; the propose project will only install an extension to the site, which will run along the highway.

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[10] Available in the Project files.
[11] The water pipeline will supply 21 L/sec from the oxidation lagoons at the Municipal wastewater treatment plant to the site.

CFE will also build a transmission line, this is however a separate project, prepared by a different division of CFE (Gerencia de Proyectos de Líneas de Transmisión) and awarded in a different bidding process. Therefore, the proposed project does not include the installation of a transmission line.

No new access roads will be constructed as the site is adjacent to a local highway, however there will be access roads inside the site as in any other power generation facility.

The project site is located far away from any sort of protected or environmentally sensitive areas: the closest federally protected area is approximately 12 Kms away, the closest priority protection area is about 13 Kms away, and the closest priority area for the protection of birds is approximately 200 Kms away. Additionally, the project location is sufficiently far away from the urban area (City of Agua Prieta), so no potential socio-economic or land use conflicts are expected.

The environmental impacts associated with the Agua Prieta II Integrated Solar Combined Cycle System (ISCCS) project are expected to be minimal given the type of intervention and the physical characteristics of the area where it will be located. This project will help meet growing demand for electricity in the region, and the operation of the solar component will have positive environmental impacts due to the reduction of CO_2 emissions.

The main environmental impacts expected from this project are related to the disposal of hazardous waste material and the emission of air pollutants. Waste material is expected to be generated at all stages of the development of the power plant. The main types of expected waste pollutants are lubricant oils, contaminated soils, insulators, and solvents.

An EMP was prepared to deal with these issues (as well as other potential impacts such as noise and impacts on local flora and fauna) and included in the EA. With regards to emission of air pollutants, climate dispersion models show that air pollution impacts from the operation of the power plant will be very low, and will typically range from 5%-50% of the official standard established by the Mexican Ministry of Environment and Natural Resources (SEMARNAT). Table 1 in Annex 10 provides a summary of the main impacts and the proposed mitigation strategies.

Under the above-mentioned conditions, this project is not expected to have any significant environmental impacts, and as such is considered a Category B project.

Environmental Assessment, EMP and Environmental License

In accordance with the Mexican legal framework, CFE prepared an Environmental Impact Assessment (EIA) and obtained an environmental license for the project.

Based on these documents and the screening of the Agua Prieta II site, CFE prepared an Environmental Assessment Report to meet Bank requirements. In addition, CFE prepared an Environmental Management Plan (EMP)[12].

Capacity Assessment

CFE is highly qualified to address the identified environmental impacts and manage the social and environmental aspects of the project including all the activities described in the Environmental Management Plan (EMP). The project will be supervised by the Social Development and Environmental Offices at the central level in CFE and by an environmental specialist at the site.

F. Safeguard policies

The Project has been categorized as "B".

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment (OP/BP 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 (OP/BP 4.10)	[ ]	[X]
Forests (OP/BP 4.36)	[ ]	[X]
Safety of Dams (OP/BP 4.37)	[ ]	[X]
Projects in Disputed Areas (OP/BP 7.60)*	[ ]	[X]
Projects on International Waterways (OP/BP 7.50)	[ ]	[X]

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.

G. Policy Exceptions and Readiness

The operation complies with all applicable Bank policies.

[12] The EA and EMP are available in the project files.

* *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 or Program Background

OVERVIEW AND CHALLENGES OF ENERGY SECTOR IN MEXICO

Hydrocarbons Sector

The energy sector in Mexico has been essential to the economic strategy of the country since the nationalization of foreign oil companies and the creation of PEMEX in 1938. After the international oil crisis in 1973-1974, the government decided to increase investments in oil exploration and production. With the discovery of new oil fields during the early 1980s, Mexico shifted from being an oil importer to becoming a net oil exporter. In 2004, Mexico ranked as the world's fifth-largest oil producer (including crude, lease condensate, natural gas liquids, and refinery gain), behind Saudi Arabia, Russia, the US and Iran.[13] Today Mexico is a major non-OPEC oil producer and has one of the largest oil utilities of the world (PEMEX).

Despite the success and significant oil revenues, PEMEX is the world's most indebted oil company, with a net debt of about 32 billion USD (2003). Historically, the Federal government has relied on PEMEX for about one third of its budget, with PEMEX and its subsidiaries turning over an estimated 60% of their annual revenues to Treasury (Hacienda) for the financing of key social and infrastructure programs on health, education and other. Both PEMEX and the national budget are therefore highly vulnerable to fluctuations in international oil prices and other shocks affecting the oil market.

Overall, PEMEX's financial obligations to the government complicate the implementation of a sound program of investments and capital expenditures, which is considered essential to sustain efficient production levels and increase proven hydrocarbon reserves. Reforms to the institutional and fiscal structures that link PEMEX to Hacienda as well as measures to promote private sector participation in the industry have been proposed by several administrations. However, these proposals have found little congressional support.

Natural Gas

Mexico has the sixth-largest natural gas reserves in the Western Hemisphere (after USA, Venezuela, Canada, Argentina and Bolivia). Yet, over the last decade the domestic demand for natural gas has outpaced the national production due mainly to the gradual installation/construction of natural gas based electricity generating plants (OCGTs, CCGTs). Today, Mexico imports about 15-20 percent of its domestic demand for natural gas from the US and it is becoming increasingly vulnerable to price fluctuations. The increasing dependence on natural gas imports and associated high prices has led the Fox administration to prioritize the implementation of a strategic plan aimed at increasing domestic natural gas production and lowering dependence on imports (Strategic Gas Plan). The plan includes the following measures:

- Increase natural gas production through Multiple Service Contracts

[13] Preliminary estimates, first three quarters 2004; EIA, DOE, 2004. Mexico Country Analysis Brief.

- Diversify natural gas supply import sources and increase LNG imports
- Reduce the flaring of associated natural gas
- Expand natural gas transport, distribution and storage facilities (strengthen interconnection capacity of pipeline grid with US)
- Allocate more exploration funding to increase proven reserves

Mexico's downstream natural gas market has been open to private investors since the passage of the 1995 Natural Gas Law. The constitution was modified to allow private companies to become involved in natural gas transportation, storage, and distribution.

Electricity Sector

The electricity sector in Mexico is characterized by a capacity stock that includes 8,250 MW of gas based independent power production (IPPs), 10,268 MW of hydroelectric capacity, 22,691 MW of thermoelectric capacity (including fuel oil and diesel), 2,600 of coal based power plants, 1,365 of nuclear capacity and 2.18 MW of wind generation for a total installed capacity of 46,137 MW as of 2005. The national interconnected system has about 45,000 km of transmission and distribution lines.

Mexico has two electricity companies: Luz y Fuerza del Centro (LFyC) which serves the Mexico City metropolitan area (roughly 5 million users) and the Federal Commission of Electricity (CFE) which serves the rest of the country. Despite the strong technical capabilities of the Federal Electricity Commission (CFE), one of the largest state-owned utilities in Latin America, the sector presents a number of challenges on the technical efficiency and quality of service fronts and across segments. In addition, as in the case of PEMEX, CFE's interdependence with Hacienda complicates the financing structure and the decision making process regarding investments and consequently the sustainability and future evolution of the company.

One of the most important concerns of internal and external analysts focuses on the tariff structure and the level and design of the electricity subsidy. For instance, the residential electricity subsidies are highly regressive. The upper middle income households (income deciles 6, 7, 8) receive the majority of the consumption subsidy. Despite steady tariff increases over the past 15 years, average tariff levels do not cover the costs of providing the service. The overall degree of cost recovery has been quite stable averaging about two thirds of total costs in the period 1997-2003. In general, it is recognized that the system lacks a coherent national policy framework for setting –and linking- electricity tariffs, subsidies and cost-recovery goals. Since the early 1990s, different governments have proposed different models for the liberalization and reform of the power sector. However, these proposals have been the source of great political debate, public opposition and congressional rejection.

ELECTRICITY SECTOR IN MEXICO

The sector is organized around two state enterprises, CFE and *Luz y Fuerza del Centro*, with 85 percent and 4 percent of generating capacity, respectively (including IPPs). PEMEX controls 2 percent; the remainder is in private self-generation. Mexico generated about 231 Terawatt-hours (TWh) of electricity in 2004, 14 percent of which was geothermal and hydropower. About 73 percent of Mexico's installed power generation capacity of 52 GW is fossil-based, with oil-fired plants, including combustion turbines, responsible for the largest share of both capacities (43 percent) and generation (49 percent). Coal plants account for 12 percent of total generation and 7 percent of capacity. Combustion turbine plants comprise less than 8 percent of total generation and are used largely for meeting demands at peak and in isolated areas. Gas-fired plants represent more than 19 percent of generation, about the same share as hydro, with just under 14 percent of total generation capacity.

Table 1 below shows the expected evolution of capacity and output in the country's electricity sector through 2014:

Table 1.1: Projected Electricity Generation, 2004–2014

Capacity (MW)	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
SEN	46,552	46,228	48,780	50,708	51,320	53,173	54,026	55,154	58,686	61,567	64,210
Other	5,475	5,507	5,556	5,556	5,556	5,556	5,830	6,031	6,031	6,031	6,031
Total Capacity	42,411	45,782	50,174	51,258	52,133	55,382	57,704	58,948	62,110	65,714	69,013
Generation (GWh)											
SEN	208,634	219,597	231,135	243,280	256,063	269,518	283,680	298,586	314,275	330,788	348,169
Other	27,793	27,998	28,175	28,175	28,175	28,175	30,427	32,179	32,179	32,179	32,179
Total Generation	209,626	216,033	231,595	243,066	256,143	273,645	289,178	305,137	322,836	341,390	360,621

Source: SENER *Prospectiva del Sector Eléctrico* 2005-2014

Peak demand has risen steadily in recent years, moving from about 18.6 GW in 1990 to 27.3 GW in 2003, an average annual growth rate of just under 4 percent. Peak demand in 2004 was just 8 percent above that in 2000, with a decrease of 0.6 percent from 2003 to 2004. In spite of the slow increase in demand, reserve margins fell throughout the 1990s. Consequently, the country has found it necessary to obtain new generating capacity from private sources. Initially CFE made use of the build-operate-transfer model (BOT) and obtained about 1,100 MW of new combined cycle capacity in the mid-to-late 1990s. Since then, the private investors have preferred the IPP approach, especially with the relative ease of using an approved contract model for purchase of power and building permits. Of more than 5,500 MW of new permitted generating capacity under construction, more than 70 percent uses the IPP contracting model.

With peak demand growing slowly, if at all, the pressing need to construct new capacity has been reduced. However, keeping older plants on line means (i) higher fuel consumption rates; (ii) more emissions of virtually all types; and (iii) more unplanned outages, as older facilities suffer from reduced reliability.[14] The total capacity of all plants expected to be completed by 2010 is approximately 11.9 GW, slightly below the expected increase in peak demand, but only 45 percent of the current permitted plant are under construction. In other words, if *all* plants in process are completed before 2010, the system reserve capacity will not fall much. However, not all plants in process are likely to be completed before 2010 and the increase in peak demand is likely to be greater than the increase in generation capacity.[15] A look at the 2000 *Prospectiva*

[14] The *Prospectiva* shows more than 5 GW of retirements during the period. However, without a more rapid rate of construction, some of these older plants are likely to be kept in service.

[15] The current *Prospectiva* indicates that both total and operating reserves will fall below desired levels by the end of the planning period in 2014.

indicates that the country is about 5 GW behind where it had expected to be with regard to new generating capacity.

The most important element of Mexico's power sector development is the considerable rearrangement of the fuel mix expected by 2014, shown below, which indicates a doubling of natural gas use and the 50 percent increase in coal for generation.

Table 1.2: Change in Fuel Consumption for Power Generation: 2004-2014 (TOE/year)

	2004	2014	percent Change
Natural Gas	14,783	30,407	105.68 percent
Coal	5,347	7,901	47.77 percent
Fuel Oil	14,364	9,591	-33.23 percent
Diesel	349	163	-53.22 percent
Total	**34,844**	**48,063**	**37.94 percent**

Source: *Prospectiva del Sector Eléctrico* 2005-2014

At the present time, plans for new coal-fired capacity are limited to the *Carboeléctrica del Pacífico* plant which was bid in 2005. The 33 percent fall in fuel oil use is contingent on sufficient new gas and coal capacity being built to take up the expected 5-6 GW of retired fuel-oil generation over the next 5-10 years.

The Mexican Constitution reserves power supply and distribution as an exclusive right of the state. Since 1992, reformist elements in government have attempted to chip away at this public monopoly through amendments to the Electricity Law to permit private participation through IPPs and self-supply schemes. Private power in various forms currently accounts for 30 about percent of Mexican electricity generation.

The Constitution mandates least-cost procurement of electricity generation sources, and CFE employs a relatively strict interpretation of this mandate. This approach has resulted in the current trend toward combined cycle gas resources, while making it particularly difficult for renewable energy sources to compete. While SENER has authority to specify how this mandate is interpreted, it has only relatively recently begun to do so, and is now seeking to incorporate a range of metrics other than simply financial cost, including energy price and supply diversification, environmental benefits, tax and other financial considerations for different energy types, and previously unrecognized attributes in clean energy sources (including carbon revenues). However, integrating these considerations into cost benefit and economic analysis of projects will take perhaps some years.

Program of Investments Electricity Sector (POISE)

The Federal Commission of Electricity (CFE) prepares every year a prospective ten year program of works and investments for the electricity sector (known as POISE). This program is used to negotiate the annual CFE budget with Hacienda for congress approval. The POISE program integrates security-of-supply and diversification policies considering least cost economic and financial considerations. The program is based on a number of models used internationally to plan the evolution of electricity sectors. CFE has also developed its own domestic models to simulate scenarios and the future composition of the capacity stock.

Renewable Energy Sources

Currently, only a small portion of Mexico's total energy needs are met by renewable energy sources other than large hydro. But, while hydroelectricity which represents more than 25 percent of installed capacity, it only represents about 18 percent of total generation. The only other major non-conventional energy source is geothermal, with less than 5 percent of both capacity and generation. Over the next decade, hydro and geothermal will gradually reduce their shares of generation to about 15 percent, with most hydro being used to meet peak demand, further replacing older combustion turbine units. Current wind installations include 2 MW from La Venta I, and will shortly be augmented with the CFE-owned 85 MW La Venta II turnkey project. Solar photovoltaic installed capacity, which is not connected to the grid, accounts for 26 MW.

Baseline projections. Current projections considering available resources and the existing legal and institutional framework estimate that renewable energy capacity for the public service will grow by 2,900 MW over the 2004-2014 period (from 11,492 MW to 14,389 MW). Excepting large hydro and geothermal projects, the scenario of renewable growth capacity between 2004 and 2014, is reduced dramatically to only 643 MW – a small figure when compared to the additional 27,357 MW in total generation capacity which must be built during this period to meet demand.

Table 1.3: Baseline Renewable Energy Capacity Additions 2001-2010 (MW)

	Installed Capacity (MW)									
Technology	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Wind CFE	2	2	88	88	189	290	391	492	593	593	593
Wind self-supply	0	0	0	0	200	800	1000	1000	1000	1000	1000
Large hydro CFE	10222	10222	10222	10976	10976	10976	10976	11876	11876	11876	12476
Small hydro CFE	308	308	308	308	308	308	308	308	308	308	308
Small hydro self-supply	59	59	74	89	89	89	89	89	89	89	89
Biomass self-supply*	287	287	287	287	287	287	287	287	287	287	287
Geothermal CFE	960	960	960	960	960	960	1010	1010	1010	1010	1010
Total	**11,838**	**11,838**	**11,939**	**12,708**	**13,009**	**13,710**	**14,061**	**15,062**	**15,163**	**15,163**	**15,763**

Off grid	
Wind	3
Solar PV (off-grid)	26

*Includes mainly bagasse, landfill gas, wastewater treatment gas, and black liquor
Source: *Prospectiva del Sector Eléctrico* 2001-2010, *Secretaría de Energía*; CRE;

Potential renewable energy sources are significant, however:

Wind. The best wind resources are located in the southeastern region of Oaxaca, with an excellent resource (power Class 5 and above) widespread in the Isthmus region. NREL estimates that there are about 6600 km^2 of windy land with good-to-excellent wind resource potential in Oaxaca (Class 7). Other good wind resources are located throughout the country in specific locations. Wind costs have declined by 12-18 percent with each doubling of global capacity, and costs are now half those of 1990 at under 6 cents per kWh. Given recent increases and volatility in gas prices, wind is currently quite close to being competitive with conventional generation sources, even gas IGCC. Countervailing pressures – including high levels of international demand due to feed-in laws and other incentives, as well as upward pressure on steel prices – have dampened cost reductions somewhat, but the cost of wind energy is expected to continue its decline. Future reductions from site optimization, improved blade and generator design, and electronic control continue to provide price reduction potential on the technology side.

Hydro-electricity. While a significant share of the large hydro potential has already been tapped, small hydroelectric facilities are again coming of age, with private investors developing self-supply projects within the framework of the Electricity Law and some including carbon finance under CDM. Most of these projects are being developed using existing infrastructure, including irrigation dams and channels. While detailed estimates require considerable site-specific information, IIE and CFE data point to up to 3,300 MW for individual plant capacity under 10 MW. Projects involving already existing dams may have capital investment costs as low as 500 US$/kW. CDM revenues may further assist in reducing costs. Barriers to development include complications in permitting (especially in connection with water rights and land ownership), and agricultural dams may be constrained by priority of agricultural releases and may thus not be judged as firm capacity.

Bio-electricity. The potential for large-scale electricity generation with bioenergy is substantial, with IIE estimating a technical limit for bioenergy power generation with of up to 23,000 MW. However, under more practical considerations, a capacity of 1,800 MW could be commercially developed, with potential levelized costs well within the range of current electric tariffs in Mexico. CDM benefits could improve competitiveness of bio-electricity by a factor of up to 58 percent (for projects involving methane). A number of investors are interested in capturing and burning biogas from these sources to obtain CDM benefits without producing electricity. Most biomass-to-electricity projects would be small (under 1 MW), making project development difficult and costly. In some cases biomass sources could be aggregated to power a larger electricity project, but field studies are necessary to determine the potential of this option.

Solar. Mexico receives significant solar insolation across much of its geography. Over 14 MW of solar photovoltaic systems are in place, mostly for rural applications and water pumping. The solar thermal hybrid project proposed in this document will add about 31 MW of solar capacity to the system. In addition, a range of off-grid photovoltaic (PV) applications will continue to be developed (some with GEF support under a rural electrification project under preparation), and there is some potential for grid-connected applications.

Key Barriers to Renewable Development

The existing Constitutional mandate of CFE is to acquire energy at "least cost." However, while combined cycle gas turbines may typically emerge as the least cost power source at a given point in time, gas price fluctuations (which have been significant in Mexico over the last several years) can upset this metric. As CFE carries the entire gas price risk for IPPs, the acquisition of least cost generation sources does not necessarily equate over time with least cost generation. The volatility of such price impacts can be further magnified by the high level of concentration in CCGTs which is emerging in Mexico. Under the Electricity Law, SENER has the legal mandate to define what least cost means in operational terms, but has heretofore not exercised this mandate due to limitations in institutional and technical capacity. A broader definition of least cost would include:

- recognition of partial capacity value of seasonal or intermittent renewable resources,
- recognition of the energy portfolio diversification value of renewables
- internalization of local/regional environment values, and
- capture of global environmental value.

Widespread adoption of renewables would not displace major quantities of natural gas, but would complement gas while diminishing risks. In addition, accessing and maximizing the value of potential carbon credits would facilitate local and industrial development by making additional technologies and projects more profitable. While there is currently broad opportunity to open the renewable energy market, this opportunity is time-limited: Mexico's efforts to expand the rate of gas-fired power installations, and the resulting increase in gas demand, are being met with an aggressive program to develop LNG port and distribution systems. Once this LNG infrastructure is in place, it may become psychologically and politically more difficult to promote renewables. It is expected that current growth and gas price/supply pressures, coupled with a significant political commitment and with analytical tasks now underway to address these factors, will facilitate progress on a broader definition of 'least cost'.

The enabling environment created under the Law for Public Electrical Energy Service (Article 3 regarding self-supply schemes) by Mexico has stimulated some action. Almost 900 MW of other wind farms are in various stages of planning by up to 7 different private sponsors, with each of these projects contemplate wheeling and third-party power sales agreements to nearby industries and municipalities (who currently pay high average-cost tariffs). While providing an initial opening, the transaction and structuring costs of such projects are high, and some uncertainties remain in the regulatory arrangements, limiting their value as a critical mass for a sustainable market.[16]

Important Policy Initiatives Related to Renewables

The project benefits from two highly important policy initiatives that have occurred during the course of project preparation (and at least in part in response to activities and dialogue associated with project):

Accelerated Depreciation. Changes to the investment tax code (*Ley del Impuesto Sobre la Renta*) now make 100 percent of investment in renewable energy technologies after January 2005 eligible for depreciation in the first year (the law includes a clause that the technologies so supported must operate for at least five years). There is no provision for tax crediting, and tax

[16] These plants are in addition to CFE's own 85 MW wind farm, La Venta II, which is now being built on a turnkey basis as an in-house demonstration project and not as an IPP or 'self-generation' project.

credit may only be deducted if tax is owed. Thus, the scope of the policy depends on the taxpayer, with large companies potentially able to depreciate all investment immediately, and a small company potentially requiring a number of years to claim the entire depreciation. Under modeling performed for project preparation, the potential benefit ranges from approximately 0.35 US cents/kWh for a smaller company and up to 1.05 US cents/kWh for a larger company.

Renewable Energy Law. A Renewable Energy Law was tabled in April 2005, and in December 2005 was passed by the lower house of the Congress. Final approval by the Senate is anticipated in mid-2006.

The Law specifies a range of conditions for development of promotional strategies and establishment of suggested national targets for renewable energy in the medium term, and from the perspective of addressing energy diversification, industrial development, and country competitiveness. It prescribes steps to address the acquisition and dispatch of renewable energy sources, including treatment for calculating capacity value for intermittent resources and treating these aspects in tariffs to adequately incentivize renewable energy sources. It provides a framework for further analysis of defining 'least-cost' sources via a variety of methods and perspectives.

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

Following a long period of low engagement by the World Bank in the energy sector in Mexico, a wide range of related projects is now under development, (supervision PSR ratings not available), including:

- The Competitiveness Development Policy Loan contains a substantial energy sector component. No fundamental energy sector reforms are supported under the DPL, but the operation promotes sector transparency and performance monitoring, both important elements in promoting sector efficiency.
- SENER requested Bank assistance to develop a national rural electrification program primary based on renewable energy and targeting delivery of basic and productive services for the 5 million (and growing) un-served. Sixty percent of this population is indigenous and is concentrated in the Southern States and Veracruz. The proposed $15 million IBRD/$15 million GEF project is targeted for appraisal for early FY'07.
- SENER requested Bank assistance to launch the Large Scale Renewable Energy Development Project. The development objective of the proposed project is to assist Mexico in developing initial experience in commercially-based grid-connected renewable energy applications by supporting construction of an approximately 101 MW IPP wind farm, while building institutional capacity to value, acquire, and manage such resources on a replicable basis. The Project ($25 million GEF grant) has been successfully prepared and appraised. Negotiations are expected May 2006. The Project was approved by the Board on June 29th, 2006.
- Several Carbon Finance projects are being pursued including wind (La Venta II), gas flaring reduction and energy efficiency. Following-on from a successfully implemented first-in-LAC GEF project in Monterrey, a second landfill gas capture site is being developed in Monterrey, as well as another gas capture facility in Guadalajara. There is substantial additional potential for carbon finance in the Mexican urban-waste-to-energy sector.
- An ESMAP technical assistance grant supports a pilot project in financial intermediation for energy efficiency. New ESMAP assistance is planned for energy efficient housing and national strategy for energy efficiency.
- SENER has been an active participant in the energy-environment component of the Environment Sectoral Adjustment Loan and the follow-on Development Policy Loan, described in Annex 4.

Other related World Bank projects include:

- Integrated Solar Thermal Combined Cycle Power Project for Morocco (in preparation)
- Integrated Solar Thermal Combined Cycle Power Project for Egypt (in preparation)

Carbon Finance projects in the World Bank's Latin America and Caribbean portfolio:

- Nova Gerar Landfill Gas, Brazil
- Alta Mogiana Sugar Bagasse Cogeneration, Brazil
- Lages Woodwaste Cogen Facility, Brazil
- Chacaboquito Run-of-River Hydro, Chile
- Hornitos Hydro, Chile
- Quilleco Hydro Power, Chile
- Jeparachi Wind Power, Colombia
- Rio Amoya Run-of-River Hydro, Colombia
- Furatena Energy Efficiency and Rural Development Project, Colombia
- Cote Run-of-River Hydro, Costa Rica
- Abanico Hydro, Ecuador
- Skeldon Sugar Modernization Project, Guyana
- La Esperanza Hydroelectric Development, Honduras
- Poechos Hydroelectric Plant, Peru
- Santa Rosa Hydroelectric Project, Peru
- Huaycoloro Landfill Gas Recovery, Peru

Wind Farm projects in the World Bank's Carbon Finance portfolio:

- NorthWind Bangui Bay Project, Phillippines
- Huitengxile Wind Farm, China
- Burgos Wind Power Project, Philippines
- Bahia Wind Irrigation, Brazil
- Shandong Luneng Jiaodong Wind Farm Project, China
- Puck Wind Farm Project, Poland

Other Development Agencies:

- UNDP/GEF: Action Plan for Removing Barriers to the Full-Scale Implementation of Wind Power in Mexico (Phase 1), October 15, 2002
- GEF/UNDP China: Capacity Building for the Rapid Commercialization of Renewable Energy
- BMZ/GTZ: Promotion of Renewable Energies in Mexico (PROMOVER)
- USAID: Various technical assistance projects

Annex 3: Results Framework and Monitoring

Results Framework

The results framework is described in the table below:

PDO	Project Outcome Indicators	Use of Project Outcome Information
1. Demonstrate the operation of an ISCCS in Mexico 2. Reduction of CO_2 emissions, which contribute to global climate change, relative to business as usual. 3. Reduction of long-term costs of ISCCS technology	1. Total electricity generated from the solar hybrid project (GWh/y) and Annual average efficiency of solar input to electric output (%) Has the integration between the thermal and solar components been successful? 2. Reduction of annual CO_2 emissions (a minimum of 20kt of CO2/year). 3. Solar Thermal Power Plant costs in ¢ / kWh Energy levelized costs	Monitor generation output (production and dispatching) Monitor solar generation cost and determine if change in operation of solar/ISCC plant is necessary to maximize solar output. Report annually experiences and lessons learned Calculate CO2 emission reductions Report energy levelized costs
Intermediate Outcomes	**Intermediate Outcome Indicators**	**Use of Intermediate Outcome Monitoring**
Components 1&2: The operational viability of solar thermal power generation is demonstrated in Mexico.	**Components 1&2:** 1. Yearly global production of electricity of the ISCC plant 2. Yearly contribution of solar electricity	**Components 1&2:** Show that solar thermal plant – a high-end technology - can be constructed and operated efficiently under the conditions of a country such as Mexico 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

The information will be used to track progress towards project development and global objectives and to adjust or improve the operation of the project if necessary during implementation.

Arrangements for results monitoring

		Target Values					Data Collection and Reporting		
Outcome Indicators	**Baseline**	**YR1**	**YR2**	**YR3**	**YR4**	**YR5**	**Frequency and Reports**	**Data Collection Instruments**	**Responsibility for Data Collection**
Reductions in main air pollutants emissions (tons/yr) for CO_2.	0	0	0	12,000	15,500	15,500	Semiannual	Continuous monitoring by CFE	CFE
Annual average efficiency of solar input to electric output	0	>12%	>12%	>12%	>12%	>12%	Semiannual	Continuous monitoring by CFE	CFE
Results Indicators for Each Component									
Components 1&2 :									
Yearly production of electricity (GWh)	0	0	0	3,000	3700	3700	Semiannual	Continuous monitoring by CFE	CFE
Yearly generation of solar electricity (GWh)	0	0	0	35	70	70	Semiannual	Continuous monitoring by CFE	CFE

Arrangements for Results Monitoring

Institutional Arrangements

CFE-Investment Projects will be in charge of monitoring and reporting activities.

CFE-CENACE will confirm the data on actual production and dispatch of the hybrid plant.

CFE-Instruments and Calibration Division will verify the quality of the monitoring activities and data collection.

Data Collection

Data collection is the responsibility of CFE (operator and dispatch center).

Capacity

It has been assessed that CFE has the capacity to undertake project monitoring and evaluation responsibilities. The Ministry of Energy (SENER) will support CFE with an additional review of data on key outcomes and indicators when considered relevant or necessary given their functions.

Transparency and Public Disclosure

On August 11, 2005, the Federal Official Diary (DOF) published the COFEMER (*Comisión Federal para la Reforma Regulatoria)* agreement that establishes the rules to present programs associated with regulatory improvement across sectors and decentralized government bodies of the Federal Public Administration. The measures established for the electricity sector include, among other:

- Perform independent transparent regulatory accounting of electricity tariffs and other works and services, based on best international practice. This measure will disclose the economic and operative performance of each of the plants that compose the generating stock as well as the fixed and variable costs associated with the transmission and distribution segments.
- Implement transparency measures and public disclosure (rendicion de cuentas) focused on State owned electricity enterprises and subsidiaries (CFE, LFC). These include the disclosure of a) dispatch rules and operations, b) short and long run marginal costs and c) managerial, economic and quality of service indicators (among others) to SENER, SHCP and CRE.

Although the programs and mechanisms to establish these measures are still being designed, it is expected that they will be operative in the short term.

In the meanwhile, CFE will be responsible for reporting project outcome and indicators. During scheduled supervision missions, the Bank will be allowed to analyze the data and verify its quality.

Annex 4: Detailed Project Description

The design, construction and operation of the proposed Integrated Solar Combined Cycle System (ISCCS) include two components:

Component 1. Design and construction of a 31 MW (net) solar field: the solar collector field consists of a large field of single-axis tracking parabolic trough solar collectors.

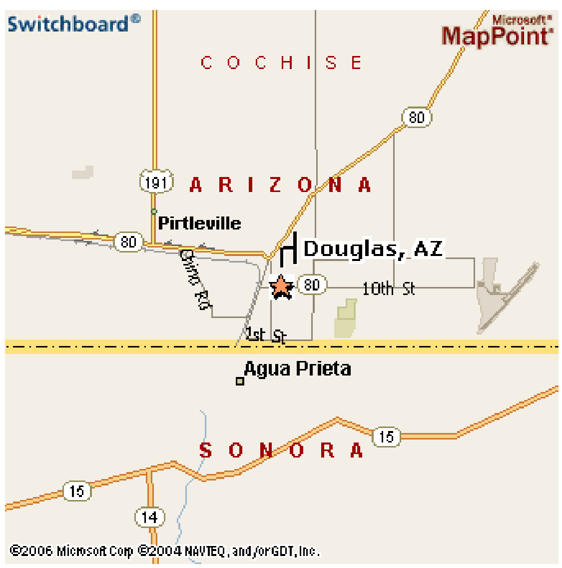
Component 2. Design and, construction of a 485.5 MW (net) gas based thermal plant: the plant is based on a standard configuration that includes two industrial frame combustion turbines each associated with a heat recovery steam generator (HRSG) and a steam turbine.

The proposed project will only finance component 1, as indicated in the Table below.

Project Location

The project will be located in the Municipality of Agua Prieta, State of Sonora, 6.2 Km from the Agua Prieta City and 2 Km from the borderline with USA. The site is located at: N. Lat. 31 º 13' 31.79" W. long. 109º 36.37' 37.83" in Mexico. The altitude is 1256 meters above mean sea level.

Figure 4.1 Site Location



The Northern States of Mexico, and particularly Sonora are located within the world's solar belt, where the direct normal insolation (DNI) is the highest and the potential to develop solar energy is the best.
Project Description

The Agua Prieta II ISCCS project will have a net thermal capacity of 485.5 MW including a solar field of about 31 MW (peak).

The project is based on a configuration with two industrial frame combustion turbines each associated with a heat recovery steam generator (HRSG) and one steam turbine. This standard configuration is typically referred to as 2x2x1.

The solar component consists of large field of single-axis tracking parabolic trough solar collectors. The solar collector field is modular and is composed of many parallel rows of solar collectors aligned on a north-south horizontal axis. Each solar collector has a linear parabolic-shaped reflector that focuses the sun's direct beam radiation on a linear receiver, filled with a heat transfer fluid (HTF) located at the focus of the parabola.

The collectors track the sun from East to West during the day to ensure that the sun is continuously focused on the linear receiver. The HFT is heated as it circulates through the receiver and returns to a series of heat exchangers in the power block where the HFT is used to generate high-pressure superheated steam.

The superheated steam supplements steam from the HRSG to a conventional reheat steam turbine generators to produce electricity. The spent steam from the turbine is condensed in a standard condenser and returned to the heat exchangers via condensate and feedwater pumps to be transformed back into steam. After passing through the HTF side of the solar heat exchangers, the cooled HTF is re-circulated through the solar field.

Figure 4.2 Technological Arrangement

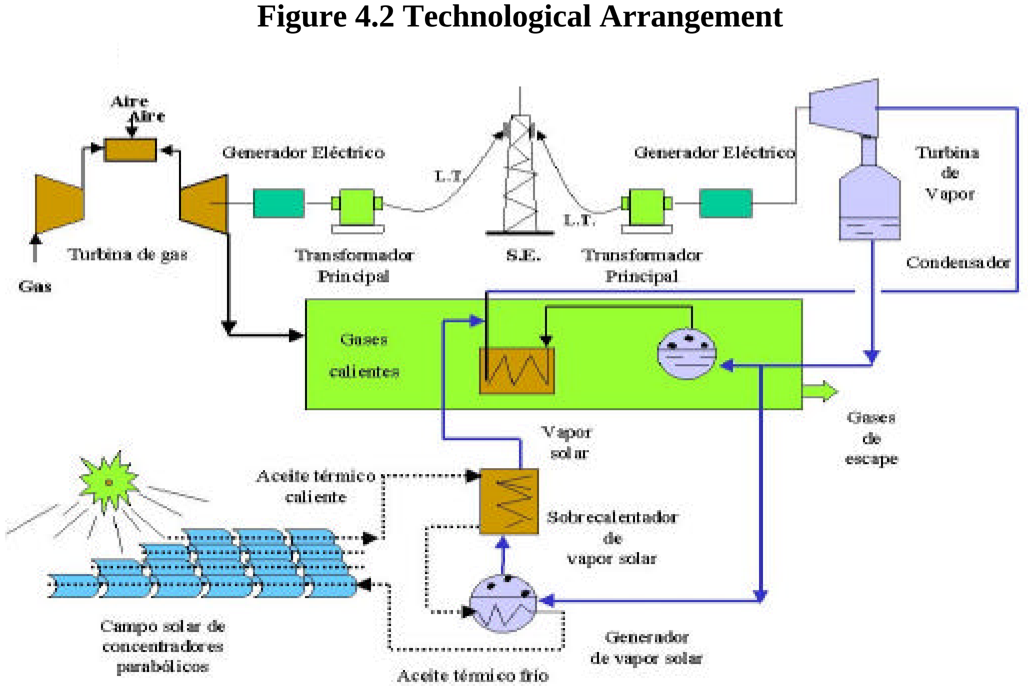
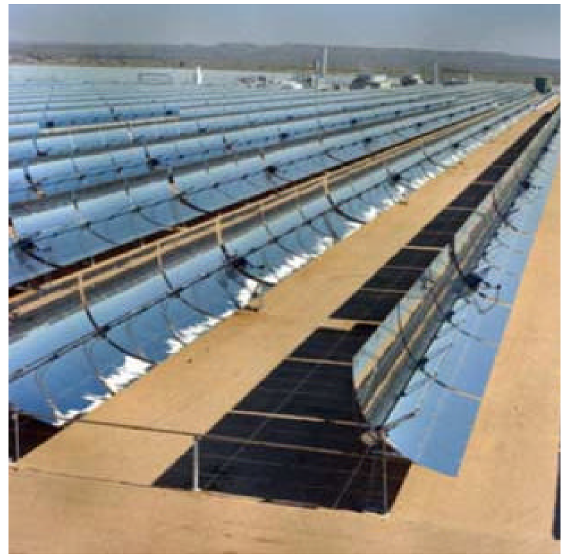


Figure 4.3 Pictures of an ISCCS



Due to the low availability of water in the region, an air cooled condenser will be used. The water supply will be gray water from a municipal sewage system/storage tank (oxidation lagoons located 5 Km from the site). The gray water will be processed to produce boiler quality makeup water for the power plant operation as well as suitable water for cleaning of the solar trough components.

Parabolic trough technology is currently the most proven solar thermal electric technology. This is primarily due to nine large commercial-scale Solar Electric Generating Stations (SEGS), the first of which has been operating in the California Mojave Desert since 1984. These plants, which continue to operate on a daily basis, range in size from 14 to 80 MW and represent a total of 354 MW of installed electric capacity. In addition to the Agua Prieta II project there are various parabolic trough power projects currently in the planning and development stages in Algeria, Australia, Crete, Egypt, Iran, Morocco, Spain and US Nevada.

ISCCS Technology Development and Experience[17]

There are currently three suppliers of solar steam systems using solar trough technology:

- Solel Solar Systems Limited
- Flagsol GmbH
- Solargenix Energy LLC

There are two suppliers of heat collection elements (HCEs). Solel uses their proprietary HCE; Flagsol and Solargenix use HCEs provided by Schott.

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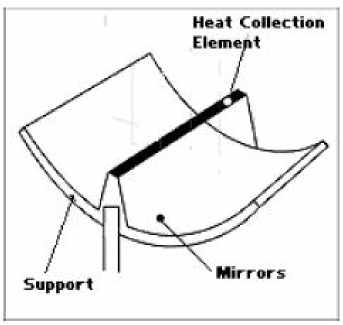
[17] This section is taken from the following source: Sargent & Lundy. November 2004. Feasibility Study of Integrated Solar Combined Cycle System (ISCCS) Mexico, a report for the World Bank (available in the Project Files)

Currently, Flagbeg is the sole supplier of mirrors. Flagbel purchased Pilkington who supplied all the mirrors for the currently commercially operating solar trough plants in the United States.

A. Parabolic Trough Solar Plant

The following review of current parabolic trough technology is focused on the three components that contribute 66% of the total solar field direct cost: support structures (29%), the HCEs (19%), and the mirrors (18%).

Figure 4.4 — Parabolic Trough Components



Support Structures

Both the Luz LS-2 and LS-3 collector, which was the final concentrator design used at the newest SEGS plants (SEGS VII-IX), are considered to represent the state-of-the-art. The thermal performance and alignment maintainability of the LS-3 collector has not proved to be equal to the earlier LS-2 design used on the SEGS IIIX plants and, as such, the LS-2 design is the likely contractor's choice of the two designs. There are at least three new parabolic trough collector structure designs under various stages of development:

- EuroTrough[18]
- Solargenix (Duke Solar)[19]
- Industrial Solar Technology (IST)[20]

The new collectors concentrate on weight reduction and emphasize simplicity of fabrication and a minimum number of required parts. Recent wind tunnel testing has

[18] "EUROTROUGH Design Issues And Prototype Testing At PSA," Proceedings of ASME International Solar Energy Conference - Forum 2001, Solar Energy.
[19] Duke Solar, 2000, "Task 2 Report: New Space-Frame Parabolic Trough Structure," Prepared for NREL by Duke Solar, Raleigh, NC.
[20] IST, 2001, "Collector Development," Presentation at *Solar Forum 2001, Solar Energy*.

provided improved data for use in optimizing the structural design, and reducing the weight, necessary for long-term reliability. Future designs may include more efficient integration of the reflectors into the overall structure, thus sharing the loads and reducing material requirements. Non-metallic materials are being considered, but they may not be cost-effective. Additional cost reductions can be realized by minimization of the number of required parts, simplification of fabrication and field erection reducing labor costs for onsite assembly and erection. This cost reduction potential has not been quantified in this evaluation since there has not been an actual erection of a new collector structure. The individual metal parts of the structure can readily be manufactured by suppliers worldwide, with potential cost reductions through competition.

The selection of the support structure should be based on suppliers that have tested their designs both in wind tunnels and in actual installations. The key operational considerations for the support structure are to ensure alignment (considered during wind loads, which can affect the efficiency) and to minimize mirror breakage due to attachment and other problems.

Heat Collection Elements

There are two suppliers of HCEs. Solel uses their proprietary HCE; Flagsol and Solargenix use HCEs provided by Schott. The Solel UVAC HCE is considered the current state-of-the-art receiver and is expected to be used in the new near-term trough plants. Schott Glass, a large international supplier of specialty glass and related products, has entered into the HCE supply market. Schott has tested their HCE and has been selected by Flagsol and Solargenix. However, start-up of HCE production is a significant cost, and a viable market growth is imperative to justify market continuity for a new supplier.

Sandia National Laboratories (SNL) is investigating new concepts in receiver design that could result in substantially lower cost receivers with nearly the same high performance as the Solel receivers.[21] One of the SNL designs uses a high-temperature gasketing approach for connecting the glass envelope to the metal absorber, in place of the glass-to-metal seal. To reduce convective heat losses, the receiver annulus between the glass and metal tube would be pressurized with an inert gas. Although preliminary data show potential, extensive longterm field-testing is required on any new receiver design to evaluate and validate the reliability and also to assess whether the receiver's life-cycle costs have been lowered. In the last couple of years, the focus of the research has been on evacuated receiver designs. The focus now is on developing a more robust and lower cost glass-to-metal seal design and on identifying higher temperature selective coating with better thermo/optic properties. Sandia has identified new materials that could be used in the glass-to-metal seal to reduce the potential stress in the seal. However, in general, the current "Housekeeper" seal used in the HCE is very expensive and a significant part of

[21] Price, H., and Kearney, D., 1999, "Parabolic-Trough Technology Roadmap: A Pathway for Sustained Commercial Development and Deployment of Parabolic-Trough Technology," NREL/TP-550-24748, NREL, Golden, CO.

the total receiver cost. Sandia has also identified some new glass-to-metal seal options that have the potential to be much lower in cost to manufacture and be more robust at the same time. NREL has been evaluating new selective coatings. Several new cermet coating have been identified that may be easier to manufacture and have better thermo/optic properties. These are multi-layer cermets as opposed to the graded cermet used by Solel. The graded cermets require a sputtered manufacturing process whereas the multilayer coating can probably be deposited with simpler coating processes and should also facilitate better quality control of the final properties. NREL is also investigating changing the materials used in the cermet to give better high-temperature performance and stability.

Alternate HCE designs[22] is various stages of development appear to have a lower cost than the Solel UVAC HCE, but at reduced efficiency levels. Reduced HCE efficiency will result in a lower net annual solar-to-electric efficiency and require a larger collector area. Schott Glass, a large international supplier of specialty glass and related products, has entered the HCE supply market.

<u>Mirrors</u>

Alternatives to glass mirror reflectors have been in service and under development for more than 15 years. It is noted that all the identified alternatives are in various stages of initial development or testing. The major current developments are listed below.

- Thin glass mirrors are as durable as a glass reflector and are relatively lightweight in comparison to thick glass. However, the mirrors are more fragile, which increases handling costs and breakage losses. To address corrosion problems, new thin-glass experimental samples were recently developed and are being tested under controlled conditions.

- 3M is developing a nonmetallic, thin-film reflector that uses a multi-layer Radiant Film technology. The technology employs alternating co-extruded polymer layers of differing refractive indices to create a reflector without the need for a metal reflective layer. 3M plans to develop an improved solar reflector with improved UV screening layers and a top layer hard coat to improve outdoor durability.

- ReflecTech and NREL are jointly developing a laminate reflector material that uses a commercial silvered-polymer reflector base material with a UV-screening film laminated to it to result in outdoor durability. Initial prototype accelerated-exposure test results have been promising, although additional work on material

[22] - Zhang, Q., Zhao, K., Zang, B., Wang, L., Shen, A., Zhou, Z., Lu, D., Xie, D., and Li, B., 1998, "New Cermet Solar Coatings for Solar Thermal Electricity Applications," Solar Energy.
- Morales, A., and Ajona, J. I., 1998, "Durability, Performance and Scalability of Sol-Gel Front Surface Mirrors and Selective Absorbers," *Proc. of 9th International .Symposium on Solar Thermal Concentrating Technologies*.
- San Vicente, G., Morales, A., and Gutiérrez, M. T., 2001, "Preparation and Characterization of Sol-Gel TiO2 Antireflective Coatings for Silicon."

production is needed. The material would also benefit from a hard coat for improved washability.

- Luz Industries Israel created a front-surface mirror that consists of a polymeric substrate with a metal or dielectric adhesion layer; a silver reflective layer; and a proprietary, dense, protective top hard coat.

- SAIC of McLean, Virginia, and NREL have been developing a material called Super Thin Glass. This is also a front-surface mirror concept with a hard coat protective layer.

- Alanod of Germany has developed a front-surface aluminized reflector that uses a polished aluminum substrate, an enhanced aluminum reflective layer, and a protective oxidized alumina topcoat. These reflectors have inadequate durability in industrial environments. A product with a polymeric overcoat to protect the alumina layer has improved durability.

Table 4-1 summarizes the characteristics of the reflector technology alternatives. At this point, thick glass will likely remain the preferred approach for large-scale parabolic trough plants, although alternative reflector technologies may be more important in the future as more advanced trough concentrator designs are developed.

Table 4.1 — Alternate Mirror Technologies

	Weighted Reflectivity %	Cost ($/m^2)	Issues
Flabeg Thick Glass	94	40	Cost, breakage
Thin Glass	93 – 96	15 – 40	Handling, breakage
All-Polymeric	99	10	UV protective coating needed with hard coat
ReflecTech Laminate	>93	10 – 15	Hard coat and improved production
Solel FSM	>95	—	Solel product durability currently unknown
SAIC Super Thin Glass	>95	10	Manufacturing scale-up
Alanod	~90	<20	Reflectivity

Luz paid a high price to the German mirror manufacturer for mirrors, because the mirror company provides bridge loans to Luz. The cost of these mirrors has stayed at this high level. The glass from Spanish manufacturers for heliostats is significantly lower than the current trough glass. There are active mirror suppliers, which will reduce costs through competition. Flabeg continues to be the sole supplier until the market increases justifying other entrants into the manufacture of solar trough mirrors.

Note that most of the solar field cost consists of components that are being regularly supplied as spare parts to the SEGS plants (mirrors and heat collection elements) and in the structure, which consists of straightforward steel parts manufacture based on competitive global procurement strategies.

The prices are expected to decline with production of significant quantities of mirrors for solar troughs and increased replacement of operating facilities.

B. Combined Cycle Plant

The combined-cycle power plant consists of a conventional F-Frame gas turbine, a three-pressure reheat heat recovery steam generator (HRSG), and a steam turbine. The combined-cycle F-Frame configuration is a proven technology. For example, the General Electric F-Frame was introduced in 1987, and the fleet has over 6 million operating hours. The General Electric Model S107FA combined-cycle 1x1x1 configuration has over 10 years of operating experience. Comparable-sized combined-cycle configurations with similar operating experience are available from different manufacturers, such as ABB, Mitsubishi, and Siemens.

C. Absorption Chillers

Absorption chillers use heat instead of mechanical energy to provide cooling. A thermal compressor consists of an absorber, a generator, a pump, and a throttling device, and replaces the mechanical vapor compressor. In the chiller, a solution mixture in the absorber absorbs refrigerant vapor from the evaporator. This solution is then pumped to the generator. There the refrigerant revaporizes using a waste steam heat source. The refrigerant-depleted solution then returns to the absorber via a throttling device. The two most common refrigerant/ absorbent mixtures used in absorption chillers are water/lithium bromide and ammonia/water.

The absorption cooling technology was patented in 1860 and absorption chillers are manufactured internationally. Low-pressure, steam-driven absorption chillers are commercially available in capacities ranging up to 1,500 tons. Absorption chillers come in two commercially available designs: single-effect and double-effect. A double-effect machine adopts a higher heat efficiency of condensation and divides the generator into a high-temperature and a low-temperature generator.

The concept of using absorption chillers to cool the gas turbine inlet air has been applied to six plants totaling 668 MW.[23]

Approach to Technical Evaluation and Optimization of the ISCCS[24]

The range for the combined cycle plant is between 455.29 to 615.98 MW which enables the use of the industrial frame combustion turbines based on a 2x2x1 configuration.

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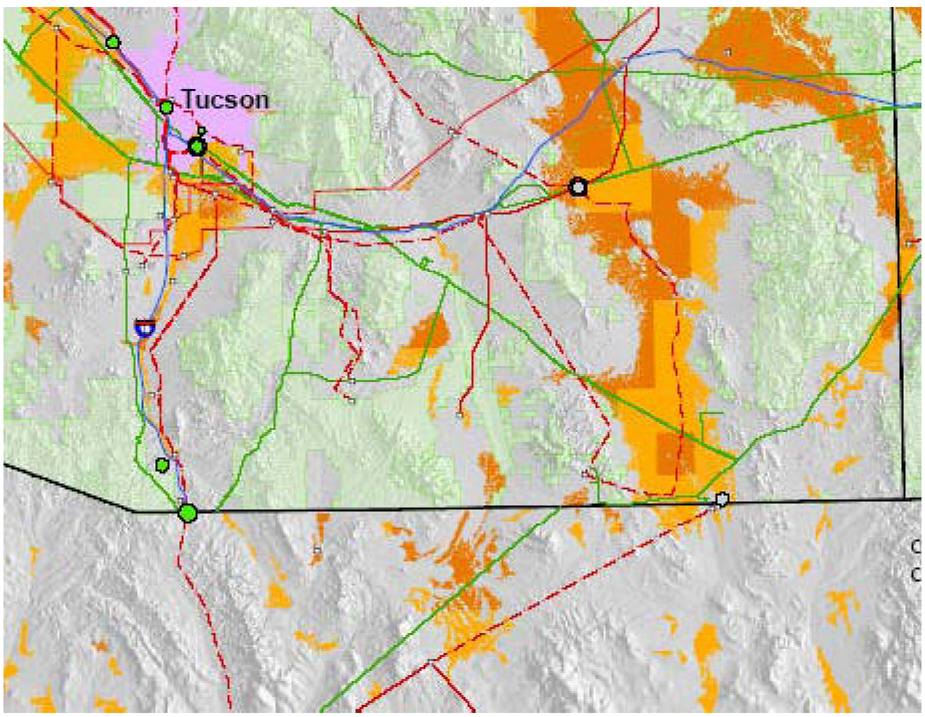
[23] Punwani, Pierson, Bagley, Ryan, *A Hybrid System for Combustion Turbine Inlet Air Cooling at the Calpine Clear Lake Cogeneration in Pasadena, Texas,* ASHRAE Winter Meeting January 2001.
[24] This section is extracted from the Sargent & Lundy report delivered in May 2006 *Agua Prieta Project Integrated Solar Combined-Cycle System Project Report*. SL-008805. The report is available in the Project Files.

Due to the increase in the ISCCS overall size by having two industrial frame combustion turbines, the goal was to establish the largest solar field (preferably>25 MW) based on current market conditions for pricing.

Determination of Insolation

Data is presented here on the solar resource both for completeness and to provide background on the comments given below on the required land area for the solar field.

The figure below shows a map of the concentrating solar power resource in Arizona and northern Sonora, including the Agua Prieta region. This map indicates that the annual Direct Normal Insolation (DNI) near the Agua Prieta sites is in the 7.0-7.5 kW/m2-average day over one year. The map, in actuality, shows more than the solar resource. Filters have been applied to eliminate protected lands, such as parks, land with a low DNI (approximately less than 6.75), and lands with a slope greater than 1%.



Portion of the GIS Map for Arizona produced by NREL
[the red and orange areas show the preferred solar system sites;
darker colors indicate higher DNI values.]

The location of Douglas to Tucson is provided in the map below.

Solar performance runs were conducted using Tucson Typical Meteorological Year data (TMY2) from NREL. That data gives an annual average DNI value of 7.2 kWh/m2-day.

A different tool was used to compare the solar resource for Tucson and Aqua Prieta based on satellite data. This showed a variation of less than 0.25% between the locations, as well as showing a similar monthly radiation pattern. More specifically, each showed peak radiation in April, May and June, then a sharp reduction in July and a modest recovery to a second high from September through November, followed by another reduction to winter levels.

Thermal Cycle Optimization

An evaluation was performed on the thermal cycle optimization for the addition of thermal energy from the solar field.

A typical plant operation model was created for evaluation of performance of ISCCS plant. To accurately determine the actual ISCCS performance it is necessary to evaluate the cycle's performance for each hour of the year taking into account hourly weather data for a typical year. For this study, results from analysis of the solar field and the ISCCS thermal cycle were integrated into a parametric approach in an Excel spreadsheet to determine plant output on an hourly basis. This calculation took into account for each hour the influence of solar radiation, ambient temperature, and ambient relative humidity on the solar field, gas turbine and steam turbine performance.

ISCCS Configuration and Cycle

The ISCCS thermal cycle is designed with steam turbine operating in the sliding pressure mode, where the main steam pressure at turbine inlet will be high during full solar contribution and will fall down when solar energy input is not available due to lower steam flow production. This results in the steam turbine operating at part load condition, which results in decreased steam turbine output.

To minimize the performance penalty when there is no solar input, the plant thermal cycle has been optimized at the no solar steam condition since the power project will operate for the majority of the time without solar energy input or at partial solar loads (after sunrise, before sunset, and when cloud cover is present).

Solar input is generally available for less than 40% of the time, at varying intensity. To accommodate the solar field energy input, the superheaters and reheaters are designed with additional surface area while considering potential effects such as excessive attemperating flow or excessive moisture in the steam turbine. Relatively large superheaters and reheaters are required for steam temperature requirements when solar steam is introduced and to minimize the reduction in steam turbine output.
The feedwater to the solar steam generator is withdrawn from the outlet of last stage of HP economizer with a temperature of 320.5 ºC and is sent to the solar steam generator. The solar steam generator consists of a preheater, evaporator and superheater.

Superheated steam is produced a temperature of 371 ºC in the solar steam generator, with varying pressure. The solar steam is then added to the saturated high pressure steam produced in the heat recovery steam generator, and the combined steam flow is superheated by the energy in the gas turbine exhaust. The combined steam flows into the HP steam turbine, and exhaust steam from HP turbine is again reheated by the gas turbine exhaust energy. The additional mass flow through the high, intermediate, and low pressure turbines increases the power output of the Rankine cycle.

At the design point, the net plant heat rate improves (decreases) by 7.3%, and the solar system contributes about 7.8% to the output. On an annual basis, the solar system supplies close to 1.4% of the annual output.

Weather Data

The evaluation of the ISCCS performance is based best available data on annual basis for 8760 hours representative to the project site. The closest data on an annual basis with coincident hourly temperatures and relative humidity was at Douglas, USA. CFE obtained data for the year 2004 and 2005.

The ISCCS calculation to obtain realistic results should be based on a typical year which would be an average of coincident data over a several years. In addition it is important to have coincident dry bulb and relative humidity data. We obtained TMY2* data for Tucson, New Mexico, in addition to the data provided by CFE.

* *TMY2 is the typical meteorological year data sets derived from the 1961-1990 National Solar Radiation Data Base (NSRDB). The TMY2s are data sets of hourly values of solar radiation and meteorological elements for a 1-year period. Their intended use is for computer simulations of solar energy conversion systems and building systems to facilitate performance comparisons of different system types, configurations, and locations in the United States and its territories. Because they represent typical rather than extreme conditions, they are not suited for designing systems to meet the worst-case conditions occurring at a location.* The TMY2 data sets and manual were produced by the National Renewable Energy Laboratory's (NREL's) Analytic Studies Division under the Resource Assessment Program, which is funded and monitored by the U.S. Department of Energy's Office of Solar Energy Conversion.

A review of the CFE data for 2005 and 2004 showed that 2005 had greater extreme temperatures - maximum temperature and minimum temperature. Based on an inspection of this data it was determined to use the 2005 data as it would be more representative for an ISCCS project.

CFE determined that the base design temperatures for Agua Prieta are:

Temperature = 35 °C
Relative Humidity = 34.3%

The following information was determined from the Douglas data used for the Agua Prieta site:

Project Location	**Agua Prieta**
Elevation	1256 meters
General Environmental	
Temperature	Annual Average 35 C
	Maximum 40.6 C
	Minimum – 9.4 C
Relative Humidity	Annual Average 40 %
	Maximum 95 %
	Minimum 5 %

Both the Tucson TMY2 and the 2005 Douglas data were analyzed for the ISCCS performance with the following conclusions:

1) The Solar contribution in the Douglas site based on 2005 hourly analysis is 1.4% of the Net Power output
2) The solar contribution in the Tucson site based on hourly analysis is 1.43% of the Net Power output
3) The Tucson site has less CCGT plant output as compared to the Douglas site primarily due to:
   a) The relative humidity is lower at Douglas site due to the higher elevation (1256 meters versus 728 meters at Tucson)
   b) Temperatures are lower at Douglas site due to higher site elevation as compared to Tucson.
4) The % increase in the CCGT output for Douglas site is 2.2% (for overall power generation for a year)
5) Overall heat rate of Douglas site is better (by 0.13%)

Please note that Douglas data for year 2005 was nearly complete. Any minor gaps were best estimated to have 8760 hourly data points.

Based on the results of the analysis, the Tucson and Douglas results are nearly the same and within the analysis accuracy. Therefore, it was determined to use the 2005 Douglas data for the evaluation.

Solar Combined Cycle Optimization

Integration of a solar thermal steam system with a conventional GTCC requires careful design for optimum operation. Recent work on the most effective integration of the solar field places considerable attention on the mitigation of possible degradation of pure combined cycle performance due to the addition of a solar system. Design optimization is essentially a tradeoff between maximizing solar contribution during hot summer days when gas turbine operation decreases, and minimizing reduction of system efficiency due to part-load steam turbine operation when solar energy is unavailable.

In general, the capacity of the steam turbine in the ISCCS is increased to accommodate the additional steam from the solar field. Therefore, when solar steam is not available the plant operation will be somewhat penalized due to part-load performance of the steam turbine. The magnitude of this effect is dependent on the capacity factor and the details of the solar steam integration via the HRSG.

Optimization requires a careful analysis of the thermodynamic cycle using a sophisticated power system code such as GateCycle, consideration of the design details of the HRSG, and an annual simulation of system performance on at least an hourly basis

Annex 5: Project Costs

Design and Construction of a 566 MW net ISCCS Plant (4)					
Component	Indicative Cost (US$M)	GEF Financing (US$M)	% GEF Financing	GOM Financing (US$M)	% GOM Financing
Component 1: 31 MW (peak) Solar Field					
Solar field 118,500- 120,000 m2	43.518	43.518	100	-	-
Fence (land of solar field)	0.241	0.241	100	-	-
Land purchase	1.5	-	-	1.5	100
Wastewater treatment plant	1.86	0.42 (1)	22.58	1.43	76.9
Incremental Cost due to Integration (2)	5.171	5.171	100	-	-
Total	**52.29**	**49.35**	**94.38%**	**2.93**	**5.60%**
Component 2: 480 MW (net) Thermal Plant					
Combustion Turbine	79.9	-	-	79.9	100
HRSG (no duct firing)	36.7	-	-	36.7	100
Steam Turbine and Auxiliaries	26.5	-	-	26.5	100
Mechanical Equipment	56	-	-	56	100
Electrical Equipment	18.9	-	-	18.9	100
Civil and Structural Work	13.3	-	-	13.3	100
Construction	65	-	-	65	100
Total	**296.3 (3)**	**0**	**0**	**296.3**	**100**
TOTAL	**348.59**	**49.35**	**14.16%**	**299.23**	**85.84 %**

(1) Includes only the expansion required for the maintenance of the solar field (i.e. cleaning of mirrors, etc).
(2) The integration of solar field requires modifications in the design of the thermal components, these include: major equipment required expansion, design modifications in the power block (based on the configuration selected during the cycle optimization phase of the project) and for the addition of duct firing.
(3) This is an indicative cost, actual costs of the thermal component will be specified once the bidding has been awarded.
(4) The operation of the integrated ISCCS is responsibility of the CFE.

Annex 6: Implementation Arrangements

Main Responsible Institutions:

The Ministry of Finance and Public Credit (SHCP) is the official recipient of the grant. SHCP is the only entity of the Federal Government that has the capacity to receive donations from international financing agencies and it also assigns the financial agent for the project.

The Federal Commission of Electricity (CFE) will execute the project. CFE's investments in power generating plants is authorized by a budgetary allocation from the central government under the scheme of Projects with Deferred Impact in the Budgetary Registry (*Proyectos de Impacto Diferido en el Registro de Gasto*, PIDIREGAS), using either the Independent Power Production scheme (IPP) or the Finance Build Transfer modality (Obra Pública Financiada, OPF). Under the OPF scheme, the contractor is responsible for the construction phase, including its financing. CFE pays the contractor in full upon satisfactory reception of the project, at which point CFE becomes the project's owner. CFE finances the project under financing modalities authorized by Treasury (SHCP), accessing the financial markets, or borrowing from national, or international, financial institutions. In some cases, the CFE buys the financial scheme already arranged by the contractor.

CFE through its Directorate for Financed Investment Projects (*Dirección de Proyectos de Inversion Financiada*) will assume overall GEF project implementation responsibilities, including:

i. Preparation of bidding package including general technical specifications
ii. Bidding process: structuring solicitation and evaluating responses
iii. Purchase and operation of the Agua Prieta II ISCCS Plant
iv. Project monitoring and evaluation
v. Regular reporting

The preparation of the bidding package has been completed. The CFE advertised the bidding documents last June 27th, 2006 and will award the bid next November 30th, 2006. The Agua Prieta II ISCCS plant is expected to start operations in March 31st, 2009.

Nacional Financiera (NAFIN) has been designated by SHCP as the financial agent for the Project and as such will provide overall financial management of the Project and the Special Account. NAFIN will also be responsible for formal correspondence with the Bank and providing procurement support to CFE.

The grant will be transferred through a special account directly to the contractor under the terms and conditions of a legal contract signed between CFE and the contractor.
The grant will be disbursed in tranches as the construction of the project proceeds under the technical supervision of the CFE.

The detailed implementation arrangements are provided in the Project's Operational Manual[25].

[25] Available in the Project Files.

Annex 7: Financial Management and Disbursement Arrangements

Financial Management Assessment (FMA)

The Mexico Country Financial Accountability Assessment (CFAA) was completed in October 2003. This assessment focused on the federal public sector, which was considered to have generally sound financial management (FM) systems and institutions. Country FM risk was rated moderate, and all individual risk factors were rated low or moderate. The results of the CFAA have an indirect impact on this project, as funds will flow into Mexico's public FM systems (the national *Comisión Federal de Electricidad*, CFE) and through a third party (bid winner). The Bank has recently supported government efforts to strengthen some of the areas considered by the CFAA to be opportunities for improvement, such as the accounting processes and information systems. Specifically for the Solar Thermal Hybrid Project Agua Prieta II, the Bank has initiated a Financial Management Assessment (FMA), which involves ensuring that the project design allows for an appropriate level of transparency that will facilitate oversight and control while also supporting smooth implementation.

Based on this analysis, the regional financial management team (LCSFM) has determined that the project risk is Moderate and has concluded the following:

(i) The CFE has an adequate internal control environment, capable people, a well-organized office, and good segregation of duties; (ii) Although the project will only involve a small number of payments (approximately three) from CFE to the bid winner, it involves a large amount so the inherent risk is moderate; (iii) Prior to project implementation certain actions will be required to strengthen program financial management, e.g. implementation of the project's Operational Manual (OM), fine-tuning of agreed audit arrangements, and the final format of the Disbursement Report; (iv) The financial agent NAFIN will provide implementation support and oversight based on its many years of experience with Bank-financed projects; (v) For disbursement purposes, the recognition of expenditures will be upon the payments from CFE to the bid winner; (vi) Considering project's characteristics at least two financial management supervision missions (FMSM) will be conducted during the first implementing year, and one FMSM during the following years; and a Bank financial management specialist will review the annual audit reports.

The FM-related procedures must be described in the above mentioned OM and will reflect the simplifications proposed in the FM/Disbursements section of the Bank's Review of Country Systems document, which was delivered to the federal government in July 2005. Before project effectiveness, additional visits will be carried out to ensure that all FM arrangements are in line with agreements before project implementation.

Implementing Entity

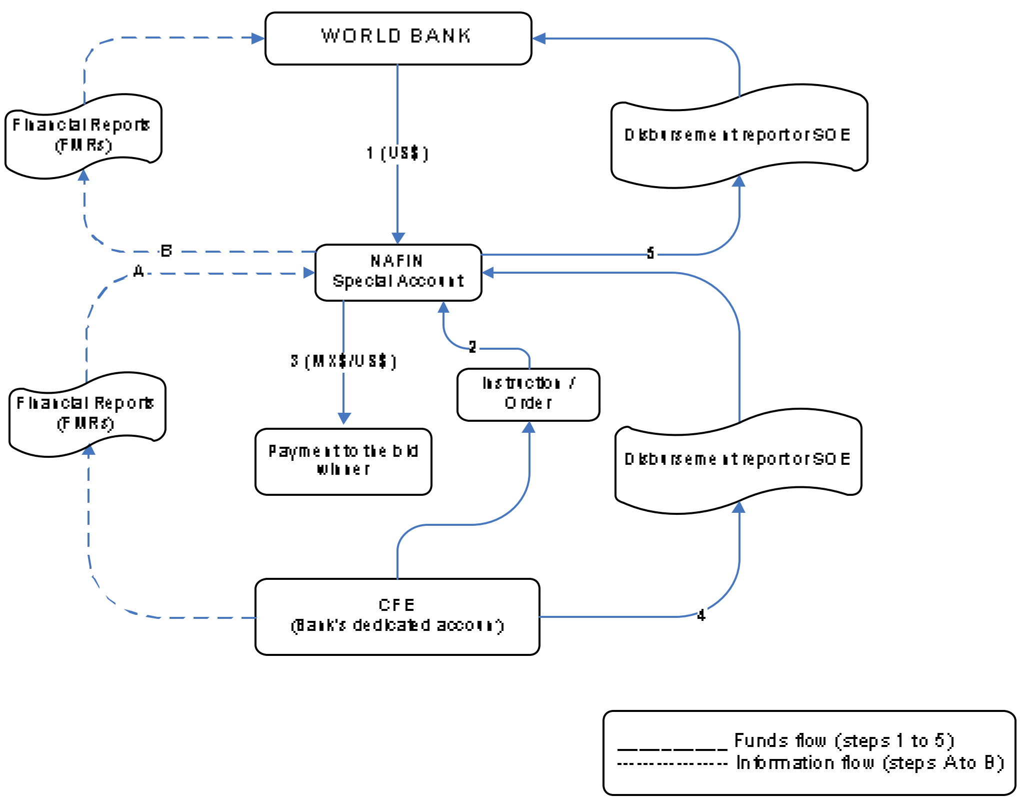
The proposed project will be executed by CFE, which is a public decentralized organism, in charge of the generation and distribution of the electricity in México, and an independent entity from the country's budgetary system. This because CFE obtains its incomes from the fees derived of the supplying of electrical services. CFE's central offices are located in Mexico City, and they have an adequate internal control environment, with capable people, a well-organized office, and good segregation of duties.

Flow of Funds and Information

Given the fact that CFE does not receive its budget from the National Treasury (TESOFE), they will receive advances in a Designated Account in order to make payments to the bid winner. Once payments are made, CFE with NAFIN's assistance, will apply for withdrawals from the Grant Account for deposit of advance amounts into the Designated Account. CFE will report the expenditures paid from the Designated Account by presenting SOE or reports at the intervals specified by the Bank.

If ineligible expenditures are identified in (i) any external or internal audit review; (ii) any Bank supervision mission; or (iii) financial agent's review, the Government of Mexico will have to reimburse the entire amount of funds corresponding to ineligible expenditures to the Bank.

The following diagram presents the preliminary proposed flow of funds for the project:



Accounting Policies and Procedures

CFE will maintain accounts for the preparation of project financial reports. LCSFM reviewed the accounting policies and procedures currently in place in CFE and consider them acceptable to the Bank. An attempt will be made before project launch to bring project accounting procedures, as much as possible, in line with existing procedures within CFE.

Information Systems and Staffing (key FM staff)

The accounting records of the project will be prepared using the existing systems in CFE. The entity is adequately staffed, and has experience in the management of externally financed loans (mainly with the Inter-American Development Bank). For its entire operation CFE uses the SAP system, which at present is being upgraded from the 4.6 to the 5.0 version. This system is considered acceptable to the Bank.

Financial Reporting

Annual project financial statements will be prepared by CFE to be used for the financial auditing of the project (see audit section below). The project financial statements should be consistent with the formats presented in the standard Terms of Reference for audit, agreed annually between the Bank and the *Secretaría de la Función Pública* (SFP). The Financial Management section of the project's OM will include detailed information on reporting and monitoring.

Financial Monitor Reports (FMRs). CFE will prepare and each calendar semester furnish to the Bank a FMR, in form and substance satisfactory to the Bank, which: sets forth sources and uses of funds for the Project, both cumulatively and for the period covered by said report, showing separately funds provided under the GEF Trust Fund Grant, and explains variances between the actual and planned uses of such funds. The first FMR will be furnish to the Bank not later than 45 days after the end of the first semester after project effectiveness, and this FMR will cover the period form the incurrence of the first advance or expenditure under the project through the end of such first semester. Thereafter, each FMR will be furnished to the Bank not later than 45 days after each subsequent calendar semester, and will cover such calendar semester.

Internal and External Audit

Annual financial audits covering the management of project funds will be carried out according to Bank policy and in combination with the country systems approach currently being implemented in Mexico. The framework for all project audits in Mexico is the Memorandum of Understanding (MOU) agreed between the Government of Mexico and the Bank. The Financial Management section of the project OM will include more detailed information on external audits.

A project audit covering all project activities is due six months after the end of any fiscal year in which project expenditures are incurred (as determined by the government's *Secretaría de la Función Pública* [SFP], which is the executive branch's auditor at a Secretariat level in charge of coordinating the audit—and by the Bank). The first audit report will likely cover the calendar years 2006 (from project effectiveness) and 2007 (covering the entire calendar year); and will be submitted to the Bank by June 30, 2008. The final audit report will be due six months after the final year of project implementation. The standard period covered each calendar year is January 1 to December 31.

The audit report which is prepared for the entity (CFE's financial statements) will cover this project. Final specific Terms of Reference (TERs) will be agreed at the end of June 2007 to allow time for all needed arrangements.

Disbursement Arrangements and Retroactive Financing

Use of Statements of Expenditures (SOEs) or Disbursement reports: It is contemplated that disbursements will be based on traditional SOE reports or disbursement reports. The final format will be agreed with CFE and the financial agency NAFIN. SOE will base disbursements for expenditures under contracts for (i) goods costing less than $500,000 equivalent per contract; and (ii) works costing less than $10,000,000 equivalent per contract. The Disbursement reports to base disbursements will reflect agreements established in the contract established between CFE and the bid winner. This contract must be satisfactory to the Bank.

Designated Account (DA): For this project, NAFIN (as financial agent) will establish a Designated Account in US dollars, which will likely maintain a "zero balance" status, but might receive Bank funds to timely pay to the bid winner on behalf of CFE. It would therefore have occasional balances for a brief time until the corresponding transfer is made. See flow of funds and information chart.

Retroactive Financing: Given the characteristics of this project, it will not be eligible to submit applications for retroactive reimbursement.

Table Allocation of Grant Proceeds (US$ million)

Category	Amount of the GEF Grant allocated (US$ Million)	% of expenditures to be financed by the Grant
Goods and works under the Project	49.35	100%

Operational Manual (OM) and Written Procedures

The project will be implemented according to an Operational Manual, which will include a section which will cover all aspects related to financial management (including detailed information on the areas covered in this annex). This OM must be satisfactory to the Bank prior to negotiations.

Supervision Plan

Considering the projects characteristics and on the results of the financial management assessment, LCSFM has decided the following: (i) at least two financial management supervision missions will be conducted during the first year of the project's implementation; (ii) at least one financial management supervision mission will be conducted during the following years; and (ii) a Bank financial management specialist will review the annual audit reports.

Annex 8: Procurement Arrangements

Procurement in Mexico: Recent Developments

1. 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 "Guidelines: Selection and Employment of Consultants by World Bank Borrowers" dated May 2004, and the provisions stipulated in the Legal Agreement.

2. The Bank has agreed with the Government of Mexico to accept the full-fledged use of the COMPRANET as a vehicle for Bank-financed procurement for NCB and ICB pursuant to paragraphs 2.11, 2.18, 2.44, 2.45 and other parts of the Procurement Guidelines of May 2004. The *Secretaría de la Función Pública* and the Bank have agreed on a new generation of standard bidding documents for goods and works under NCB. The Bank, IDB, and the Government reached agreement on a harmonized Request for Proposals package, and SBDs for ICB for Goods and Works. In addition, the Bank has completed two sector studies: one at the federal level and another one at the state level to determine the acceptability of the country systems in procurement and other fiduciary areas, and to monitor and evaluate government procurement performance at the state level. The findings of the studies continue to demonstrate that Mexico has robust procurement procedures.

Procurement Summary

3. The only procurement method under the Project consists of an ICB under the national law and CFE procedures. The case was presented to OPRC in June 2004 that authorized, on an exceptional basis, the use of the CFE international bidding procedures.

Procurement of Works

4. The GEF grant will finance the supplemental solar energy field of a thermal power plant in a fixed amount of US$ 49.35 million under a scheme known locally as Lump-Sum Privately-Financed Publicly-Owned Works. The GEF grant will be applied only towards the cost of the solar energy field.

Procurement of Goods and Non-consulting Services

5. The construction of a thermal power plant of 510 MW is at the core of this project. Since the Bank does not have SBDs for such contracts, the plant will be awarded following Comisión Federal de Electricidad (CFE) international bidding procedures which have been reviewed and found acceptable to the Bank under the provisions of para. 3.13 (a) of the Procurement Guidelines. Nonetheless, the Bank will closely monitor relevant parts of the process to ensure that it is fully consistent with Bank Guidelines.

6. In particular, the Bank will continue to be directly involved in the drafting of the bidding documents, through its ex-ante review of the documents, which are based on

documents used in past by CFE for similar transactions. Recent amendments to Mexico's national procurement laws in July 2005 replaced the two-envelope bidding system with the one-envelope system recommended by the Bank and this will apply to this bidding. No other procurement action is expected under the Project.

Employment of Consultants

7. The project does not include any consultant services.

8. **Prior Review Thresholds:** The Bank and CFE had agreed on a schedule of reviews including the bidding documents, advertisement and the bid evaluation report under special arrangements that will ensure confidentiality of the award until it is final.

Procurement Capacity Assessment

9. CFE is the second-largest government company in the country. Its performance in procurement was reviewed against international standards in the recent review of the federal procurement and FM systems. The experience, capacity and organization of CFE is more than adequate to carry out highly complex procurement procedures, such as that required for the Project.

Table 1: Project Costs by Procurement Arrangements
(US$ million equivalent)

	Procurement Method[1]			
Expenditure Category	ICB	NCB	Other	Total Cost
1. Supply and Install Power Plant	300 (49.35)			300.0 (49.35)
Total	300 (49.35)			300.0 (49.35)

[1]Figures in parentheses are the amounts to be financed by the GEF grant. All costs include contingencies.

Procurement Plan

10. The GEF participation includes only one large and specialized bidding. There is no need to prepare a procurement plan for a single activity.

Annex 9: Economic and Financial Analysis

Global Environmental Objective

In accordance with the objectives of the GEF Operational Program 7 the main global environmental goal of this project is to contribute to, and accelerate, the commercial breakthrough of solar thermal technology worldwide. The project would considerably increase the efficiency of a gas-fueled combined cycle plant in Agua Prieta, while also adding average firm capacity. In conjunction with other planned GEF solar thermal projects of similar size this will contribute to building critical mass and bringing down the production costs of this technology.

An ancillary global benefit of the project is the direct carbon abatement achieved by substituting solar energy for fossil fuels.

This annex presents two main components: (a) an economic justification of the Solar Thermal Power Project within the context of then power sector least-cost expansion objectives; and (b) the financial indicators of the proposed project given the generation alternatives or avoided costs in the Mexican system. This annex is complemented by the background of the Mexican power sector presented in Annex 1 and the Incremental Cost analysis (Annex 15) which is an inherent part of the project's economic justification.

Least Cost Expansion Plan

The expansion of the power sector system follows a least-cost approach that is mandated by law. This approach has resulted in the current trend toward gas-fueled combined cycle plants which dominate the expansion plans for the next decade. Figures 1 and 2 show the current fuel use in generation and the corresponding expected mix by 2014. The most significant aspect of this evolution is the increase in natural gas use (to be doubled in absolute terms) while there will be a considerable reduction in the use of fuel oil. This increase is explained by the understanding that in spite the volatility and uncertainty of gas prices, gas-fueled combined cycle will remain as the main component of the least-cost expansion of generation.

The least cost approach confirms also the economic justification of the plants included in the expansion plan, since they constitute the investment plan that maximizes economic benefits in meeting the growth needs of the power system. The proposed solar thermal project implies a variation in the least-cost plan adding a solar component that increases capital investment and operation and maintenance costs, while increasing the overall efficiency of the plant and thus reducing fuel costs. The balance of this impact is an incremental cost that is analyzed in Annex 15. The proposed GEF grant will therefore help achieving a sustainable development consistent with the least cost objective – ensuring the maximization of benefits- while bringing the environmental benefits of the solar component.

Figure 9.1: Current Fuel Mix in Generation

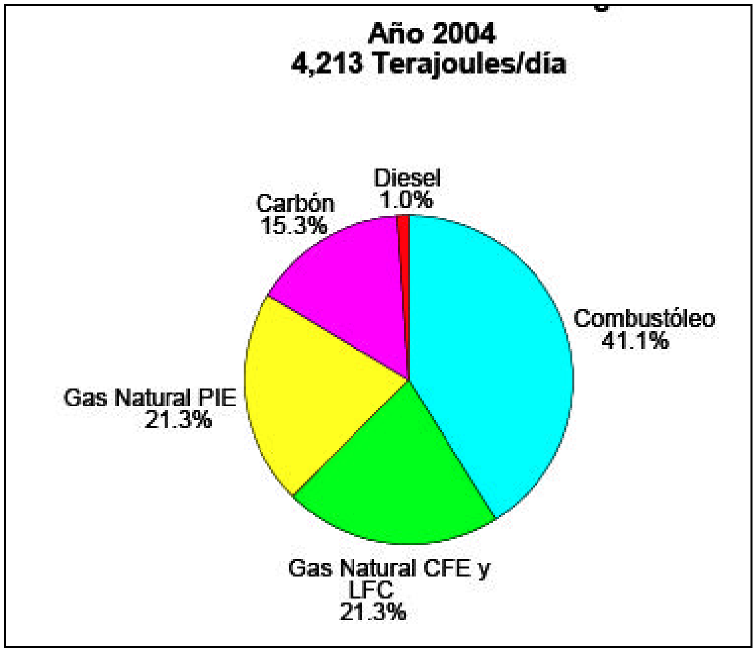
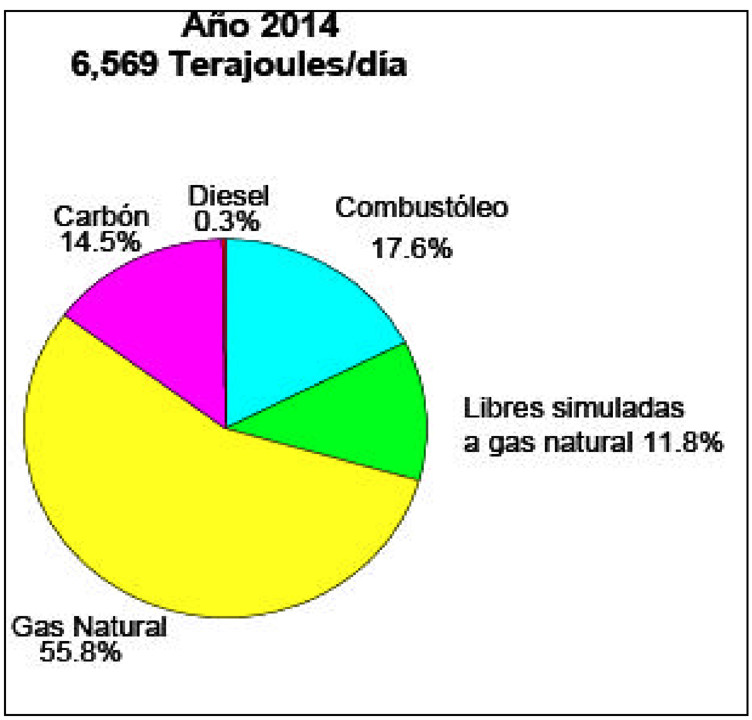


Figure 9.2: 2014 Fuel Mix in Generation



Economic Analysis of the Solar Thermal Project

For the purposes of this project, the base case is taken as the SENER/CFE expansion plan, including demand forecasts, economic growth forecasts and technology expectations. Although the size of the proposed plant (a net capacity of about 535 MW) is small compared to the expected capacity demand of the system by the end of the decade (around 53 GW), the commissioning of the solar thermal plant will have a clear positive impact because it will offer firm capacity in an environment of declining reserve margin, and help reducing fuel costs through its higher thermal efficiency displacing older and less efficient plants.

The main economic benefits of the Solar Thermal Plant Agua project are: (a) the production of electricity; and (b) the reduction of GHG emissions in the global atmosphere. Since the latter benefits are directly associated to the incorporation of the solar component dealt with in the Incremental Cost analysis (Annex 15), this analysis focusses on the electricity production benefits only.

Meeting the growing electricity demand of a system requires investments in generation capacity as proposed in CFE's least cost plan. The economic benefits of electricity generation are set, for the purposes of this analysis, at the level of the avoided cost of generating electricity using other options. For the base case referred above, the system average avoided cost of generation falls into the range of $50-54/MWh, for the SENER *alto* crude oil forecasts[26]. The base case for this analysis uses an avoided cost of $52 /MWh corresponding the *alto* forecast avoided costs (*Prospectiva alto* forecast: $46/bbl) considering the versatility of operation of the solar thermal plant, its base load plant factor of 80% and its provision of firm capacity.

The cost stream comprises: (a) investment in the solar thermal plant, including EPC costs, owners costs, land and water treatment; (b) Operation and maintenance costs; and (c) fuel costs. To this end, gas prices are taken from SENER's *alto* case which assume an average of 4.9 $/mmBtu for the period of analysis (2009-2033) at constant values. It should be noted that recent forecasts (DOE, 2006) exceed these values by a significant margin, both for gas and oil prices. This is dealt in the sensitivity analysis which includes a range of values for fuel costs, and capital costs. In the high fuel price case scenario avoided costs are considered to increase to $61.36/MWh, corresponding to crude prices of $60/bbl, and average gas prices are increased to DOE's estimate: 6.34 $/mmBtu

Economic Internal Rate of Return. The EIRR is the rate at which the project returns value to the investors and society, based on the real cost to Mexico of the resources used in the project and opportunity cost of the displaced energy and capacity that is

[26] The estimated future costs for electricity generation in Mexico are strongly dependent on assumptions regarding the economic costs of oil and natural gas and, to a lesser extent, of coal. CFE's planners use reference values provided by SENER, which in turn elaborates such estimates with the assistance of the national petroleum company (Petróleos Mexicanos, PEMEX).

attributable to the project. Table 1 summarizes the results of the economic analysis. The EIRR for the base case is 14.4% for the base case. An economic return close to the base case discount rate (12%) is not surprising since the project fits into the least cost expansion plan which is determined using the same parameter. The sensitivity analysis concludes that the project economic returns are not sensitive to an increase in fuel prices since this variable would have an impact in both the stream of costs and benefits (estimated as avoided costs). To least favorable results are obtained in the very unlikely case where gas prices go up while oil prices remain constant. Results are sensitive to variations in capital costs. The project will break even at capital cost increase of 14.9%.

Table 9.1: Summary of Project Economic Indicators

Scenario	Project NPV (US$ millions)	Project EIRR	Value of Output per MWh
Base Case	49.61	14.42	49.86
Base Case - Excluding GEF Grant	5.86	12.25	51.69
+ 10% Capital Costs	16.24	12.76	51.26
- 10% Capital Costs	82.98	16.50	48.46
High fuel prices; • Gas prices at 6.34$/mmBtu • Avoided costs at 61.36 $/MWh (crude oil: 60$/bbl)	40.10	13.96	59.61
High avoided costs • at 61.36 $/MWh (crude oil: 60$/bbl)	272.62	24.64	49.86
High gas prices; • at 6.34$/mmBtu	(182.91)	1.29	59.61

Financial Analysis of the Solar Thermal Power Project

This section presents a financial analysis of the Solar Thermal Power Project in Agua Prieta. A financial spreadsheet model was used, with values in real U.S. dollar. Project income is derived by two sources: electricity payments over the project's lifetime (25 years), and one single subsidy payment (GEF's project contribution for a total of about US$49.35 million). In the model it is assumed (for simplicity, and because this is likely to be the final IPP arrangement) that capacity payments for the plant are bundled with energy payments.

Financial outflows relate to operating expenses, including fuel costs, and taxes. The model also accounts for depreciation provisions.

<u>Project Financing</u>. The project has been approved and assigned a budget allocation by the GoM under the general scheme of Projects with Deferred Impact in the Budgetary Registry (Proyectos de Infraestructura Productiva a Largo Plazo, PIDIREGAS), using the Financed Public Project (Obra Pública Financiada, OPF) modality. The winning bidder

for the power plant 'turn-key' contract will assume the financing and construction risk of the project. CFE pays the contractor when the project is completed satisfactorily and received by CFE; CFE's payment to the contractor is fully backed by government guarantees. CFE then obtains long-term financing for the amount of the OPF. The details of the financing to be employed for the project have yet to be decided, but CFE is exploring various public and commercial options. These options consider annual interest rates between 6% and 7% and a loan duration period of ten years.

Actual figures and other general assumptions used for the financial model are summarized in Table 9.2 below.

Table 9.2: Financial Analysis Assumptions

GENERAL	VALUE	UNIT
Rated Capacity (ave)	485.5.	MW
Net Capacity Factor	80 percent	
Start Year	2009	Calendar Year
Project Lifetime	25	Years
Capital Cost	7,116	$/kW
Total Project Cost (1)	$ 373'771,000	
FINANCING		
Debt Contribution in Financing	100 percent	
	Loan1	*Loan2*
Amount (2)	$ 373'771,000	
Schedule Type	Level Mortgage	
Debt Percentage (percent)	1100 percent	
Interest Rate (percent)	7.0 percent	
Term (years)	10	
Equity ($)	$	
Debt ($)	$ 373'771,000	
EXPENSES		
Fixed Operation & Maintenance (O&M)	12.063	$/kW
Variable O&M	0.0011	$/kWh
Tax Rate (percent of Net Income)	9 percent	
INCOME		
Electricity Price – avoided cost (c/kWh)	5.2	cents/kWh
Subsidy	$ 49,350,000	

(1) This is an indicative cost; actual costs of the thermal component will be specified once the bidding has been awarded.
(2) The amount includes: US$ 349.957 Million on EPC Cost (including escalation and financing costs) as US$ 22,703 as CFE's owner's cost (as determined by the consultant company Sargent & Lundy)

Key Modeling Results

To evaluate the financial viability of the project, net present values (NPV) of the project's (financial) rate of return figures are calculated for a range of discount rates. The project has a positive NPV for discount rates of up to 21 percent.

Table 9.3: NPV of the project for the sponsor for various discount rates

Discount Rate	*Project (Sponsor's) NPV*
10 percent	$239,372,356
12 percent	$204,288,343
14 percent	$121,176,190
16 percent	$79,544,361
18 percent	$45,843,483
20 percent	$18,256,952
22 percent	($4,544,851)

The full cash-flow analysis for the project is presented in the following pages in Table 4.

Table 9.4: cash Flow Analysis

Year	0	1	2	3	4	5	6	7	8	9	
Calendar Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Revenues											
Energy Payment		$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$
Tariff Subsidy Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
Interest on Reserves		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
Total Revenues		$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$
Operating Costs											
Fuel Costs		$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$
Fixed O&M		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
Variable O&M		$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$
Site Owner Royalty		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
Insurance		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
Other Costs		$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$
Total Operating Costs		$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$
Operating Income	$ (324,770,757)	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$
Other Expenses											
Interest on Loans		$26,163,954	$24,270,272	$22,244,033	$20,075,957	$17,756,115	$15,273,885	$12,617,898	$9,775,993	$6,735,154	
Depreciation Percentage		100%	0%	0%	0%	0%	0%	0%	0%	0%	
Maximum possible depreciation		$ 261,639,538	$ 239,311,086	$ 215,088,953	$ 188,840,580	$ 160,424,131	$ 129,687,840	$ 96,469,320	$ 60,594,813	$ 21,878,400	$
Maximum depreciation without compensation against other activities		$ 22,328,452	$ 24,222,133	$ 26,248,373	$ 28,416,449	$ 30,736,290	$ 33,218,521	$ 35,874,507	$ 38,716,413	$ 21,878,400	$
Actual depreciation		$ 22,328,452	$ 24,222,133	$ 26,248,373	$ 28,416,449	$ 30,736,290	$ 33,218,521	$ 35,874,507	$ 38,716,413	$ 21,878,400	$
Pending depreciation		$ 239,311,086	$ 215,088,953	$ 188,840,580	$ 160,424,131	$ 129,687,840	$ 96,469,320	$ 60,594,813	$ 21,878,400	$ -	$
Total Other Expenses		$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$28,613,554	
Before-Tax Profits		$0	$0	$0	$0	$0	$0	$0	$0	$19,878,852	
Profits x tax rate		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,789,097	$
Income Tax Paid		$0	$0	$0	$0	$0	$0	$0	$0	$1,789,097	
After-Tax Profits		$0	$0	$0	$0	$0	$0	$0	$0	$18,089,755	
Additions											
Depreciation		$ 22,328,452	$ 24,222,133	$ 26,248,373	$ 28,416,449	$ 30,736,290	$ 33,218,521	$ 35,874,507	$ 38,716,413	$ 21,878,400	$
Released from Reserve		0	0	0	0	0	0	0	0	0	
Total Additions		$ 22,328,452	$ 24,222,133	$ 26,248,373	$ 28,416,449	$ 30,736,290	$ 33,218,521	$ 35,874,507	$ 38,716,413	$ 21,878,400	$
Subtractions											
Loan Principal		($27,052,595)	($28,946,276)	($30,972,516)	($33,140,592)	($35,460,433)	($37,942,664)	($40,598,650)	($43,440,556)	($46,481,395)	(
Total Subtractions		($27,052,595)	($28,946,276)	($30,972,516)	($33,140,592)	($35,460,433)	($37,942,664)	($40,598,650)	($43,440,556)	($46,481,395)	(
Before-Tax Cash Flow	$ (324,770,757)	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	
Taxes Payable (Benefit Received)		$0	$0	$0	$0	$0	$0	$0	$0	$1,789,097	
Tariff Subsidy payment if not taxable		$ 49,000,012	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
After-Tax Cash Flow	$ -	$44,275,869	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	($4,724,143)	($6,513,240)	
Cumulative After-Tax Cash Flow		$44,275,869	$39,551,726	$34,827,583	$30,103,440	$25,379,297	$20,655,154	$15,931,011	$11,206,868	$4,693,628	
ProjectCashFlow	$ (324,770,757)	$ 70,820,857	$ 72,714,539	$ 74,740,778	$ 76,908,855	$ 79,228,696	$ 81,710,926	$ 84,366,913	$ 87,208,818	$ 68,581,709	$
Loan1											
Beginning Balance		$ 373,770,768	$346,718,174	$317,771,897	$286,799,381	$253,658,789	$218,198,356	$180,255,692	$139,657,042	$96,216,487	
Interest		($26,163,954)	($24,270,272)	($22,244,033)	($20,075,957)	($17,756,115)	($15,273,885)	($12,617,898)	($9,775,993)	($6,735,154)	
Principal		($27,052,595)	($28,946,276)	($30,972,516)	($33,140,592)	($35,460,433)	($37,942,664)	($40,598,650)	($43,440,556)	($46,481,395)	(
Loan Total		($53,216,549)	($53,216,549)	($53,216,549)	($53,216,549)	($53,216,549)	($53,216,549)	($53,216,549)	($53,216,549)	($53,216,549)	(
Loan2											
Beginning Balance		$ -	$0	$0	$0	$0	$0	$0	$0	$0	
Interest		$0	$0	$0	$0	$0	$0	$0	$0	$0	
Principal		$0	$0	$0	$0	$0	$0	$0	$0	$0	
Loan Total		$0	$0	$0	$0	$0	$0	$0	$0	$0	
Debt Service Coverage Ratio (DSCR)		0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.88	
Logical Test for DSCR>required		1	1	1	1	1	1	1	1	1	

Year	13	14	15	16	17	18	19	20	21	22
Calendar Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Revenues										
Energy Payment	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968
Tariff Subsidy Payment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest on Reserves	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenues	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968	$ 176,923,968
Operating Costs										
Fuel Costs	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734	$112,984,734
Fixed O&M	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Variable O&M	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823	$ 15,446,823
Site Owner Royalty	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Insurance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other Costs	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5
Total Operating Costs	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562	$ 128,431,562
Operating Income	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406	$ 48,492,406
Other Expenses										
Interest on Loans	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Depreciation Percentage	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Maximum possible depreciation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Maximum depreciation without compensation against other activities	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Actual depreciation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pending depreciation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Other Expenses	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Before-Tax Profits	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406
Profits x tax rate	$ 4,364,317	$ 4,364,317	$ 4,364,317	$ 4,364,317	$ 4,364,317	$ 4,364,317	$ 4,364,317	$ 4,364,317	$ 4,364,317	$ 4,364,317
Income Tax Paid	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317
After-Tax Profits	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089
Additions										
Depreciation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Released from Reserve	0	0	0	0	0	0	0	0	0	0
Total Additions	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtractions										
Loan Principal	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Subtractions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Before-Tax Cash Flow	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406	$48,492,406
Taxes Payable (Benefit Received)	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317	$4,364,317
Tariff Subsidy payment if not taxable	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
After-Tax Cash Flow	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089	$44,128,089
Cumulative After-Tax Cash Flow	$128,302,767	$172,430,856	$216,558,945	$260,687,034	$304,815,123	$348,943,213	$393,071,302	$437,199,391	$481,327,480	$525,455,569
ProjectCashFlow	$ 44,128,089	$ 44,128,089	$ 44,128,089	$ 44,128,089	$ 44,128,089	$ 44,128,089	$ 44,128,089	$ 44,128,089	$ 44,128,089	$ 44,128,089
Loan1										
Beginning Balance	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Principal	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Loan Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Loan2										
Beginning Balance	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Principal	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Loan Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Debt Service Coverage Ratio (DSCR)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Logical Test for DSCR>required	0	0	0	0	0	0	0	0	0	0

Cost Reduction and Sustainability of Solar Thermal Power Generation Technology

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[27]. This section summarizes the studies taking into account the learning curve concept which assumes that each doubling of the cumulated production of any kind of product results in a specific cost reduction by a so-called learning factor of typically 20-30 %.

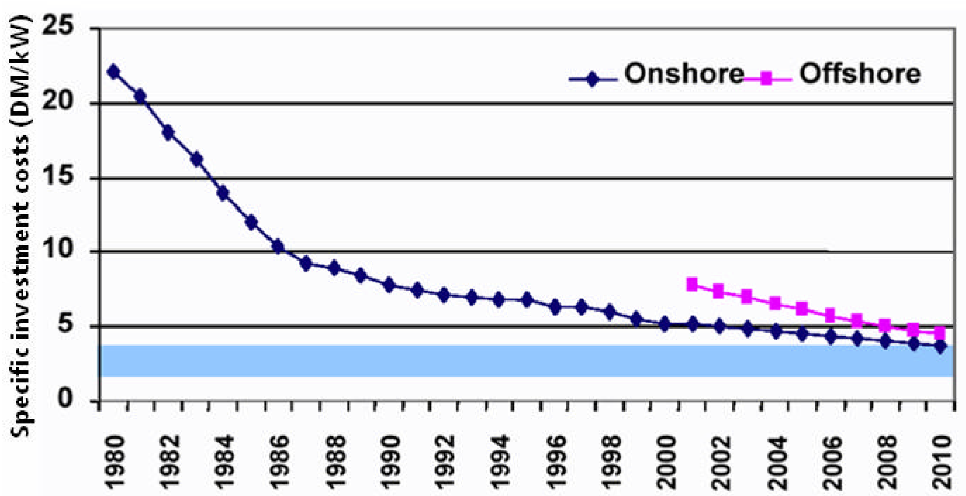
Cost reduction and growth rates of other renewable energy technologies

Narrowing down the perspective fom general technology cost reduction to renewable energy technologies, the progress of wind energy and photovoltaics were analysed with respect to two main factors of learning curves:

1. the specific cost reduction, and
2. the market development of these.

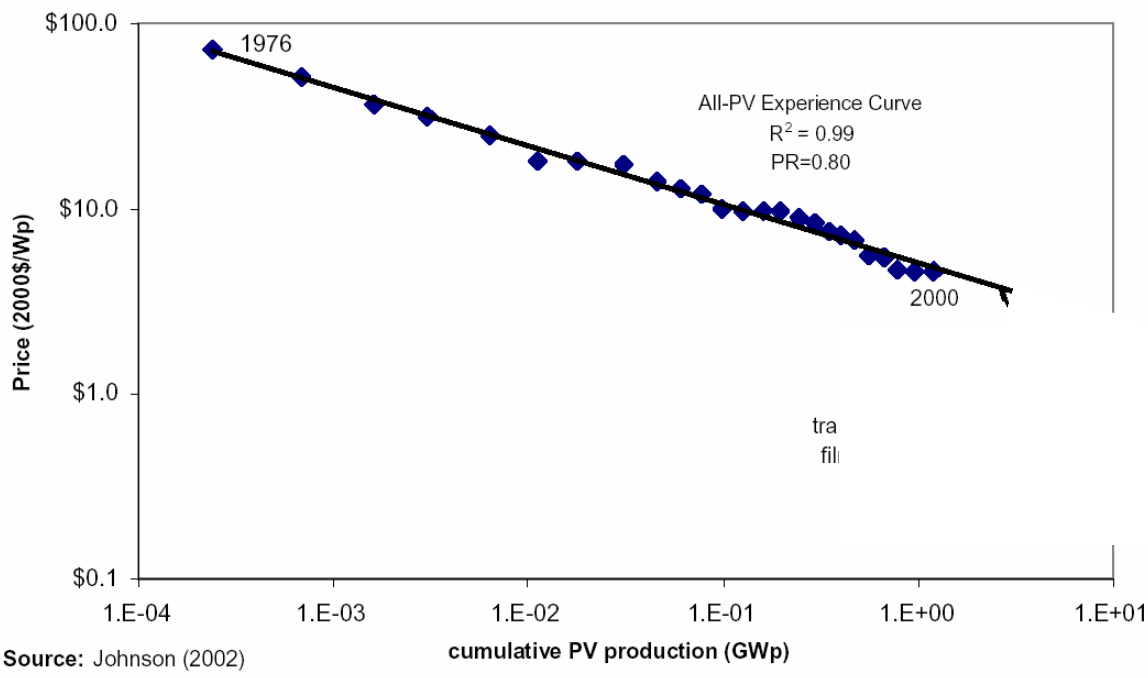
Figures 10 and 11 show the specific cost reduction for wind energy converters and photovoltaics.

Figure 9.3: Specific investment costs of wind energy converters over the time



[27] The most important studies in this context are Enermodal (1999), DLR (2004), Sargent & Lundy (2003) and DLR et al. (2005).

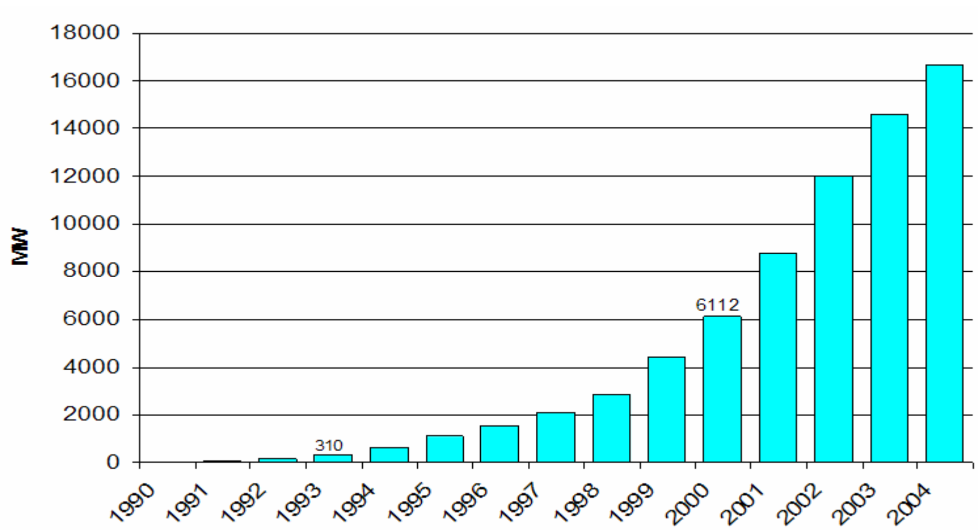
Figure 9.4: Specific investment costs of photovoltaics as a function of cumulated production volume



Source: Duke (2002)

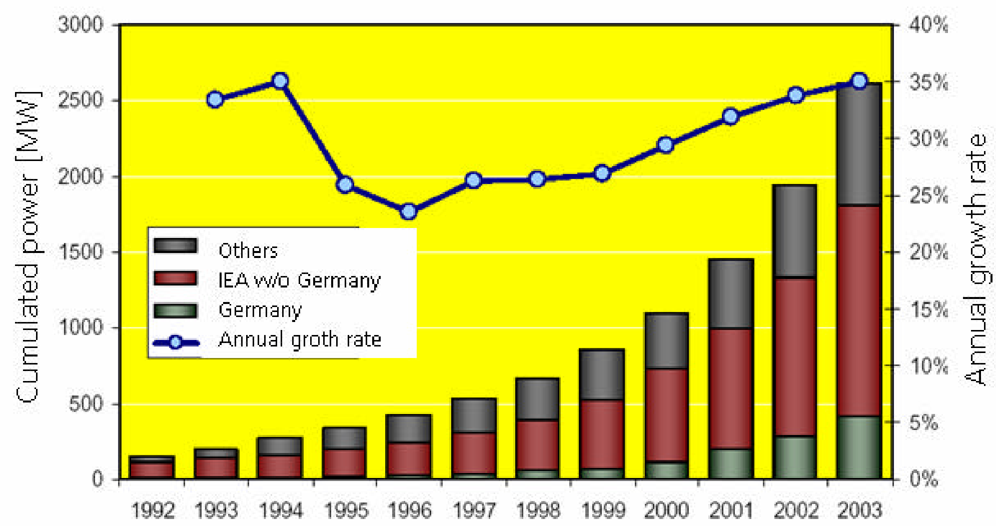
Figures 12 and 13 show the market growth for wind energy converters and photovoltaics during the last fifteen years:

Figure 9.5: Development of installed Wind Capacity in Germany



Source: BMU (2004)

Figure 9.6: Development of the worldwide installed PV capacity and annual growth rate.



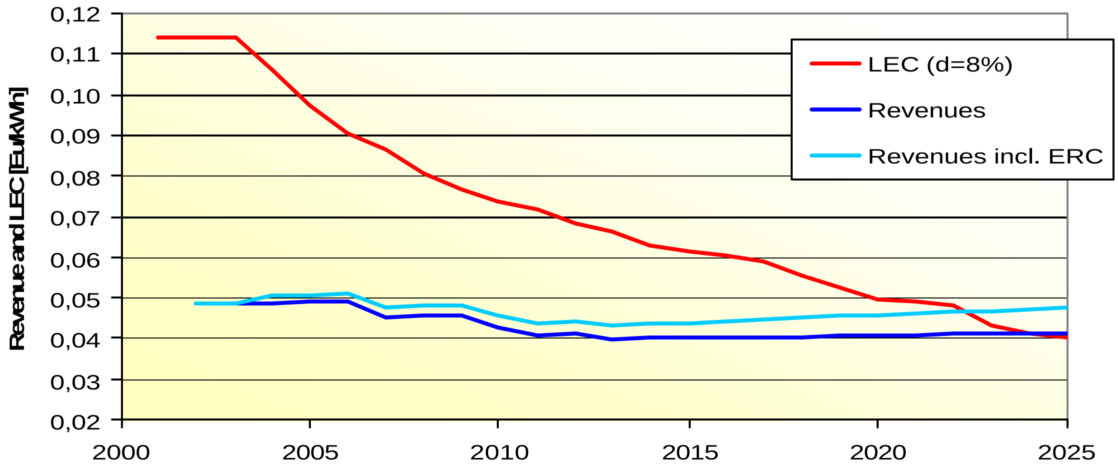
Source: Quaschning (2004)

Cost Reduction

All quoted studies assume a conservative global Solar Thermal market development compared to the past technology deployment of wind energy. It is acknowledged also that many of the countries in the world's sunbelts lack the financial resources to finance relatively expensive solar energy. However, with the present Solar Thermal market movements in Spain and the USA a strong technology growth similar to wind energy would appear feasible.

Taking into account the development of the wind market worldwide, market development studies for Solar Thermal conclude that the technology has the potential to be cost competitive within 10-25 years and will then become a major electrical power option for developing countries located in the sunniest parts of the world. Due to the possibility of hybridisation and thermal energy storage, solar thermal power has the particular advantage of providing dispatchable power that helps to support grid stability, as opposed to many other renewable energy sources (Figure 14 shows a forecast for Solar Thermal levelized electricity costs of one of the main development studies: DLR's Athene model).

Figure 9.7: Development of levelised electricity costs and revenues from the power exchange market referred to by LEC of fossil power plants (plant project interest rate 8 %), 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



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ANNEX 10. SAFEGUARD POLICY ISSUES

Social Issues

The project is located in the Municipality of Agua Prieta, approximately 6.2 Km from Agua Prieta City. The 2000 National Census reported a total number of 63,942 inhabitants living in the municipality, with 99.87 percent of them residing in the Agua Prieta City. The industrial sector is the main source of economic activities in the area.

During the preparation of the project, a social screening was conducted. The result of the screening showed that the construction and operation of the project will not cause any social adverse impacts.

The project is located in an isolated area, 6.2 km from the Agua Prieta city and counts on excellent access by a federal road.

The installation and operation of the plant requires an area of 112 hectares.

The land where the project will be installed belongs to one legal private owner, and currently it does not have any productive or social use. The owner is willing to sell his property to CFE, and in accordance with the Mexican law, the value of the property will be appraised based on its commercial value.

The project is already included in the Municipal Development Plan and it will not create any conflict with other future development plans and/or proposed land uses.

A public consultation was held by CFE on May 4, 2006 with the attendance of representatives of local authorities, associations, mass media, NGOs, labor unions, church and communities members. The results of the consultation were positive. In general terms the participants welcomed the construction and operation of this innovative technological arrangement.

In terms of positive impacts, the project will generate 660 jobs during the pre-construction and construction phases. Of these, 450 will be provided to non-qualified labor. CFE expects these positions to be filled with local people. The more specialized work force is generally hired from the region or State.

During the construction and operation of the project CFE will implement the following community activities:

- Launch an energy efficiency program to lower household expenditure in electricity bills (e.g. incentives to replace old inefficient refrigerators and other).

- Implement a communication program during the construction and operation stages to inform local authorities, communities and different stakeholders about the project

- Due to the nature of a solar thermal hybrid facility, it is possible that the plant will attract international and national attention. CFE will explore the possibility to engage the community in a program for information and dissemination (e.g. schools, universities)

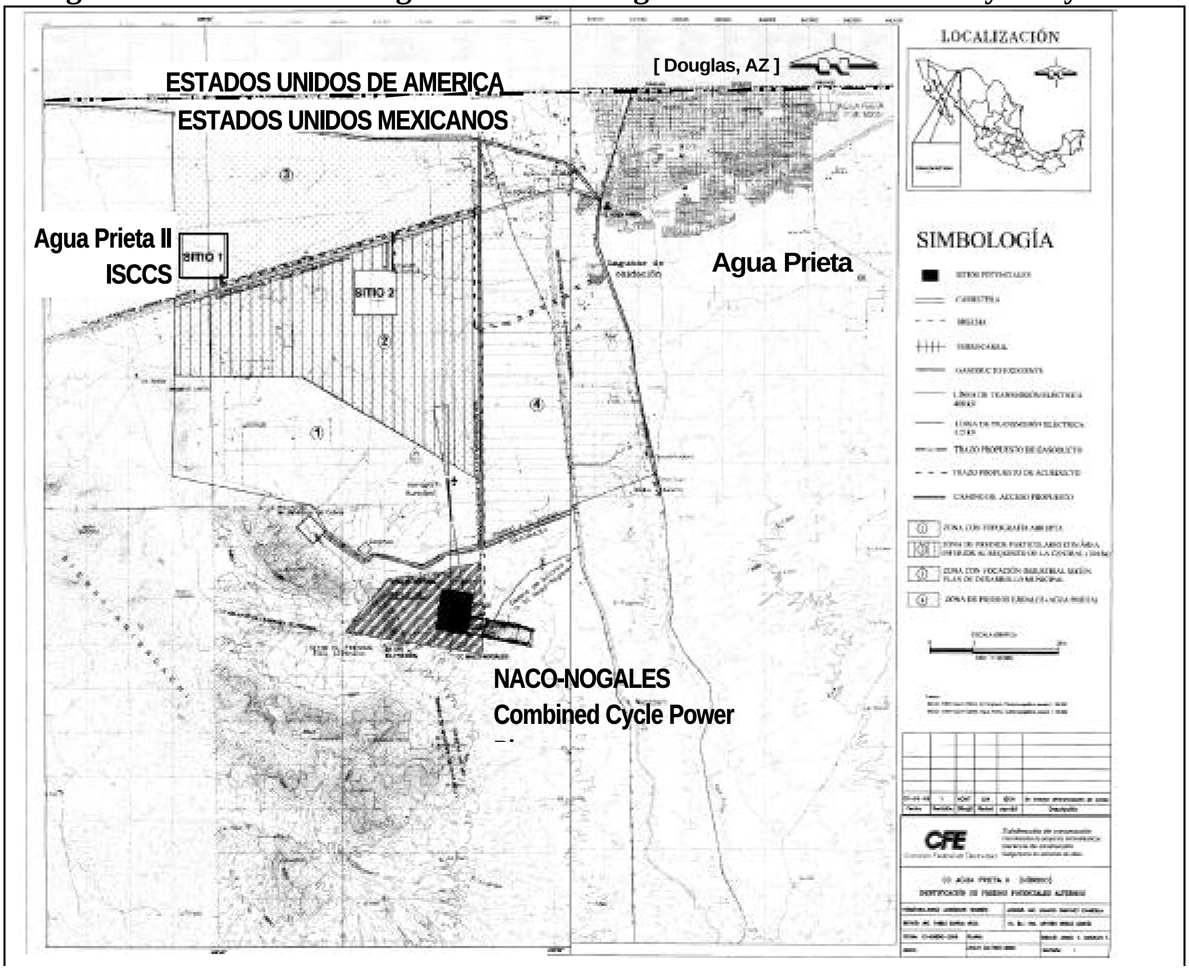
- The possibility to develop a botanical garden within the installations of the solar thermal hybrid plant is being explored. This will require the participation of local universities and local work force.

Environmental Issues

Project Site Description

The project site for the Agua Prieta II Integrated Solar Combined Cycle System (ISCCS) is located in the northern part of Mexico, approximately 6 kilometers south-west of the border between the City of Agua Prieta, State of Sonora, and the City of Douglas, Arizona (Figure 1). This zone has the characteristics of a desert, with very low precipitation, and a high incidence of solar radiation. Though some small scale agricultural production exists, the main source of income for the region comes from industrial activities, mainly manufacturing.

Figure 10.1: Location of Agua Prieta II Integrated Solar Combined Cycle System.



The region surrounding the project site has been significantly affected by human intervention. The city of Agua Prieta, approximately 6 kilometers east of the project site, is growing slowly and taking over agricultural land. The Naco-Nogales combined cycle gas power plant is 7 kilometers south-east. Oxidating lagoons for the water treatment plant for the city can be found east of the site, in the outskirts of the urban area. In addition, other industries such as quarries and assembly plants (maquiladoras) can be found in the region.

<u>Environmental Impacts</u>

The project is not expected to have significant adverse environmental impacts on human population or environmentally protected areas.

As mentioned before, this project is defined as a Category B given that its potential adverse environmental impacts on human population or environmentally protected areas are considered very small.

In accordance with the Mexican legal framework, CFE prepared an Environmental Impact Assessment (EIA) and obtained an environmental license for the project.

Based on these documents and the screening of the Agua Prieta II site, CFE prepared an Environmental Assessment Report to meet Bank requirements. In addition, CFE prepared an Environmental Management Plan (EMP)[28].

Environmental Impacts

The main environmental impacts expected from this project are associated with the disposal of hazardous waste material and the emission of air pollutants. Waste material is expected to be generated at all stages of the development of the power plant. The main types of expected waste pollutants are lube oils, contaminated soils, insulators, and solvents. An EMP was prepared to deal with these issues (as well as other potential impacts such as noise and impacts on local flora and fauna) and included in the EA. With regards to emission of air pollutants, climate dispersion models show that air pollution impacts from the operation of the power plant will be very low, and will typically range from 5%-50% of the norm established by the Mexican Ministry of Environment and Natural Resources (SEMARNAT). Table 1 below provides a summary of the main impacts and the proposed mitigation strategies. There are other minor impacts that are not included in the table below, but these are included in the EA.

Table 10.1: Main environmental impacts from Agua Prieta II ISCCS

	Impact	**Mitigation option**
Waste Management		
	Production of hazardous waste materials such as used lube oils, thermal insulators, solvents, batteries, and welding butts	Disposal of hazardous waste material will follow Mexican federal and local laws (1) - The general procedure states that hazardous materials will be stowed, in a confined place, for a maximum of 6 months at the plant, and then will be disposed of according to official national environmental standards - Lube oils and batteries should be recycled
	Soil polluted with lube or fuel oils, construction material soaked with greases and oils	
	Residuals from construction; residuals from land clearing and land leveling	These residuals will be stored in piles, and later carried by truck to be disposed of in authorized places
	Residuals from septic tanks and latrines	A specialized company will be in charge of their collection and transfer to a residual water treatment plant for its final disposal
	Domestic trash	This will be placed in closed metal containers. Municipal utility will transfer it for final disposal
Air Pollution		

[28] The EA and EMP are available in the project files.

Table 10.1: Main environmental impacts from Agua Prieta II ISCCS		
	Impact	**Mitigation option**
	During construction, air pollution emissions from vehicles used, dust and other particles, smoke from burning of materials	- All vehicles must meet the norms related to exhaust emissions [2] - To minimize the production of dust, main access roads must be humidified - All material carried in trucks for disposal must be covered with a canvas - Burning of trash or other materials is not allowed
	Air pollution emissions during operation	- Low NOx generating technologies must be used. NOx emissions must meet standards [3] - NOx and O_2 emissions must be continuously monitored - Air quality standards must be met [4]
Noise		
	From vehicles and construction equipment during construction	-Vehicles must meet sound norms [5] - Construction equipment must only be used during schedules of normal activity of the local population
	From the plant during operation	- A buffer zone 10 meters wide will be used to buffer sound. The recommended sound barrier should be composed of both trees and bushes that are native to the area
Notes: [1] Ley General de Equilibrio Ecologico y Proteccion al Ambiente en Materia de Residuos Peligrosos [2] NOM-041-ECOL-1993 for gasoline vehicles; NOM-045-ECOL-1993 for diesel vehicles [3] NOM-085-SEMARNAT-2001 [4] NOM-023-SSA1-2004 [5] NOM-080-ECOL-1994		

Under the above-mentioned conditions, this project is not expected to have any significant environmental impacts, and as such is classified as Environmental Category: B (Partial Assessment).

The Environmental Assessment (EA) includes: (i) a detailed description of the project (combined cycle natural gas power plant with solar generators) as well as the project location; (ii) a description of potential socio-economic impacts of the project; (iii) a detailed description of potential environmental impacts at each stage of development of the project, including hazardous waste generation, air pollution, noise pollution, and impacts on local flora and fauna.; (iv) and an environmental management plan.

What are the main features of the EMP and are they adequate?

The EMP provides a detailed description of the potential impacts at each stage of project development as well as the measures that should be followed in order to minimize such impacts. The main issues raised by the EA are related to the disposal of lubricants (including soil polluted with oil), solvents, and other waste products produced both during construction and operation. The EMP outlines clearly the existing federal norms and the steps that need to be followed at each different stage of the process in order to be in compliance with Mexico's environmental regulation and to minimize environmental impacts from the project. These steps are adequate and comprehensive.

How have stakeholders been consulted at the stage of (a) environmental screening and (b) draft EA report on the environmental impacts and proposed environment management plan? Describe mechanisms of consultation that were used and which groups were consulted?

A couple of preliminary meetings between the CFE and the authorities of the Municipality of Agua Prieta took place in the period September 2004 and November 2005 at the offices of the Municipal President, Carlos Alvarez Samaniego. The participants of these meetings included only government authorities: representatives of the municipal planning commission (COPLADEMUN), the municipal president and CFE representatives including the project manager and the project environmental engineer.

During these meetings CFE gave a presentation on the characteristics of the Agua Prieta II plant to government authorities and specifically requested information on the availability of municipal grey water. During these meetings, the representatives of COPLADEMUN explained the details of the Municipal "Plan de Ordenamiento Territorial" and confirmed that the Agua Prieta II plant was welcomed and that indeed grey water was available to supply the needs for operation and maintenance requested by CFE.

A formal consultation process was subsequently organized as described in detailed below.

Dates and Venues

The project consultation process included the following event:

The general project consultation took place on May 4th, 2006 at the Auditorio Deportivo Agua Prieta, at the Municipality of Agua Prieta, Sonora. The event was organized by the social communications unit of the CFE. Prior to the event, CFE extended a public invitation through posters and the local press and distributed a data sheet in the form of leaflets with information on the general characteristics of the project. The information was placed at convenient locations (Instituto Tecnológico, Offices of the Municipal President and other government Institutions). Prior to the event, CFE had disclosed the EA of the project at its official website[29].

The World Bank was also invited to participate in the consultation event however the task team could not to attend.

Participants

The participants included the municipal president, representatives of the COPLADEMUN, Director of Economic Development Municipality of Agua Prieta, about 86 people - including the civil society, students and professors of the Instituto Tecnológico- a representative of the El Paso

[29] www.cfe.gob.mx at link "negocios con CFE" in "licitaciones".

Natural Gas, and the local press (with the coverage of three different newspapers: Expresso, El Clarin and El Diario). Pictures of the consultation process are shown in the Figures below.

The consultation process consisted of presentation by different CFE representatives on the characteristics of the Agua Prieta Project including the technical details and the identified or expected environmental impacts including the mitigation measures and characteristics of various programs to be implemented during the different phases of the project (EMP). The CFE presentation followed a session of questions and answers of which a summary of results is presented below.

Results and Recommendations of the Consultation Process

The results of the consultation are summarized below.

Investment amount: the question was focused on what percentage of the total investment would be indirectly captured by the Municipality. CFE explained that the Municipality will benefit by the construction and operation of the Agua Prieta II Plant in the following ways: a) employment generation, b) purchase by CFE of the municipal wastewater (with income generation of about 65,000 USD per year[30] to the Municipality) and c) and number of initiatives that will promote education in energy efficiency at the household level and others contemplated in the EMP.

Impacts on the costs of regional electric tariffs: the community (as all the other communities or urban centers located at the North of Mexico where the extreme high temperatures signify a high electricity bill) wanted to know how the construction and operation of the Agua Prieta II plant will impact the regional electricity tariff level. CFE explained that the electricity tariff including the subsidy is defined by Secretaría de Hacienda y Crédito Pública (SHCP) and not by CFE. CFE also explained that the capacity addition of Agua Prieta II to the interconnected system will indeed have effects on the system's marginal cost (SMC) but further explained that SHCP defines the tariff levels based on a number of different considerations, which escape the decision making and authority limits of the CFE. In addition, CFE explained that they can contemplate activities to educate people on how to save energy and lower their electricity bill.

Implications regarding the promotion of tourism: the participants wanted to know if the Agua Prieta II project, being an innovative technology development plant, would attract tourism and the visit of schools, academic institutions, research centers and international visitors. CFE explained that it is indeed possible that the plant will attract visitors but also said it was difficult to predict the flow and or frequence of these visits.

Implications regarding the development of a local airport. As the Municipality is planning the construction of a local small one lane airport, they also wanted to know how the Agua Prieta II plant can affect this development (positively or negatively). CFE explained that it is difficult to predict the increase of tourism for visits to the Agua Prieta II facility. CFE also explained that the operation of the solar field would not affect this future initiative in a negative way.

The installation of future solar field or integrated plants and natural gas availability in the area. The Director of Economic Development of the Municipality of Agua Prieta wanted to know if the Agua Prieta II project can be replicated in the area and in general what is the availability of natural gas for future projects in the area. CFE explained that if the performance of the plant is good, it is possible that a similar hybrid plant is installed in the future in Mexico, although CFE at this stage doesn't know when, the scale or even the location.
With regards to the availability of natural gas CFE explained that both the Naco-Nogales plant (operated by Union Fenosa some kms away from Agua Prieta) and the Agua Prieta II Plant, will use imported natural gas from USA. The capacity of the existent natural gas pipeline is sufficient to supply these two plants during their life cycles.

Periods of construction and operation. CFE explained in detailed the program of activities.

Employment Generation. CFE clarified that considering the experience with the Naco-Nogales plant (located some kms away from the municipality if Agua Prieta), the plant is expecting to

[30] With a need of 21 L/sec. The tariff was set by the municipal authorities (1.2 Pesos/m3).

hire up to 1,500 local workers during the construction phase, of which 450 are expected to be allocated to people from the Agua Prieta Municipality. The local representative of the electricity sector union (CFE-SUTERM) confirmed they will advertise the types of position available in the local media soon after the bidding process is completed (November 2006).

Type and origin of the technology, environmental performance. There were some technical questions from the students and professors of the Instituto Tecnológico de Agua Prieta (ITAP) regarding the type of technology, the country of origin, and the NOx emissions associated with the installation. The CFE's technical team answer all technical questions and clarified that the Agua Preita II plant will comply with the Mexican standards (NOMs) and that the maximum allowable limits for NOx emissions specified in the bidding documents are even lower than those specified in the corresponding NOM.

Greenhouse Gas Emissions. Students of the ITAP wanted to know if the project will increase or reduce GHGs at the global and local levels and impacts of the plant on the local temperature. CFE explained that the solar field will contribute to reduction of X and that reductions in GHGs have an impact at a global level. CFE also explained that the temperature at the local level will not be affected.

Reasons why the plant will use wastewater from the Municipality. CFE explained that given the lack of water availability in the zone, the Agua Prieta II plant will use grey water from the Municipality in minimum quantities for general operation and maintenance activities including the cleaning of the solar mirrors. The grey water will be treated in situ in a small modular plant.

In general terms CFE reported a generalized acceptance to the project from the participants to the consultation event. The next the local press (Expresso, El Clarin and El Diario) issued informative notes on the project and a brief summary of what was said during the consultation. Two of the articles were positive about the operation of the plant, a third article showed skepticism regarding the benefits to the community.

Decisions

At the end of the session, CFE decided to formalize the implementation of programs and activities involving the community. The following programs were added to the second version of the EMP presented to the Bank before appraisal activities:

- Program to Support Community Activities: which includes activities associated to employment generation (*bolsa de trabajo*), education and civil protection. The activities are detailed in the EMP, included in the project files.

- Program to Support Municipal Initiatives: CFE offered a review of the Municipal "Plan de Ordenamiento Territorial" soon after the completion of the bidding process to determine whether the project can contribute to the "Plan de Ordenamiento Territorial" or Municipal Development Plan in any significant way.

-

Feedback Mechanisms and Disclosure

At the end of the event, the CFE's social communications unit distributed among participants a CFE press bulletin with information about the plant and CFE contact information for future questions and concerns regarding the project. CFE has also a local office in the area, and people were encouraged to contact the local representative for additional questions or concerns regarding the Agua Prieta II initiative.

In addition, SEMARNAT had disclosed the EIA of the project in its offices and made it publicly available for consultation. CFE also disclosed the EA and EMP of the project at its official website[31].

Recently, CFE received an invitation from the ITAP for a talk to students on renewable energy and the technical details of a solar field. CFE gave this presentation last May 24th at the Instituto Tecnológico de Agua Prieta (ITAP) with the participation of more than 85 people including students and professors.

The EA will be made publicly available by the Ministry of Environment (SEMARNAT) and through the World Bank's Infoshop.

What mechanisms have been established to monitor and evaluate the impact of the Project on the environment? Do the indicators reflect the objectives and results of the EMP?

The project's Environmental Monitoring and Follow-up Plan will be presented by the CFE to SEMARNAT's Office of Environmental Impact and Risk before the bidding process is completed. This will be a necessary condition to obtain SEMARNAT's clearance related to the project's environmental impact and initiate construction. The results from this Plan will be reported to the local and federal environmental authorities, and will be verified by PROFEPA (*Procuraduría Federal de Protección al Ambiente*). Mitigation and compensation measures are also included in the EMP.

The overall impact of the Project on greenhouse gas reduction will be monitored as a key output indicator.

[31] www.cfe.gob.mx

Annex 11: Project Preparation and Supervision

	Planned	Actual
PCN review		
Initial PID to PIC		May 25th, 2006
Initial ISDS to PIC		May 25th, 2006
Appraisal		June 14th, 2006
Negotiations		July 10, 2006
Board/RVP approval	October 3, 2006	
Planned date of effectiveness	December 4, 2006	
Planned date of mid-term review	June 11, 2007	
Planned closing date	October 31, 2009	

Key institutions responsible for preparation of the project:

Comisión Federal de Electricidad (CFE) with support from the *Secretaría de Energía* (SENER)

Bank staff and consultants who worked on the project included:

Name	Title	Unit
Gabriela Elizondo	TTL, Senior Energy Specialist	LCSFE
Ernie Terrado	Senior Energy Specialist, Consultant	LCSFE
Enrique Crousillat	Lead Energy Specialist	LCSFE
Juan David Quintero	Lead Environmental Specialist	ESSD
Elena Correa	Senior Social Specialist	ESSD
Efraim Jimenez	Lead Procurement Specialist	LCOAA
Juan Carlos Alvarez	Legal Counsel	LCOAA
Victor Ordonez	Senior Financial Management Specialist	LCOAA
Juan Carlos Serrano	ET Consultant	LCOAA
Hernan Gonzalez	ET Consultant	ESSD
Georg Caspary	ST Consultant	LCSFE

Bank funds expended to date on project preparation:

1. Bank resources: 0
2. Trust funds: $305,000 – GEF project Preparation Grant 'PDF B' (TF022852)
3. Total: $350,000

Estimated Approval and Supervision costs:

1. Remaining costs to approval: $45,000
2. Estimated annual supervision cost: $75,000

Annex 12: Documents in the Project File

- Sargent & Lundy. 2006. *Integrated Solar Combined Cycle System Project: Technical and Economic Evaluation*, A Report prepared for the World Bank. Project Number 11697-003
- Spencer Management Associates. 2006. *Technical Review of Study by S&L entitled Integrated Solar Combined Cycle System Project: Technical and Economic Evaluation and developed May 2006.*
- Federal Commission of Electricity (CFE). 2006. *Social and Environmental Assessment Project Agua Prieta II and Environmental Management Plan*.
- Global Research Alliance. 2005. *Assessment of the World Bank / GEF Strategy for the Market Development of Concentrating Solar Thermal Power*. A report for the World Bank.
- Sargent & Lundy 2004. *Feasibility Study of Integrated Solar Combined Cycle System (ISCCS) Mexico*. A Report prepared for the World Bank. Project Number 11697-001.
- Spencer Management Associates. 2000. *Final Report Mexico Feasibility Study for an ISCCS Mexico*. A Report prepared for the World Bank.

The project files also include all relevant official letters and communications between the Bank and the Government of Mexico including SHCP, SENER and CFE.

Annex 13: Statement of Loans and Credits

			Original Amount in US$ Millions						Difference between expected and actual disbursements	
Project ID	FY	Purpose	IBRD	IDA	SF	GEF	Cancel.	Undisb.	Orig.	Frm. Rev'd
P098299	2006	MX Competitiveness DPL	300.76	0.00	0.00	0.00	0.00	300.76	0.00	0.00
P091695	2006	MX Modernization Water & Sanit Sector TA	25.00	0.00	0.00	0.00	0.19	24.75	0.24	0.00
P089171	2006	MX GEF Environmental Services Project	0.00	0.00	0.00	15.00	0.00	0.26	0.00	0.00
P088732	2006	MX Access to Land for Young Farmers	100.00	0.00	0.00	0.00	0.75	97.01	21.76	0.00
P088728	2006	MX (APL1) School-Based Management Prog	240.00	0.00	0.00	0.00	0.00	240.00	27.00	0.00
P085593	2006	MX (APL I) Tertiary Educ Student Ass	180.00	0.00	0.00	0.00	0.00	180.00	21.35	0.00
P087038	2006	MX Environmental Services Project	45.00	0.00	0.00	0.00	0.00	45.00	0.00	0.00
P085851	2005	MX Basic Education Dev Phase III	300.00	0.00	0.00	0.00	1.61	99.84	-28.56	0.00
P074755	2005	MX State Judicial Modernization Project	30.00	0.00	0.00	0.00	0.00	30.00	7.00	0.00
P088080	2005	MX Housing & Urban Technical Assistance	7.77	0.00	0.00	0.00	0.00	7.13	3.55	0.00
P089865	2005	MX-(APL1) Innov. for Competitiveness	250.00	0.00	0.00	0.00	0.00	239.80	18.20	0.00
P087152	2004	MX (CRL1)Savings & Rurl Finance(BANSEFI)	75.50	0.00	0.00	0.00	0.38	25.29	-27.64	0.00
P080149	2004	MX Decentralized Infrastructure Developm	108.00	0.00	0.00	0.00	0.00	56.13	-7.87	0.00
P035751	2004	MX Community Forestry II (PROCYMAF II)	21.30	0.00	0.00	0.00	0.00	13.80	3.80	0.00
P035752	2004	MX Irrigation & Drainage Modernization	303.03	0.00	0.00	0.00	0.00	149.10	-17.93	0.00
P070108	2003	MX Savings & Credit Sector Strengthening	64.60	0.00	0.00	0.00	0.00	12.98	6.68	0.00
P059161	2003	GEF MX-Climate Measures in Transport	0.00	0.00	0.00	5.80	0.00	2.00	5.58	0.00
P065988	2002	GEF MX Consolidat.Prot Areas (SINAP II)	0.00	0.00	0.00	16.10	0.00	3.56	16.10	0.00
P077602	2002	MX Tax Admin Institutional Development	52.00	0.00	0.00	0.00	0.00	6.55	5.15	0.00
P060908	2001	GEF MX-MESO AMERICAN CORRIDOR	0.00	0.00	0.00	14.84	0.00	11.41	11.37	5.80
P066321	2001	MX: III BASIC HEALTH CARE PROJECT	350.00	0.00	0.00	0.00	0.00	265.74	240.44	42.99
P066674	2001	GEF MX-Indigenous&Community Biodiversity	0.00	0.00	0.00	7.50	0.00	2.61	6.82	0.00
P049895	1998	MX HIGHER ED. FINANCING	180.20	0.00	0.00	0.00	0.00	18.80	18.80	0.00
		Total:	2,633.16	0.00	0.00	59.24	2.93	1,832.52	331.84	48.79

MEXICO
STATEMENT OF IFC's
Held and Disbursed Portfolio
In Millions of US Dollars

		Committed				Disbursed			
		IFC				IFC			
FY Approval	Company	Loan	Equity	Quasi	Partic.	Loan	Equity	Quasi	Partic.
1998	Ayvi	2.86	0.00	0.00	0.00	2.86	0.00	0.00	0.00
	BBVA-Bancomer	11.33	0.00	0.00	0.00	11.33	0.00	0.00	0.00
1995	Baring MexFnd	0.00	0.29	0.00	0.00	0.00	0.29	0.00	0.00
1999	Baring MexFnd	0.00	1.41	0.00	0.00	0.00	1.41	0.00	0.00
1998	CIMA Puebla	3.25	0.00	0.00	0.00	3.25	0.00	0.00	0.00
2005	CMPDH	14.50	0.00	0.00	0.00	14.50	0.00	0.00	0.00
2006	Carlyle Mexico	0.00	20.00	0.00	0.00	0.00	8.28	0.00	0.00
	Chiapas-Propalma	0.00	0.97	0.00	0.00	0.00	0.97	0.00	0.00
2001	Compartamos	0.00	0.66	0.00	0.00	0.00	0.66	0.00	0.00
2004	Compartamos	15.23	0.00	0.00	0.00	15.23	0.00	0.00	0.00
2002	Coppel	25.71	0.00	0.00	0.00	25.71	0.00	0.00	0.00
2005	Coppel	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1999	Corsa	3.71	3.00	0.00	0.00	3.71	3.00	0.00	0.00
2005	Credito y Casa	20.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2004	DTM	17.04	0.00	0.00	0.00	17.04	0.00	0.00	0.00
2001	Ecomex	4.00	0.00	0.24	0.00	2.00	0.00	0.24	0.00
2000	Educacion	3.54	0.00	0.00	0.00	3.54	0.00	0.00	0.00
2005	FINEM	14.78	0.67	0.00	0.00	4.75	0.00	0.00	0.00
1998	Forja Monterrey	3.71	3.00	0.00	3.71	3.71	3.00	0.00	3.71
2001	GFNorte	97.81	0.00	0.00	0.00	47.81	0.00	0.00	0.00
1996	GIBSA	5.41	0.00	0.00	18.19	5.41	0.00	0.00	18.19
2000	GIRSA	22.50	0.00	0.00	30.00	22.50	0.00	0.00	30.00
2005	GMAC Financiera	117.96	0.00	0.00	0.00	9.63	0.00	0.00	0.00
1998	Grupo Calidra	4.67	6.00	0.00	0.83	4.67	6.00	0.00	0.83
2004	Grupo Calidra	22.23	0.00	0.00	0.00	21.49	0.00	0.00	0.00
1989	Grupo FEMSA	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00
1996	Grupo Posadas	1.60	2.60	0.00	0.00	0.00	2.60	0.00	0.00
1999	Grupo Posadas	0.00	0.00	10.00	0.00	0.00	0.00	10.00	0.00
1998	Grupo Sanfandila	4.29	0.00	0.00	1.40	4.29	0.00	0.00	1.40
	Grupo Su Casita	0.00	7.08	0.00	0.00	0.00	7.08	0.00	0.00
2006	Grupo Su Casita	0.00	7.68	0.00	0.00	0.00	7.68	0.00	0.00
2000	Innopack	0.00	13.29	0.00	0.00	0.00	13.29	0.00	0.00
	Interoyal	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00
2003	Lomas de Real	48.87	0.00	20.00	98.48	47.58	0.00	20.00	98.48
1998	Merida III	24.86	0.00	0.00	52.30	24.86	0.00	0.00	52.30
2003	Mexmal	0.00	0.00	1.30	0.00	0.00	0.00	1.30	0.00
1995	Mexplus Puertos	0.00	0.55	0.00	0.00	0.00	0.55	0.00	0.00
1999	Mexplus Puertos	0.00	0.25	0.00	0.00	0.00	0.25	0.00	0.00
2003	Occidental Mex	24.90	0.00	0.00	33.20	24.90	0.00	0.00	33.20
	Occihol	0.00	9.99	0.00	0.00	0.00	9.99	0.00	0.00

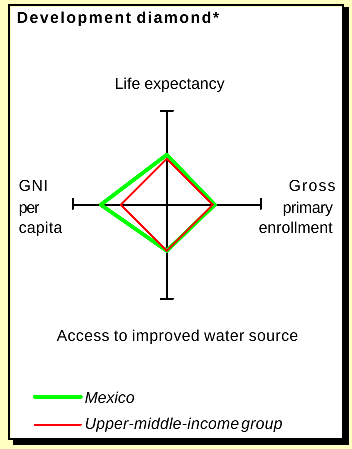
2003	POLOMEX S.A.	4.94	0.00	0.00	0.00	4.94	0.00	0.00	0.00
2000	Pan American	0.00	1.15	0.00	0.00	0.00	1.15	0.00	0.00
2002	Puertas Finas	8.94	0.00	0.00	0.00	8.94	0.00	0.00	0.00
2002	Qualita	0.00	0.00	3.50	0.00	0.00	0.00	3.50	0.00
2000	Rio Bravo	44.10	0.00	0.00	48.26	44.10	0.00	0.00	48.26
2004	SSA Mexico	44.75	0.00	0.00	0.00	44.75	0.00	0.00	0.00
2000	Saltillo S.A.	31.16	0.00	0.00	34.89	31.16	0.00	0.00	34.89
2000	Servicios	5.92	1.52	0.00	5.07	5.92	1.52	0.00	5.07
2004	Su Casita	16.12	0.00	0.00	0.00	16.12	0.00	0.00	0.00
2005	Su Casita	49.53	0.00	0.00	0.00	49.53	0.00	0.00	0.00
1997	TMA	1.11	0.00	3.29	3.86	1.11	0.00	3.29	3.86
2005	UNITEC	29.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	Valle Hermoso	51.40	0.00	20.00	105.61	50.81	0.00	20.00	105.61
	ZN Mexico II	0.00	7.40	0.00	0.00	0.00	5.83	0.00	0.00
1998	ZN Mxc Eqty Fund	0.00	1.69	0.00	0.00	0.00	1.69	0.00	0.00
	Total portfolio:	838.06	89.23	58.33	435.80	578.15	75.27	58.33	435.80

		Approvals Pending Commitment			
FY Approval	Company	Loan	Equity	Quasi	Partic.
2001	Ecomex	0.00	0.00	0.00	0.00
2003	Mexmal	0.00	0.00	0.01	0.00
2005	Coppel II	0.01	0.00	0.01	0.00
2000	Educacion	0.00	0.00	0.00	0.00
2001	GFNorte-CL	0.00	0.00	0.00	0.10
2006	BANSEFI AFORE	0.00	0.00	0.00	0.00
2006	Protego Sofol	0.00	0.00	0.00	0.00
2005	Centro Espanol	0.01	0.00	0.00	0.00
2005	Credito y Casa	0.02	0.00	0.00	0.00
2006	Mexico MBS CEF	0.03	0.00	0.00	0.00
2005	Pan American 2	0.00	0.00	0.00	0.00
2005	Sanfandila (R)	0.00	0.00	0.00	0.01
1998	Cima Hermosillo	0.00	0.00	0.01	0.00
	Total pending commitment:	0.07	0.00	0.03	0.11

Annex 14: Country at a Glance

MEXICO: Hybrid Solar Thermal Power Plant

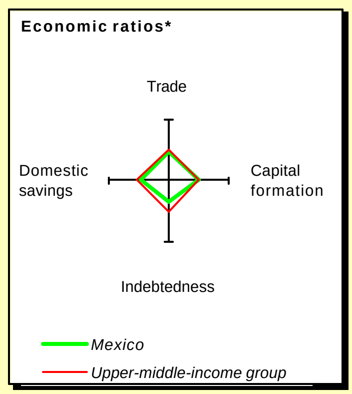
POVERTY and SOCIAL	Mexico	Latin America & Carib.	Upper-middle-income
2004			
Population, mid-year *(millions)*	103.8	541	576
GNI per capita *(Atlas method, US$)*	6,790	3,600	4,770
GNI *(Atlas method, US$ billions)*	704.9	1,948	2,748
Average annual growth, 1998-04			
Population *(%)*	1.4	1.4	0.8
Labor force *(%)*	2.5	0.9	-0.9
Most recent estimate (latest year available, 1998-04)			
Poverty *(% of population below national poverty line)*	18	..	..
Urban population *(% of total population)*	76	77	72
Life expectancy at birth *(years)*	74	71	69
Infant mortality *(per 1,000 live births)*	23	28	24
Child malnutrition *(% of children under 5)*	8	..	..
Access to an improved water source *(% of population)*	91	89	93
Literacy *(% of population age 15+)*	90	89	91
Gross primary enrollment *(% of school-age population)*	110	123	106
Male	111	126	108
Female	110	122	106


Development diamond*

KEY ECONOMIC RATIOS and LONG-TERM TRENDS

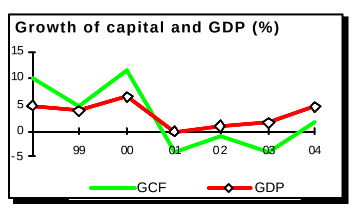
	1984	1994	2003	2004
GDP *(US$ billions)*	175.6	421.7	639.1	676.5
Gross capital formation/GDP	19.9	21.9	20.6	21.3
Exports of goods and services/GDP	17.4	16.8	27.8	30.1
Gross domestic savings/GDP	27.7	17.1	19.0	19.9
Gross national savings/GDP	22.7	14.9	19.3	20.8
Current account balance/GDP	2.4	-7.0	-1.3	-1.1
Interest payments/GDP	6.4	2.1	1.8	1.6
Total debt/GDP	54.0	32.9	22.0	20.8
Total debt service/exports	45.1	25.7	17.6	15.0
Present value of debt/GDP	..	..	24.6	..
Present value of debt/exports	..	..	80.7	..

	1984-94	1994-04	2003	2004	2004-08
(average annual growth)					
GDP	2.7	3.3	1.4	4.4	3.0
GDP per capita	0.8	1.8	-0.1	2.9	1.6
Exports of goods and services	6.0	9.6	2.7	11.5	4.1


Economic ratios*

STRUCTURE of the ECONOMY

	1984	1994	2003	2004
(% of GDP)				
Agriculture	9.4	6.0	3.9	4.1
Industry	34.9	26.8	25.8	26.4
Manufacturing	22.7	18.7	18.0	18.1
Services	55.7	67.2	70.3	69.5
Household final consumption expenditure	63.1	71.4	68.6	68.5
General gov't final consumption expenditure	9.2	11.5	12.4	11.7
Imports of goods and services	9.6	21.6	29.5	31.9


Growth of capital and GDP (%)

	1984-94	1994-04	2003	2004
(average annual growth)				
Agriculture	0.8	1.9	3.5	4.0
Industry	3.3	3.3	-0.2	3.8
Manufacturing	3.5	3.6	-1.3	3.8
Services	2.7	3.3	1.9	4.6
Household final consumption expenditure	3.6	3.7	2.3	5.5
General gov't final consumption expenditure	2.2	1.2	0.8	-1.2
Gross capital formation	5.6	4.8	-4.2	1.5
Imports of goods and services	14.8	10.6	0.7	10.2

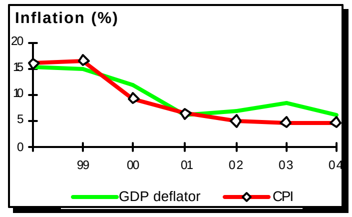

Growth of exports and imports (%)

Note: 2004 data are preliminary estimates.

* The diamonds show four key indicators in the country (in bold) compared with its income-group average. If data are missing, the diamond will be incomplete.

PRICES and GOVERNMENT FINANCE

	1984	1994	2003	2004
Domestic prices				
(% change)				
Consumer prices	65.4	7.0	4.5	4.7
Implicit GDP deflator	59.1	8.5	8.5	6.1
Government finance				
(% of GDP, includes current grants)				
Current revenue	31.2	22.7	23.2	23.2
Current budget balance	-1.2	3.3	2.2	3.1
Overall surplus/deficit	-6.4	-0.3	-0.7	-0.3



Inflation (%)

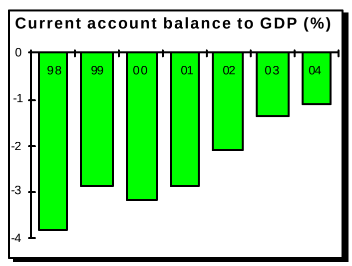
TRADE

	1984	1994	2003	2004
(US$ millions)				
Total exports (fob)	29,100	60,882	164,923	189,159
Oil	16,601	7,445	18,654	23,706
Agriculture	1,461	2,678	4,664	5,421
Manufactures	10,499	50,402	141,087	159,093
Total imports (cif)	15,916	79,346	170,546	197,247
Food	..	..	..	..
Fuel and energy	..	..	..	..
Capital goods	2,573	13,322	20,205	22,599
Export price index *(2000=100)*	114	90	105	117
Import price index *(2000=100)*	77	93	103	108
Terms of trade *(2000=100)*	148	97	102	108

Export and import levels (US$ mill.)

BALANCE of PAYMENTS

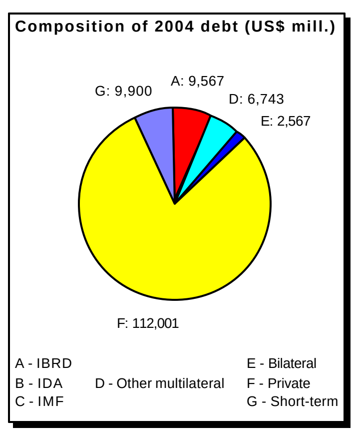
	1984	1994	2003	2004
(US$ millions)				
Exports of goods and services	33,926	71,184	177,299	201,911
Imports of goods and services	21,028	91,616	187,680	215,372
Resource balance	12,898	-20,432	-10,380	-13,460
Net income	-10,076	-13,012	-12,082	-10,938
Net current transfers	1,361	3,782	13,858	17,044
Current account balance	4,183	-29,662	-8,604	-7,355
Financing items (net)	-2,034	12,463	18,437	11,416
Changes in net reserves	-2,149	17,199	-9,833	-4,061
Memo:				
Reserves including gold *(US$ millions)*	7,355	6,300	59,027	64,204
Conversion rate *(DEC, local/US$)*	0.2	3.4	10.8	11.3



Current account balance to GDP (%)

EXTERNAL DEBT and RESOURCE FLOWS

	1984	1994	2003	2004
(US$ millions)				
Total debt outstanding and disbursed	94,830	138,545	140,391	140,778
IBRD	2,852	13,038	10,717	9,567
IDA	0	0	0	0
Total debt service	16,960	20,076	34,279	33,568
IBRD	485	1,989	1,972	2,499
IDA	0	0	0	0
Composition of net resource flows				
Official grants	27	47	..	..
Official creditors	832	-583	-372	-182
Private creditors	791	5,296	-418	1,578
Foreign direct investment (net inflows)	390	10,973	12,625	17,377
Portfolio equity (net inflows)	0	4,084	..	..
World Bank program				
Commitments	576	2,380	888	621
Disbursements	682	942	1,258	767
Principal repayments	253	1,065	1,359	1,976
Net flows	430	-123	-101	-1,209
Interest payments	233	924	613	524
Net transfers	197	-1,046	-714	-1,733



Composition of 2004 debt (US$ mill.)

Annex 15: Incremental Cost Analysis

Broad Development Goals and Baseline

About 73 percent of Mexico's installed power generation capacity of 44 GW is fossil fuel-based, with oil-fired plants, including combustion turbines, responsible for the largest share of both capacities (43 percent) and generation (49 percent). Combustion turbine plants comprise less than 8 percent of total generation and are used largely for meeting demands at peak and in isolated areas. Gas-fired plants represent more than 19 percent of generation, about the same share as hydro, with just below 14 percent of total generation capacity.

The most important element of Mexico's power sector development is the considerable re-arrangement of the fuel mix expected by 2014 which indicates a doubling of natural gas use and a 50 percent increase in coal for generation. By 2020 the IEA expects Mexico to increase gas use in the power sector five-fold, to 44 percent of all generation.

At the Federal level, the Energy Sector Program (PROSENER) establishes the increase in the use of renewable energy resources as a sector priority and defines a number of strategic actions including: i) development of programs, projects and actions to increase the use of renewables, ii) increase in the capacity share of renewable energy in the electricity sector, iii) strengthening of research and technology development activities on renewable energy and iv) promotion of education on renewable energy.

Recently policy measures were initiated to increase the market share of renewable energy. These include: i) a provision for Accelerated Depreciation, which makes 100% investment in renewable energy technologies after January 2005 eligible for depreciation in the first year, and ii) a proposed Renewable Energy Law (passed by the lower house of Congress in late 2005; pending before the Senate) that specifies a range of methodologies and dispatch conditions to better capture the value of contributions of renewable energy sources.

Global Environmental Objective

1. In accordance with the objectives of GEF Operational Program 7 the main global environmental goal of this project is to contribute to, and accelerate, the commercial break through of solar thermal technology worldwide. The project would add about 30 MW of additional solar thermal capacity. In conjunction with other planned GEF solar thermal projects of similar size in Egypt, and Morocco this will contribute to building critical mass and bringing down the production costs of this technology.

2. An ancillary global benefit of the project is the direct carbon abatement achieved by substituting solar energy for fossil fuels. Since the replaced fuel is natural gas and the proportion of the plant output attributable to the solar field is low, this benefit is relatively modest. It translates into carbon dioxide savings of about 391,270 tonnes over the 25 year lifetime of the plant.

GEF Alternative

3. The proposed GEF alternative is the construction of a solar thermal - fossil fuel hybrid instead of the planned pure gas-fired CCGT power plant in Sonora, Mexico (Agua Prieta II). The capacity of the planned CCGT plant ranges from 455 to 615 MW, with a minimum net summer design output of about 455 MW. A solar portion of about 30 MW will be integrated to the CCGT, resulting in a hybrid system called Integrated Solar Combined Cycle System (ISCCS).

4. The exact plant size and configuration will be confirmed after review of bids submitted to CFE by competing companies in in the period July-November, 2006. To assure that optimum technology at least cost is employed, the choice of technology and configuration will be left as open as reasonably possible within the parameters of CFE and the GEF Operational Program 7.

5. The incremental cost analysis presented here is preliminary and based on the results of a consultant study on the cost and performance of a possible ISCCS configuration for Agua Prieta II. The configuration studied has two industrial frame combustion turbines each associated with an HRSG and one steam turbine. This standard configuration is typically referred to as 2x2x1. A typical plant operation model was created to evaluate the performance of the ISCCS plant for each hour of the year taking into account hourly weather data for a typical year. This calculation took into account for each hour the influence of solar radiation, ambient temperature, and ambient relative humidity on the solar field, gas turbine and steam turbine performance.

5. The Reference Case analyzed has the following characteristics:

Table 15.1: Analyzed characteristics of ISCCS reference case

Plant type	Integrated solar combined cycle system
Nominal power (MWe, net)	485.5
Capacity of combined cycle portion	479.3
Solar field (MWe), peak	31
Solar field (MWe), average	6.2
Solar field (sq. meters)	120,000
Net electricity to grid (GWh/yr)	3402
Solar share (% of energy output)	2
EPC costs of ISCCS (US$ million)	$348,000
Levelized electricity costs w/o grant (US¢/kWh)	5.3

Scope of the Analysis

System boundary

6. The analysis is based on the direct comparison of the proposed solar thermal plant with the least-cost conventional solution in the same capacity range. It is recognized that the introduction of solar-thermal capacity to the national grid might require further adjustments in the system expansion plan, not least because the output from the proposed plant may not meet system peaking or baseload needs precisely. These system-wide effects are ignored in the current analysis. A simple plant-by-plant comparison is considered sufficient at this point, for the following reasons:

- The Mexican power system is growing relatively fast, with planned capacity additions of around 1,7 GW per year over the next 10 years. Relative to this expansion and the overall size of the system, the proposed addition (particularly the solar thermal element) is relatively minor and can be absorbed without major repercussions;

- There is a trade off between the spatial and temporal system boundary: A plant-by-plant comparison ignores systemic effects, but allows the analysis of the entire plant lifetime. A system expansion analysis, on the other hand, has a wide spatial system boundary, but usually covers no more than 10-15 years of plant life. In the current context -- where systemic effects are assumed to be small, and the time horizon of the expansion plan is relatively short -- covering the entire plant life was considered more important.

Additional domestic benefits

7. The GEF alternative will result in some improvements in domestic air quality, but these additional domestic benefits are marginal and can be ignored. Mexico has already initiated and implemented important actions dealing with local air pollution, especially in those areas where it is worst.

8. This project will position Mexico as one of the world leaders in the commercialization of solar thermal technology and as a potential source of goods and services for future Solar Thermal Power (STP) projects.

Costs

Capital costs

9. A cost estimate was developed for the a 2x2x1 configuration based on the GE Frame 7FB combustion turbine with standard pricing for remaining equipment. A separate cost estimate was also developed to establish the differential costs between a "standard" combined cycle plant and the configuration suitable to accept the solar energy based on the optimization approach. Finally, a cost estimate was developed for a "standard" combined cycle plant with duct firing equivalent to the energy produced by the solar field. This would be the baseline conventional CCGT plant.

Recurrent costs

10. The main recurrent cost elements are fuel purchases and operation and maintenance (O&M). Gas prices were taken from SENER's *alto* case which assume an average of 4.9 $/mmBtu for the period of analysis (2009-2033) at constant values. Annual non-fuel O&M costs were independently estimated on the basis of recent costs for similar combined cycle plants currently in operation. Adjustments were made to account for differences in staffing, labor rates, and operating assumptions. Costs were converted to annual values averaged over the long-term major maintenance cycle.

Incremental costs

11. The results of the incremental cost analysis for the Reference Case are shown in Table 15.2 below.

Table 15.2: Present Value, Levelized, and Incremental Costs, $ Millions
Reference Case (2009-2033)

Baseline (CCGT Plant)	Present Value	Capital Costs	Recurrent Costs
Capital Costs	**364.5**	**364.5**	
O&M Costs	**112.9**		**112.9**
Fuel Costs	**909.2**		**909.2**
Total Costs	**1,386.6**	**364.5**	**1,022.1**
Levelized Costs	**176.8**	**46.5**	**130.3**
$/MWh	**51.96**	**13.66**	**38.30**

Alternative (ISCCS Plant)	Present Value	Capital Costs	Recurrent Costs
Capital Costs	**418.6**	**418.6**	
O&M Costs	**121.1**		**121.1**
Fuel Costs	**884.6**		**884.6**
Total Costs	**1,424.3**	**418.6**	**1,005.6**
Levelized Costs	**181.6**	**53.4**	**128.2**
$/MWh	**53.37**	**15.69**	**37.69**

Incremental Costs	Present Value	Capital Costs	Recurrent Costs
Capital Costs	**54.2**	**54.2**	
O&M Costs	**8.1**		**8.1**
Fuel Costs	**-24.6**		**-24.6**
Total Costs	**37.7**	**54.2**	**-16.5**
Levelized Costs	**4.8**	**6.9**	**-2.1**
$/MWh	**1.41**	**2.03**	**-0.62**

Discussion of results and conclusions

12. The incremental capital cost—representing the additional upfront cost for establishing the solar component—is approximately $54 million. The net incremental cost, when fuel savings and non-fuel O&M costs are considered, is about $38 million. Sensitivity analysis shows that the incremental capital cost can range from $47 to $61 million and net incremental cost from $31 to $47 million depending on assumptions of higher or lower solar component costs by 10% and on variations of the discount rate from 10-14%. Although the above analysis is based on latest hardware costs and results of state of the art software simulation of ISCCS performance, the results are still preliminary estimates. However, they represent concrete starting points for bidders. Thus, the actual dimensions of the solar field and the final incremental costs of capital, fuel and non-fuel O&M could only be known after the bidding process and may differ significantly from the results of the above preliminary analysis

13. These preliminary results differ markedly from the earlier case of the Cerro Prieto plant in Mexicali (1999), where a solar component of approximately similar output as the present case was proposed to be added to a 245 MW CCGT. In that case, the incremental capital cost was

preliminarily calculated to be about $52 million, and the net incremental cost to be about $50 million, a relatively insignificant difference that, even if confirmed by the results of final bids, was not considered by CFE as an insurmountable barrier to project execution. The reason for this result was the very low gas price at the time of about US$2/MMBtu compared to US$4.9/MMBtu in the present case.

14. The differential in the present case of about $16-17 million is substantial and, if confirmed by the results of final bids, is equivalent to the amount that CFE itself would need to provide upfront, if the only grant available to it equals the net incremental cost of $38 million. Given the fact that the proposed technology is relatively new in Mexico, and that the O&M costs are uncertain, it is not reasonable to expect Mexico to fully finance the up-front capital costs of the plant. In addition to this uncertainty, the differential is based on future fuel savings that CFE considers uncertain. As well, CFE would need to request additional financing from the Ministry of Hacienda which is well above the budget ceiling already imposed by the Ministry on the Agua Prieta II project. Thirdly, since Congressional approval (a lengthy administrative process) is required for such an increase, the solar component would be so far behind the bidding process for the project that it may be dropped. Bidding for the Agua Prieta II project, with or without the solar addition, is set for June 27th, 2006.

15. The change in cost calculations presents a challenge to the implementation of the ISCCS demonstration project. The first option open to the Bank and GEF is to provide a grant of $38 million, corresponding to the estimated net incremental cost. For the reasons explained above, this decision almost certainly assures non-realization of the solar project. As stated above, the Bank does not believe that Mexico should bear the many risks. The proposed option is to provide CFE the full GEF grant of $50 million to be applied to the incremental cost of establishing the solar component. At the bidding stage, bidders will be asked to maximize the size of the solar field within the constraints of the available GEF grant of $50 million and the minimum power output requirements of the whole plant.

16. To compensate for the fuel savings benefit that is expected to be obtained during the operation of the ISCCS, CFE has agreed "on a good will basis" to apply an equivalent amount of funds to finance priority renewable energy projects chosen by the GOM. So as not to delay the bidding process, the exact modality of this agreement will be developed during implementation.

Matrix Summary

17. The results of the overall incremental cost analysis for the Reference Case are summarized in the matrix shown in Table 6.

Table 15.3: Incremental Cost Matrix

	Baseline	**Alternative**	**Increment**
Domestic Benefits			
a) physical	3,400 GWh per year of electricity	3,400 GWh per year of electricity	0
b) programmatic	CFE interest focused solely on conventional grid-connected power generation Minimal CFE/Energy staff capability to develop complex renewables-based generation projects	Demonstrated practical viability of utility-based solar thermal technology Participation in planning, preliminary design of technical and financial requirements, preparation of bidding documents for hybrid plant	Reduction of perceived risks in renewables-based power; gain in operational experience
Global Benefits			
a) environmental	1,225,500 tonnes of CO2 per year	1,209,900 tonnes of CO2 per year	15,600 tonnes CO2 abated per year (391,270 over 25 years of project)
b) programmatic	No hybrid solar thermal power plants in utility operation; high risk perceived by investors Solar thermal industry dormant with little future prospects; costs high	31 MW (peak) STP hybrid with 479 MW CCGT providing demonstration effect/combining impact with similar demonstration plants in other countries	More private investors globally willing to consider STP hybrid options Revitalized global STP industry
Costs (M$)			
Capital Costs	364.5	418.6	54.2
Fuel Costs	909.2	884.6	-24.6
O&M	112.9	121.1	8.1
Total	1,386.6	1,424.3	37.7
Amount of GEF grant proposed to be applied to incremental capital costs			$50

Process of Agreement

18. The current incremental cost estimates are based on the findings of the pre-feasibility study. Although the exact specifications and costs of the winning proposal will only be known until after the completion of the tender and the selection of the winning bid, the requested incremental capital cost grant of US$49.35 Million is not expected to change. The bidders will be encouraged to maximize the size of the solar component using the full amount of US49.35 Million.

Annex 16: STAP Roster Review

UNIVERSITY OF CALIFORNIA, BERKELEY

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ENERGY AND RESOURCES GROUP
310 BARROWS HALL
UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720-3050
WWW: *http://socrates.berkeley.edu/erg*

DANIEL M. KAMMEN
ASSOCIATE PROFESSOR OF ENERGY AND SOCIETY
DIRECTOR,
RENEWABLE AND APPROPRIATE ENERGY LABORATORY
TEL: (510) 642-1139
FAX: (510) 642-1085
EMAIL: dkammen@socrates.berkeley.edu
TEL & FAX: (510) 643-2243 (RAEL)

September 28, 1999

REVIEW AND EVALUATION OF

1. WORLD BANK/GLOBAL ENVIRONMENT FACILITY HYBRID SOLAR THERMAL POWER PLANT PROPOSAL

Project Summary:

This project proposal details the design, installation, and operation of a hybrid (gas-based fossil fuel & solar thermal) power plant that would have an installed capacity roughly 300 MW. A likely combination would be 270 MW from a Combined Cycle Gas Turbine (CCGT) using natural gas and 30 MW from an Integrated Solar Combined Cycle (ISCC) component. The project would be implemented by an Independent Power Producer (IPP) contractor under a Build-Own-Operate arrangement (BOO), with GEF grant of $52 million funding for the solar component. Mexican and foreign private commercial sources providing the roughly $128 million required for the CCGT system.

There are currently contracts for over 80 IPP facilities in Mexico, which are currently producing or are scheduled to provide almost 4,000 MW of power (> 21,500 GWh of annual production). The proposed hybrid solar thermal power plant would be located in Mexicali, Mexico, where in the state as a whole over 500 MW of new capacity is anticipated and needed over the coming decade. This demand, and the commitment by the Government of Mexico and the Federal Electricity Commission (CFE) to expanding the clean energy component in the national mix together provide an excellent environment for the successful planning and implementation of the hybrid solar thermal project.

The project would be the first large-scale commercial solar thermal power facility in a developing nation. It is envisioned to both build experience with solar thermal power plants to lower cost through experiential learning, and in particular to develop expertise within the Mexican industry so that they can compete for future contracts both regionally and internationally.

Overall, this is an excellent project that should be supported. Solar thermal power generation facilities are technically ready for deployment, and the hybrid nature of this facility reduces the risk and thus increases the attractiveness of the installation to a prospective IPP. Cost reductions require operational experience and sustained project implementation. The opportunity to build technical and economic experience with a diversity of IPPs, as well as seeding further renewable energy capacity in the Mexican national grid are key steps to a sustainable clean energy industry.

General Issues and Comments:

The solar component (the ISCC field) will be operated for intermediate and peak loads rather than as a base-load plant. This increases the attractiveness of the facility in terms of overall plant efficiency, and thus improves the overall financial attractiveness to the prospective IPP. A basic premise of the project, however, is that the design, construction and operation of this facility will increase the experience with hybrid power plants. This will, in turn, decrease costs and increase the viability of future renewable energy power generation facilities. Thee justification for this approach is the well-documented learning by doing, or experience curve process (Neij, 1997; Vettas, 1998; Duke and Kammen, 1999)[32]. The experience curve model relates decreases in per unit generating costs as a function of total units produced (typically a 20% decrease in cost for each doubling of capacity). There are two issues relating to the application of experience curve theory that need to be discussed in relation to this project.

First, the renewable energy component of this project is relatively small (30 MW solar: 270 MW gas, or a renewable energy contribution factor of only 11%). There is little doubt that a CCGT plant with such a small solar component added on for peak shaving will work well. Thus, an argument needs to be added to the Concept Document indicating why this project is justified. Potentially two approaches could be pursued. One argument is that a proof of concept is justified and that little or no solar thermal power capacity would be considered seriously or installed without this initial project. Further, the project document could and should indicate why a policy directive by the CFE could not achieve the same goal (e.g. requiring a renewable component for IPP proposals) without the large grant ($52 million grant package). Given the

[32] The Photovoltaic Market Transformation Initiative (PVMTI) implemented by the International Finance Corporation is also based on this theory (World Bank, 1996).

commitment of the CFE to clean power, it is not obvious off-hand why this second strategy alone would not work.

Second, cost improvements through learning generally assume that the manufacturing will be of similar units where production and management lessons can inform later production of additional similar units. The peaking facility proposed here is, however, likely to be a fairly unique. It is therefore not clear that the design, manufacturing, installation and operating lessons learned from the ISCC component will, in fact, generate new capacity and experience applicable to other units that would likely be installed in the near future. Given the uniqueness of this project design, and the lack of other similar projects elsewhere, how will production and operation of this facility position the successful company for further solar thermal projects in Mexico or abroad? This needs to be addressed directly in the document, because if the answer is 'no', then it is difficult to justify this outlay, even with such a compelling overall project[33].

In several places the project document indicates that a detailed forecast of likely tariff structures must wait for the selection of the IPP and the approval of specific project plans (e.g. section E.2). While the electricity tariffs charged to consumers will be not be impacted by this proposal, the plant profitability will likely be impacted by the design and the operation of the solar peaking facility. In light of this, it makes sense for the Concept Document, or an associated financial feasibility study, to explore the potential impacts of the solar hybrid component on the overall plant economics.

The Incremental Cost Analysis (Annex 4) is particularly clear and complete, and could serve as a model for other project analysis presentations. In particular, if this material were available as a spreadsheet that public and private sector (e.g. IPP) organizations could access, it might clarify the thinking and spur additional proposals for clean energy projects such as the hybrid solar thermal power plant.

[33] Furthermore, it is unclear how the award of one contract for this project will contribute significantly to the program goal of 10 solar thermal supply companies by the year 2010. Will, for example, follow up contracts, additional projects, or other measures to stimulate the industry beyond this particular hybrid solar thermal power plant be awarded or stimulated by the Mexican government? If not, is there a feeling or a set of analysis to suggest that supporting this plant will build sufficient industry interest or infrastructure to spur further private-sector activity?

Specific and Minor Comments:

The *Global Environmental* project goals (Section A.1) stated in the summary are: (a) improving the economic attractiveness; and (b) developing backstop technologies as the objectives of this project. Direct reduction of greenhouse gas emissions should be included in this listing (this may be a simple oversight, given that this is correctly listed in Section C.3). In Annex 4, Table 6 the avoided emissions (based on a similar size fossil-fuel only facility) are estimated to be over 8,000 tC/year, or over 200,000 tC for full project lifetime.

The projected date for solar thermal power plants to be competitive with fossil fuels (2025, as per Annex 1, Table) is surprisingly distant. If this date is true, it is less clear that projects such as this one can reasonably said to have discernible impact in terms of market enhancement and acceleration.

References:

Duke, R. D. and Kammen, D. M. (1999) "The economics of energy market transformation programs", *The Energy Journal*, **20 (4)**, 5 – 55.

Neij L. (1997). "Use of experience curves to analyze the prospects for diffusion and adoption of renewable energy technology," *Energy Policy*, **25 (13)**, 1099-1107.

Vettas, N. (1998). "Demand and supply in new markets: diffusion with bilateral learning", *Rand Journal of Economics*, **29**, 215-233.

World Bank Group (1996). "Photovoltaic Market Transformation Initiative project documents," International Finance Corporation Staff.

Response by the Project Team to Comments by the STAP reviewer

MEXICO: Hybrid Solar Thermal Power Plant

Second page of STAP comments, paragraph 2, first part

Smallness of the demonstration project. The proposed argument is valid and crucial. No ISCCS plant has been constructed, and a proof-of-concept installation will reduce risks, or perceived risks, with respect to the optimal configuration, HRSG design issues and system control issues. It is important that this first step be manageable. From the systems aspect, a larger system will present a greater design and operational challenge, and higher risk. From the cost aspect, a tradeoff has to be made between having a high solar component that has larger demonstration impact but costs more and a low solar component with a relatively smaller demonstration effect but with a more manageable incremental cost. From the solar system viewpoint, the modularity of the technology means that even this smaller system is very relevant to future large projects. Along with other contemplated pilots elsewhere , the present project will contribute to providing cost reduction manufacturing opportunities to the solar thermal industry in the long term (See revised Section B1a).

Second page, paragraph 2, second part

Mandating inclusion of solar component. Due to the higher cost presently of Solar Thermal Power compared to pure combined cycle gas turbine (CCGT) plants, it is not possible for CFE to mandate to IPPs the inclusion of an STP in future bids unless it is willing to pay for the higher cost of power (See revised Section B3).

Second page, paragraph 3

Value of "unique" plant design. First, the project design has many aspects in common with other possible ISCCS variations, and is not particularly unique with respect to later plants. Second, Mexico is not unique amongst GEF-eligible countries in terms of having economic dispatching of supply resources to meet intermediate and peak loads. As other developing countries' electric power sectors become more mature,, there will be further opportunities for intermediate and peaking power plants rather than just baseload.

The Mexico experience, combined with a successful demonstration phase for the overall global GEF program, cannot but position Mexico (not just the winning IPP) as an important player with respect to future plants. Even if different variations of STP technology emerge in the future, the planning, design, implementation and parts manufacturing experience acquired in this project by the Mexicans, as well as from other capacity building activities planned for the project, will definitely result in a cadre of Mexican professionals that will be in demand as technical advisers, consultants and parts provider to future plants. On the footnote comment as to how one project can possibly result in up to 10 more plants 2010, the answer is it cannot but the possibility increases if the overall GEF program for 3-4 countries is considered (See revised Section D1).

Second page, paragraph 4

Tariff structure. The "tariff" referred to by the reviewer is the payment to the IPP by CFE for power delivered. The information provided by the previous SMA study, while extensive, is insufficient to present a credible payment schedule to the IPP, particularly as regards the GEF grant component. The scope of that study did not include a detailed analysis of options for disbursement of the GEF grant. The present consultant study will examine several scenarios for the grant payment terms and schedule with the principal objective of ensuring maximum utilization of the solar component during plant operation. It is possible that with a properly optimized design of the integration of the STP with the CCGT that there will be a natural incentive for the plant operator to maximize the generation of solar electricity, in which case full disbursement of the GEF grant could be made at the investment stage. If this is found to be not feasible, a disbursement schedule linked to operational performance would be designed (See revised Section E2).

Third page, paragraph 1

Emissions reduction goal. Actually, the direct reduction of GHG emissions is, from the point view of the GEF, a secondary and minor objective of the installation. The overriding goals are "programmatic" in nature, which are to contribute, along with other contemplated pilot plants elsewhere, to improving the economic attractiveness and hence demand for the technology.

Third page, paragraph 2

Forecast date for competitiveness. There is a very large uncertainty band associated with this projection. The justifications for this forecast and the impact of the phase one demonstration plants were made in the GEF-commissioned Cost Reduction Study.

Annex 17: Maps