# Global Environment Facility

GEF

**Leonard Good**
*Chief Executive Officer*
*and Chairman*

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June 2, 2006

Dear Council Member,

The World Bank, as the Implementing Agency for the project, ***Mexico: Large Scale Renewable Energy Development Project***, has submitted the attached proposed project document for CEO endorsement prior to final approval of the project document in accordance with the World Bank procedures.

The Secretariat has reviewed the project document. It is consistent with the proposal approved by the Council in May 2003, and the proposed project remains consistent with the Instrument and GEF policies and procedures. The attached explanation prepared by the World Bank satisfactorily details how Council's comments and those of the STAP have been addressed. I am, therefore, endorsing the 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 the World Bank or UNDP 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: May 31, 2006

TO: Mr. Leonard Good, CEO/Chairman, GEF

FROM: Steve Gorman, GEF Executive Coordinator

EXTENSION: 35865

SUBJECT: **MEXICO: Large-Scale Renewable Energy Development 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 and endorsement. This project was approved for Work Program entry at the May 2003 Council meeting, under streamlined CEO endorsement procedures. The scheduled Board date for this project is June 29, 2006. We would appreciate receiving your response, so that we may finalize the Bank Board submission, by June 6, 2006.

2. The GEF Project Document is fully consistent with the objectives, scope, and overall cost of the proposal approved at the May 2003 Council meeting. GEFSEC, STAP, and Council comments have also been addressed. Modifications to the Project Document and how comments have been addressed are detailed in the table below.

| Council Comments | World Bank Response |
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| 1. <u>From the German Council Member</u> | |
| • The Mexican Energy Ministry presented the GEF-project to the German delegation in February, 2003 and asked for German support (technical as well as financial assistance). GTZ and KfW are currently examining the different possibilities to support the project and the sector in general. | • The project team consulted closely with BMZ/GTZ throughout the preparation of the project. BMZ/GTZ will be providing US$0.12m of co-financing for the technical assistance activities of the project (in addition to GEF TA funding of US$3.9m).<br><br>• Specifically, BMZ/GTZ co-financing will contribute towards technical assistance activity 1.1 (in the Project Document): an evaluation of methodologies and development of operational guidelines to interpret least cost power acquisition mandate and assessment of the value of energy diversification, including the application of the Capital Asset Pricing Model, |

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| | options analysis, probabilistic simulation and other approaches. |
| 2. <u>From the French Council Member</u><br><br>• This project is very ambitious and the contribution of the GEF is very important It would be appropriate to obtain more precise explanations on the following points: | |
| i. One does not include/understand well how is established the total cost of 272 M$ on the basis of aggregate wind park of 100 MW -115 M$- (see summary) or 200 MW. | i. The early cost estimate included costs for the development of wind energy self-supply projects. The total cost is now estimated at US$150 million (investment + GEF grant) for the La Venta III project, and self-supply project costs are not included. |
| ii. The considered wind fields are not described. The speeds of the winds and their availability, (and thus their producible in kWh) are not highlighted so that it is difficult to appreciate the interest of the Mexican wind. | ii. Annex 4 details the high quality of the wind resource. |
| iii. The institutional framework of the wind IPP is not well defined, so that it appears delicate to commit on two heavy phases. | iii. This project, as proposed, is for Phase I only. A further project document will be submitted to the GEF if the decision is taken to undertake a Phase II. |
| iv. In addition, 8 M$ for the technical aid in a sector, which already beneficiated from the support of the PNUD-GEF and knew a first experiment in la Ventos, appear quite high and should be argued. | iv. The technical assistance requirements have been scaled-down to US$3.9 million. As carefully coordinated with UNDP, the UNDP/GEF project focuses on wind energy technology development, whereas the World Bank/GEF project focuses on wind energy market development. |

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| 3. <u>From the Swiss Council Member</u><br>i. Focus on wind energy, locking out other, potentially viable RETs. | i. While the project's ability to support a broader range of RE technologies is limited by resource constraints, wind energy (as a large-scale and replicable resource with relatively low incremental costs) was considered to be the most favorable target for a combined policy/tariff support intervention, and as a foundation for replication. Resource and market information on additional technologies that could be addressed in a potential Phase II were investigated under the PDF-B as "Preliminary Assessment of the Potential for Electricity Generation in Mexico with Renewable Energy other than Wind" (Instituto de Investigaciones Eléctricas, IIE). A summary of this information is found in Annex 1, and the full document is available in the project files. |
| ii. Unclear coordination between WB and UNDP initiatives | ii. Regular consultation and coordination, chaired by SENER, has taken place throughout project development between SENER, IIE, UNDP, and the World Bank, and will continue during the implementation phase. The projects are fully complementary. |
| iii. Unclear implications of key role of SHCP in setting consumer tariffs | iii. Consumer tariffs affect the long-run financial sustainability of the electricity sector. However, their possible inadequacy does not threaten the achievement of the objectives of the GEF project. CFE (Comisión Federal de Electricidad, the national electricity utility) willingness to pay for wind energy has been set on the basis of avoided generation <u>costs</u>, not tariffs. |
| iv. Unclear consumer tariff issues | iv. These issues will be studied and addressed during the implementation of the technical assistance activities. However, it should be noted that the question of least-cost <u>dispatch</u> of generation sources, including environmental externalities, can be separated from the question of how any environmental cost burden will be allocated. The latter is the subject of an |

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| | ongoing dialogue between SHCP (Minstry of Finance and Public Credit (*Secretaría de Hacienda y Crédito Público*) and CFE. |

| **GEF Secretariat – Expected at CEO Endorsement** | **World Bank Response** |
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| 2. <u>PROGRAM AND POLICY CONFORMITY</u><br><br><u>Project Design</u>:<br><br>• Outputs of PDF-B activities | • PDF-B financed outputs consist of the following and are available in the Project Files and reflected in the GEF Project Document:<br>i. "Financial Mechanism and Guidelines for GEF Incentive Support" (Protego Asesores et al)<br>ii. "Work Plan for Business Development and Financing Facilitation Services" (Protego Asesores et al)<br>iii. "Project Implementation Plan" (Protego Asesores et al)<br>iv. Installation, training and simulations with WASP IV generation planning model (Argonne National Laboratories)<br>v. Incremental cost analysis – Project Document Annex 15 (Dr. Donald Hertzmark, with CFE Programmación)<br>vi. "Preliminary Assessment of the Potential for Electricity Generation in Mexico with Renewable Energy other than Wind" (Instituto de Investigaciones Eléctricas, IIE, Mexico Electric Power Research Institute) |
| • Implementation Plan for the Project | • Please see item (iii) immediately above, as fully reflected and detailed in Annex 6 of the Project Document |
| • Final set of conditions for release of Phase II funds | • These are defined in Annex 4 of the Project Document as:<br>i. Definition of a clear policy, contractual, and market framework for acquiring renewably- |

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| | generated power by CFE, including introduction of a competitive tariff support function of no more than US 1.5 cents/kWh delivering $ 17 million of GEF funds to private sector investors, resulting in the acquisition of at least 70 MW renewable energy generation capacity in Phase I. *If the La Venta III project is successfully bid-out and implemented, these benchmarks will be exceeded by a comfortable margin.*<br><br>ii. Under GEF supported technical assistance in Phase I, establishment of a pricing and procurement methodology for properly valuing renewable energy additions to the CFE system, shifting from a proxy plant, short-run marginal cost (SRMC) based tariff to an enhanced valuation based on (i) full system SRMC, plus (ii) adjusted capacity value associated with the renewable energy power generation capacity, plus (iii) energy portfolio diversification value of the renewable power generation capacity. *This trigger has already been substantially met by Phase I project appraisal. CFE's methodology for valuing the wind power output of La Venta III recognizes (i) full system SRMC, plus (ii) an estimate of the adjusted capacity contribution of the wind resource. Further recognition of the capacity contribution of intermittent energy sources will be promoted under Phase I project technical assistance designed to improve system dispatch modeling and control, and introduce day-ahead and hour-ahead wind forecasting to improve operational predictability. Estimation and incorporation of energy diversification value of renewables is similarly to be addressed under Phase I technical assistance.*<br><br>iii. Decline in the need for subsidies over time, demonstrated by a shift from a maximum GEF grant of 1.5 US cents per kWh of wind energy generation in Phase I to a reduced maximum GEF grant in Phase II. This figure |

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| | is estimated to be less than 1 US cent per kWh of wind energy generation in Phase II. *The 1.1 US cents per kWh GEF grant adopted in Phase I indicates substantial progress toward longer-term price competitiveness goals.* |
| • Commitment by CFE and SENER to: | • As documented in the Project Document: |
| i. Define methodology for calculating least-cost | i. CFE's methodology for valuing the wind power output of La Venta III recognizes (i) full system SRMC, plus (ii) an estimate of the adjusted capacity contribution of the wind resource. Further recognition of the capacity contribution of intermittent energy sources will be promoted under Phase I project technical assistance designed to improve system dispatch modeling and control, and introduce day-ahead and hour-ahead wind forecasting to improve operational predictability. Estimation and incorporation of energy diversification value of renewables is similarly to be addressed under Phase I technical assistance. |
| ii. Acquire RE power under competitive procurement at an agreed reference price | ii. With SENER approval, CFE requested the Ministry of Finance (Hacienda) for the authority to structure and competitively procure a 101 MW IPP wind farm. This request formed part of the Federal Budget which was approved by the Mexican Congress in December 2005. CFE's willingness to pay is indicated by the bid reservation price derived from their system long-run marginal avoided cost of energy and capacity contributions from the La Venta III project. |
| iii. Establish a financial mechanism to provide competitively bid subsidies for competitively acquired RE power | iii. The establishment of the GEF capitalized financial mechanism is integral to the economic justification submitted by CFE to the Ministry of Finance and its operation is detailed in the project Operational Manual. |
| • Development of standard bidding and contractual forms for renewable energy projects | • Presentation of a draft wind Power Purchase Agreement contract satisfactory to the Bank |

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| | was a Condition of Negotiations. Presentation of a final wind PPA and incentive allocation provisions satisfactory to the Bank is a Condition of Disbursement. Extension to other forms of renewable energy acquisition is addressed through GEF-financed technical assistance. |
| • Establishment of agreed methodologies for least-cost calculations | • CFE's methodology for valuing the wind power output of La Venta III recognizes (i) full system SRMC, plus (ii) an estimate of the adjusted capacity contribution of the wind resource. Further recognition of the capacity contribution of intermittent energy sources will be promoted under Phase I project technical assistance designed to improve system dispatch modeling and control, and introduce day-ahead and hour-ahead wind forecasting to improve operational predictability. Estimation and incorporation of energy diversification value of renewables is similarly to be addressed under Phase I technical assistance. |
| • Detailed operations manual for NAFIN [as financial agent in place of BANOBRAS] | • Presentation of a draft Operational Manual, satisfactory to the Bank, was a Condition of Negotiations. |
| • Development of a framework for identifying, assessing and managing potential environmental impacts related to the program and subprojects | • An Environmental Manual has been developed which will become an annex to the CFE bidding documents for La Venta III, and which adherence will become binding on the winning bidder. Certification by the independent party (retained by SENER) of environmental compliance, satisfactory to the Bank, is a Condition of Disbursement. |
| • Establishment of technical standards for inter-connection and assessment of networks to accommodate renewable energy systems. | • As documented in the Project Document, provisions of the September, 2001 renewable energy self-supply regulations, as enacted by the regulator, the Comisión Reguladora de Energía, were amended and gazetted on January 30, 2006, and are available on the CRE web site: www.cre.gob.mx |
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| 2. PROGRAM AND POLICY CONFORMITY<br><br>Monitoring and Evaluation:<br><br>• A detailed M&E plan with a budget, final organizational arrangements for implementing M&E and specification of indicators, including benchmarks and means of measurement. | • Please see Annex 3 of the Project Document. |
| 3. FINANCING<br><br>Financing Plan:<br><br>• All project co-financing (government, private and bilateral) will be lined up and properly documented by CEO endorsement. GEF will not release any funds for the financial mechanism (tariff supports) until all co-financing is in place. | • With SENER approval, CFE requested the Ministry of Finance (Hacienda) for the authority to structure and competitively procure a 101 MW IPP wind farm. This request formed part of the Federal Budget which was approved by the Mexican Congress in December 2005. Under the Mexican Government's PIDIREGAS scheme for privately financed works for "public service" purposes, the Government of Mexico provides its sovereign guarantee that CFE will meet is power off-take and payment obligations to the IPP, and CFE is obligated to buy out the asset (the wind farm) should it fail to abide by its obligations. This provides high assurance to IPP bidders and their financiers. In addition, CFE IPP procurement regulations require bidders to demonstrate financial strength as part of the pre-qualification process, and the PPA including its GEF incentive allocation provisions is not executed until IPP project financial closure is reached. |

| **STAP Review Comments** | **World Bank Response** |
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| | *(The STAP reviewer was broadly supportive of the project design at work program entry. Most concerns were addressed at that time, and this* |

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| | *exchange is included as Annex 18. Other issues have been addressed in the GEF Secretariat Review Sheet comments described above; only residual issues are addressed here).* |
| • Phase I focus on only wind energy is potentially restrictive | • While the project's ability to support a broader range of RE technologies is limited by resource constraints, wind energy (as a large-scale and replicable resource with relatively low incremental costs) was considered to the most favorable target for a combined policy/tariff support intervention, and as a foundation for replication. |
| • More discussion required on other RE technologies and their potential | • As above. Resource and market information on additional technologies that could be addressed in a potential Phase II were investigated under the PDF B as "Preliminary Assessment of the Potential for Electricity Generation in Mexico with Renewable Energy other than Wind" (Instituto de Investigaciones Eléctricas, IIE). A summary of this information is found in Annex 1, and the full document is available in the project files. |
| • Additional details needed on project monitoring | • A detailed M&E plan has been prepared and is included as Annex 3 of the Project Document. |
| • Identification of global environmental global benefits should be reconciled | • These benefits have been re-estimated in detail using the WASP IV/ENPEP model, and revised figures are described in Annex 15. |

3. A significant change concerns the process for the determination of the GEF output-based subsidy. Originally the GEF subsidy was to be determined as an outcome of the CFE competitive solicitation for the La Venta III IPP wind farm. While various approaches were explored to efficiently allocate the GEF tariff support element under such a scheme, they proved to be unwieldy and in themselves at odds with CFE legal mandates: CFE must specify a one-time budget authorization from Hacienda (Min. of Finance) to undertake the project. In this budget request, CFE must demonstrate: (a) economic feasibility, and (b) a precise level of maximum contingent liability. In addition, under Mexican federal procurement rules, CFE cannot issue the bid package unless they have legal certainty (i.e., World Bank Board approval) that the GEF grant resources are available. This situation requires fixing the GEF support level on an *ex-ante* basis based on detailed simulations of CFE avoided costs and estimates of

technology supply costs (similar to all other GEF grant investments). Appraisal was therefore based not on the winning bid, but on the conformance of the IPP project design, as contained in the officially adopted Least Cost Plan (POISE) and Federal Budget request (PEF), with Bank energy sector and GEF climate change programmatic criteria. This situation was reviewed with GEF Secretariat on December 20, 2004, and the Secretariat concurred with the use of an *ex-ante* determined per-unit subsidy.

4. 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. GEF PROGRAM COORDINATION (GEFSEC); Goldmark, Feinstein, Crousillat, Papathanasiou, Elizondo, Farchy (LCSFP); Albert (LCSES); Khanna, Wedderburn, Monier-Illouz, Govindarajalu, Kennedy (ENV); ENVGC ISC, Regional Files

Document of
The World Bank

Report No:

PROJECT DOCUMENT

ON A

PROPOSED GRANT FROM THE
GLOBAL ENVIRONMENT TRUST FUND

IN THE AMOUNT OF USD 25.0 MILLION

TO THE

UNITED MEXICAN STATES

FOR A

LARGE-SCALE RENEWABLE ENERGY DEVELOPMENT PROJECT

June 1, 2006

CURRENCY EQUIVALENTS

(Exchange Rate Effective {Date})

| | | |
|---|---|---|
| Currency Unit | = | MXP |
| | = | US$1 |
| US$ | = | SDR 1 |

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| BMZ | German Ministry for Economic Cooperation and Development |
| BOT | Build-Operate-Transfer |
| CAS | Country Assistance Strategy |
| CCGT | Combined Cycle Gas Turbine |
| CDI | Indigenous Peoples Development Commission (*Comisión de Desarrollo de Pueblos Indígenas*) |
| CDM | Clean Development Mechanism |
| CEC | California Energy Commission |
| CENACE | National Dispatch Center (*Centro Nacional de Control de Energía*) |
| CFE | National Electric Commission (*Comisión Federal de Electricidad*) |
| $CO_2$ | Carbon Dioxide |
| $CO_2e$ | Carbon Dioxide Equivalent |
| CRE | Energy Regulatory Commission (*Comisión Reguladora de Energía*) |
| DGIDTMA | The Directorate General for Research, Technological Development, and the Environment of SENER (*Dirección General de Investigación, Desarrollo Tecnológico y Medio Ambiente*) |
| EMP | Environmental Management Plan |
| ER | Emissions Reduction |
| ERPA | Emissions Reduction Purchase Agreement |
| GEF | Global Environment Facility |
| GHG | Greenhouse Gas |
| GoM | Government of Mexico |
| GPG | The Geothermal-electric Project Management Division of CFE (*Gerencia de Proyectos Geotermoeléctricos - Morelia)* |
| GW | Gigawatt |
| GWh | Gigawatt-hour |
| IEA | International Energy Agency (Paris) |
| IIE | Mexico Electric Power Research Institute (*Instituto de Investigaciones Eléctricas*) |
| INEGI | National Institute of Statistics, Geography and Computer Science (*Instituto Nacional de Estadística, Geografía e Informática*) |

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| IPP | Independent Power Producers |
| IRR | Internal Rate of Return |
| kWh | Kilowatt-hours |
| LNG | Liquid Natural Gas |
| MEC | Marginal Energy Cost |
| MW | Megawatt |
| NAFIN | Mexico state development bank (*Nacional Financiera*) |
| NFFO | UK Non-Fossil Fuel Obligation |
| NPV | Net Present Value |
| NREL | U.S. National Renewable Energy Laboratory |
| O&M | Operation and Maintenance |
| OPEC | Organization of Petroleum Exporting Countries |
| OPF | Publicly Financed Works (*Obra Pública Financiada*) |
| PEF | Federal Budget (*Presupuesto de Egresos de la Federación*) |
| PEMEX | Mexican Petroleum Corporation (*Petróleos Mexicanos*) |
| PERGE | Spanish acronym for Large-Scale Renewable Energy Development Project (*Proyecto de Energías Renovables a Gran Escala*) |
| POISE | Least Cost Plan (*Programa de Obras e Inversiones del Sector Eléctrico*) |
| PPA | Power Purchase Agreement |
| PROFEPA | Federal Ministry for Environmental Protection (*Procuraduría Federal de Protección al Ambiente*) |
| RPS | Renewable Portfolio Standard |
| SBC | System Benefit Charge |
| SEDESOL | Ministry of Social Development (*Secretaría de Desarrollo Social*) |
| SEMARNAT | Ministry of the Environment and Natural Resources (*Secretaría de Medio Ambiente y Recursos Naturales*) |
| SEN | National Electric System (*Sistema Eléctrico Nacional*) |
| SENER | Ministry of Energy (*Secretaría de Energía*) |
| SHCP | Minstry of Finance and Public Credit (*Secretaría de Hacienda y Crédito Público*) |
| SP | The Planning Department of CFE (*Subdirección de Programación)* |
| SRMC | Short Run Marginal Cost |
| SSA | The Health Ministry (*Secretaría de Salud)* |
| Tcf | Trillion cubic feet |
| TW | Terawatt |
| TWh | Terawatt-hours |
| UNDP | United Nations Development Programme |
| UNFCCC | United Nationsal Framework Convention on Climate Change |
| UPI | Unit for Promotion of Investment within SENER (*Unidad de Promoción de Inversiones*) |
| USAID | United States Agency for International Development |

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| Vice President: | Pamela Cox |
| Country Manager/Director: | Isabel Guerrero |
| Sector Manager: | Susan G. Goldmark |
| Task Team Leader: | Charles Feinstein |

**MEXICO**
**Large-Scale Renewable Energy Development Project**

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## STRATEGIC CONTEXT AND RATIONALE

### 1. Country and sector issues

Mexico is an OPEC country rich in fossil fuel resources. Nonetheless, policy inadequacies and a scarcity of investment resources have meant that it may not be able to exploit these natural resources at a sufficient rate to ensure future economic growth and macroeconomic stability. Natural gas production, in particular, has been insufficient to satisfy domestic demand and the power sector has been particularly affected by this. By some estimates natural gas imports are likely to rise by 500 percent over the next few decades. This situation has prompted growing interest from the *Secretaría de Energía* (SENER) and *Comisión Federal de Electricidad* (CFE) to develop domestic sources of renewable energy to complement fossil fuels in power production. In particular, the State of Oaxaca is endowed with world class wind resources, offering the prospect of economic competitiveness within the medium term. Development of these resources will offer benefits to the local economy, on a national economic basis, and to the environment.

The Mexican electricity system, operated primarily by *Comisión Federal de Electricidad* (CFE), serves 95 percent of the population, but is strained by under-investment and limited private sector participation. 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 capacity (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 under 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. The country has seen a rapid rise in gas imports (presently from the U.S.), now running at over 820 million $ft^3/d$, equal to about 20 percent of total use in the country and expected to rise to 25 percent in the next decade, equivalent to the entire *current* gas production of the country. Coal (including one coal/oil plant) currently provides almost 10 percent of electric power system capacity (public service) and about 12 percent of generation. Current annual output of 11 million tons falls short of consumption of 20 million tons. Some 40 percent of CFE's installed capacity is old and is due for replacement, and CFE has put out tenders to import LNG to fuel their newer power stations at increasingly higher costs. 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.

The Constitution reserves power supply and distribution as an exclusive right of the state (except for self-suppliers with less than 20 MW capacity, which can sell power to the grid). Since 1992, reforms have been sought with limited success, and private power still accounts for no more than 30 percent of electricity generation. In September, 2002, the Fox administration tabled an electricity sector reform bill that would create a wholesale electricity market and unbundle transmission and distribution, but reform remains stalled. The Constitution also mandates least-cost procurement of electricity generation sources, and CFE employs a relatively strict interpretation of this mandate. While the *Secretaría de Energía* (SENER) has authority to specify how this mandate is interpreted, it has only relatively recently begun to do so.

The monolithic nature of CFE (and its relatively recent experience with IPP projects), its preference to develop projects internally, coupled with its focus on the 'least-cost' mandate and its pursuit of a significant shift to gas as a means to meet this mandate, have resulted in minimal experience to date with renewable energy. Despite having at least 5,000-6,000 MW of world class wind resource in the Isthmus of Tehuantepec and more in other regions, small hydro potential of up to 3,300 MW, and other potential significant bio-electricity sources, only a small portion of Mexico's total energy needs are met by renewable energy sources other than large hydro. Grid-connected wind from CFE's small demonstration project, La Venta I, currently provides only 2 MW. This will be augmented later this year when the CFE-owned 85 MW La Venta II, a build-transfer turnkey project slated to benefit from World Bank carbon emissions reduction purchase, enters into service. While hydro-electricity which represents more than 23 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.

Recently, two important policy initiatives aim to reduce development barriers for renewables. These include a) a provision for Accelerated Depreciation, which makes 100 percent investment in renewable energy technologies after January 2005 eligible for depreciation in the first year, and b) 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, as well as creation of a domestically financed financial mechanism, the "*Fondo Verde*".

### 2. Rationale for Bank involvement

As noted in the April 2004 CPS, "the most important value-added of the Bank is not in transferring resources but in helping Mexico achieve better development effectiveness through targeted analytical work and improved project and policy design". The World Bank and GEF, with other bi-lateral agencies, have engaged a broad array of Mexican policy, technical, financial, and environmental agencies and actors in 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 and other agencies have acknowledged the World Bank and GEF value added 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.

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 helping Mexico position itself within emerging international accords on mitigating greenhouse gases (GHGs). While Mexico has assumed responsibilities beyond its legal obligations under the U.N. Convention on Climate Change and was the first non-industrialized country to create an inventory of its GHG emissions, Mexico is the world's ninth largest greenhouse gas emitter and $CO_2$ emissions from fuel combustion increased by 23 percent between 1990 and 2000. The main $CO_2$ emission sources (excluding land use-related emissions) are energy combustion (89 percent) and industrial processes (11 percent).

Based on relationships and mutual understanding developed during the project development process, the World Bank is well positioned to integrate its broad experience (in power sector reform, renewable energy technologies and markets, and emerging financing potential from carbon mitigation sources) into the Mexican development context and make the project an example of international best practice for large scale renewable energy development. The key role of the World Bank will be to continue to provide oversight on coordination of the various TA components, and keeping a sustained focus on the least-cost power issue to ensure cost-effective use of GEF funds applied through the project's Financial Mechanism.

### 3. Higher level objectives to which the project contributes

The project provides strong synergies in energy and sustainable development, and the energy diversification thrust underlying the project addresses these goals. The Country Program Strategy (Report No. 28141-ME, April 15, 2004) notes environmental sustainability as included in basic objectives for Bank activity in Mexico, i.e. to "promote development in harmony with nature and the environment" (p. 9). In this context, consolidating infrastructure development to provide reliable and important public utilities services within a framework of fiscal restraint is also seen as critical for sustaining development. (p. 14). The CPS notes the importance of improving the business climate through further unbundling, strengthening regulatory frameworks, increasing private investment, and enhancing corporate governance. As the BAU scenario indicates a need to import 25 percent of its natural gas supply in the next decade, the project will contribute to energy fuel and source diversification.

## B. PROJECT DESCRIPTION

### 1. Lending instrument: Free standing GEF project

GEF Project – No associated Bank investment

### 2. Program Objectives

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.

### 3. Project Phases and Key Indicators

The project will provide targeted GEF tariff support to an initial 101 MW wind energy IPP investment to overcome initial entry risks and stimulate learning, and will support a combination of policy and technical assistance activities to support development of additional renewable energy generation resources on a diversified basis.

The key GEF global objective performance indicators on global objectives include:

- Total electricity generated (GWh/yr) from renewable energy
- Total renewable energy generation capacity (MW)
- Emissions reduced (tons/year): $CO_2$, NOx, SOx, Particulates
- RE barrier removal as indicated in 'Institutional Capacity' described below

Key outcome indicators include:

- A successful IPP tender, including CFE reference price and GEF tariff support, resulting in construction and operation of a 101 MW wind farm.
- Institutional capacity sufficient to issue subsequent tenders for additional wind farms/other RE resources at a higher reference price and/or lower incentive support level (GEF or other).

Additional details on intermediate indicators can be found in Annex 3: Results Framework and Monitoring.

Project Approach: The project addresses two primary tracks for developing and sustaining large-scale renewable energy development:

1. To open avenues for direct sale to CFE at prices that increasingly recognize over time the full value of renewable resources - including intermittent resources - to the grid system.
2. To reduce transaction costs barriers currently limiting private projects serving municipalities and industrials under provisions of the September, 2001 renewable energy self-supply regulations enacted by CRE, and amended and gazetted on January 30, 2006.

Project Phases: To achieve these objectives, the project is structured as the first phase of a proposed two-phase approach to address key policy and tariff issues currently hindering renewable energy development, and facilitate an initial investment in grid-connected wind IPP project with use of GEF support in a Financial Mechanism to overcome initial investment barriers. The $25 million Phase I, including technical assistance implemented over three years and tariff support payments for the wind installation spanning five years, was authorized by the May, 2003 meeting of the GEF Council. Based on Phase I project performance and subject to availability of funds, the GEF Council indicated its commitment to review a subsequent request for a Phase II $45 million program that would continue project replication and cost reduction with both wind and additional renewable energy technologies.

Trigger Conditions: The performance indicators used to trigger an anticipated second phase, as discussed with and agreed with the GEF Council at work program entry, are:

- Definition of a clear policy, contractual, and market framework for acquiring renewably-generated power by CFE, including introduction of a tariff support function of no more than US 1.5 cents/kWh delivering $ 17-20 million of GEF funds to private sector investors, resulting in the acquisition of at least 70 MW renewable energy generation capacity in Phase I.

- Under GEF supported technical assistance in Phase I, establishment of a pricing and procurement methodology for properly valuing renewable energy additions to the CFE system, shifting from a proxy plant, short-run marginal cost (SRMC) based tariff to an enhanced valuation based on (i) full system SRMC, plus (ii) adjusted capacity value associated with the renewable energy power generation capacity, plus (iii) energy portfolio diversification value of the renewable power generation capacity.
- Decline in the need for subsidies over time, demonstrated by a shift from a *maximum* GEF grant of 1.5 US cents per kWh of wind energy generation in Phase I to a reduced maximum GEF grant in Phase II.

Trigger conditions are described in more detail in Annex 4). Funds for a Phase II operation would be requested from the GEF Council through a new Project Concept Note/Project Appraisal Document to be submitted prior to the end of Phase I to maintain project continuity. This new document will specify progress toward the triggers summarized above, review the global market situation for renewable energy, and specify which additional renewable energy technologies will be targeted in Phase II.

### 4. Project components

In its first phase, the GEF project supports three main components to remove policy, financial and transactional cost barriers in order to open IPP markets in renewable energy:

1) A **Financial Mechanism** to stimulate organizational learning and cost reduction, that will provide US$20.4 million in energy production incentives on an Output-Based Aid basis (1.1 US cents per kWh for the first 5 years of generation), offered in response to a CFE competitive solicitation for 101 MW of IPP wind power;
2) **Technical Assistance** activities valued at US$3.9 million (plus CFE and BMZ/GTZ co-financing of approximately US$0.37 million) to address analytical and policy barriers, and provide business development assistance to stimulate and facilitate project investment in both IPP and renewable energy self-supply markets; and
3) **Project Management** support in the amount of US$0.7 million to assist SENER, in coordination with NAFIN, in the management of both of the above substantive components, and to fulfill oversight, monitoring and evaluation, and reporting responsibilities.

**Component 1: Financial Mechanism** (GEF = $20.4 million)

Incorporating lessons from British, Irish and California experiences promoting renewable energy, tariff price support for renewable projects will be delivered from a Financial Mechanism on a per kWh production basis for the first five years of operation of a 101 MW wind farm to be built on an Independent Power Production (IPP) basis. This project, designated as La Venta III, will expand experience with grid connected wind energy in Mexico by moving procurement and operation to the IPP modality. It will build on CFE's initial 2 MW demonstration plant (La

Venta I), and the turnkey 85 MW La Venta II project that CFE has successfully tendered and which will be commissioned in November 2006. While La Venta II will provide CFE with important operational and technical experience, La Venta III (and the technical assistance associated with the project) will significantly augment this experience as well as provide CFE with the tools to replicate additional wind and other renewable energy projects cost-effectively, while limiting claims on scarce public resources.

The project approach couples CFE competitive procurement for renewable energy IPPs with additional tariff support. CFE's willingness to pay would be indicated by a bid reservation price derived from their system long-run marginal avoided cost of energy and capacity contributions from the La Venta III project. An additional payment from the Financial Mechanism, announced as part of the same competitive tender, would be provided to bridge the difference between the reservation price and the generation cost bid by the developer. The methodology for the determination of CFE's avoided cost is based on differential runs of CFE's generation planning model. This reservation price has been disclosed to SENER, which has provided the Bank with assurances that the CFE price, taken in conjunction with the calculated GEF tariff support payment, adequately minimizes the risk of bid failure and is consistent with the Bank's estimates of CFE avoided costs.

Guidelines for the operation of the CFE wind power bid solicitation and the Financial Mechanism are described in Annex 4 and are available in the project files.

<u>IPP Wind Project (La Venta III)</u>: The project consists of wind energy power plant of a nominal capacity of 101 MW (+/- 2 percent) and its associated interconnection system. At an estimated net capacity factor of the plant, conservatively estimated as 42 percent, the plant would provide annually about 371.6 GWh on average, resulting in an annual reduction of GHG of about 247,000 tons of $CO_2$ ($tCO_2e$), or some 4.94 million tons over its expected 20 year economic life. CFE has identified a suitable site for La Venta III, and will build transmission to the site; a sponsor selecting another site will pay costs for transmission lines. Total overnight investment cost for the La Venta III wind farm is estimated as US$123 million, plus an additional US$5.1 million for the above described transmission reinforcement.

**Component 2: Technical Assistance** (GEF = $3.9 million; CFE = $ 0.25 million; BMZ/GTZ = $0.12 million)

The technical assistance activities supported under the GEF project include:

1. **System based least cost determination** - Analytical and methodological activities designed to enhance value recognition of renewable resources within the CFE system and determine reference prices.
2. **Integration of renewables in system operations** - Modeling capabilities and associated training within CFE and dispatch operations for improved technical integration of renewables.
3. **Project and business development** – Development of protocols and capabilities to strengthen SENER's *Unidad de Promoción de Inversiones* (UPI) capacity to serve as a "one stop shop" for renewable energy project developers, and design of green power and renewable energy tradeable permit systems.

4. **Wind potential assessment** – Development of a national wind resource map and measuring/monitoring equipment.
5. **Regional plan for southern Isthmus of Tehuantepec region** – Development of a regional long-term wind development plan for southern Isthmus of Tehuantepec area, including a strategic environmental assessment, and other studies on issues such as existing land use regulations, social impacts, transmission constraints, and industrial development.

**Component 3: Project Management** (SENER) (GEF = $0.7 million)

As described in Annex 6, Implementation Arrangements, SENER's management capacities will be augmented through specialized project management consultants financed by the GEF project on an incremental cost basis. These include a Project Manager (full-time local consultant), a Utility and Renewable Energy Expert (part-time local consultant/as needed), and a Procurement Assistant (part-time local consultant). In addition, existing NAFIN procurement and financial management staff or consultants will be detailed on a part-time basis to render assistance to SENER and CFE for processing of procurements and liaison with the World Bank. Specialized consultants will be periodically engaged to conduct monitoring and evaluation assessments in accordance with the project's M&E Plan and Environmental Management Plan.

## 5. Lessons learned and reflected in the project design:

Increasingly, incentive mechanisms and elements of mandated markets are being used as mutually reinforcing tools, and tailored to suit specific country circumstances and objectives. Further, as the Kyoto Protocol has emerged as an international framework to limit $CO_2$ emissions, new green pricing, Clean Development Mechanism, and/or tradable certificate mechanisms have emerged in response and can provide an important additional source of revenue for clean energy projects. Mexico has weighed the emergence of these carbon avoidance markets with other lessons learned in financing and implementing renewable energy support programs. Key elements include application of "close to market" level of incentives introduced in a competitive market framework, coupled with performance-based payments.

## 6. Alternative considered and reasons for rejection

Approaches to develop renewable energy sources in Mexico are constrained by several practical realities:

- Significant direct government funds were not available, particularly given the 'least-cost' procurement mandate, and ratepayer surcharges of any size were not politically practical;
- A mandated market policy is of limited applicability for Mexico as the existence of essentially one monopoly utility provides limited options for effective trading among different utilities to pursue cost reductions.
- Incentives would also require a clear set of policies, grid access terms and institutional capacity development to facilitate sustainable mainstreaming of renewable technologies.

Several strategic choices were made to reflect the nature of opportunities in Mexico:

- While potential deal flow exists in the 'self generation' market, the transaction and structuring costs of such projects are high, and cross-shareholdings required increase commercial risks. As a result, the project seeks to develop a long-term private IPP commercial market, including the requisite contractual and tariff linkages with CFE.
- Initially, multiple rounds of smaller projects were considered for Phase I to reduce risks of a failed bid or project. However, evaluation of CFE and CRE (the regulator) screening criteria for CFE bid solicitations, and a strong track record by CFE in successfully completing IPP bid solicitations led to the decision that a single bid would be prudent as well as more likely to extract economies of scale in cost, construction, and operation.

Based on these considerations, Mexico has elected to undertake a hybrid approach that strikes a balance across financial incentives and policy underpinnings:

- A competitive IPP solicitation coupled with limited tariff support
- Agreement with CFE on to assess the value of renewable generated electricity on a long-run marginal avoided cost basis and to use this as a base price in competitive IPP tenders; and
- Augmented renewable generation investment through an accelerated investment depreciation scheme.

While the original intent of the program had been to operate the project tender such so as to seek simultaneous competition on both the CFE tariff and the required GEF subsidy, and several approaches were reviewed to achieve this, this proved to be legally and practically unwieldy. As a result, the GEF tariff support has been fixed at 1.1 US cents and only the CFE tariff will come under competitive tender. Further details can be found in Annex 4.

## C. IMPLEMENTATION

### 1. 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 and it also assigns the financial agent for the project.

The ***Secretaria de Energia*** **(SENER)** through its Research, Technological, Development and Environment Directorate (*Direccion General de Investigación, Desarrollo Tecnológico y Medio Ambiente*) within the Undersecretariat for Energy Planning will maintain a Project Coordinating Unit and execute certain components of the Project. SENER will also be responsible for project monitoring and evaluation, and regular reporting. In addition, SENER will contract for services under the Technical Assistance component, and will be responsible for outreach and business development services under this component. SENER's Investment Promotion Unit, (UPI, *Unidad de Promoción de Inversiones*) will serve as the primary interface with private sector investors regarding the promotional mechanism financed by the GEF and parallel technical assistance. While ultimate responsibility for GEF project execution will reside with the management of SENER's Research, Technological Development and Environment Directorate, SENER's capacities will be augmented through specialized project management consultants financed by the GEF project on an incremental cost basis, including a Project Manager, a Utility/Renewable Energy Expert, and a Procurement Assistant. Although SENER's energy policy capabilities are strong, its capacity in terms of financial management and procurement remains limited. This will be addressed by the Mexican state development bank, NAFIN.

***Comisión Federal de Electricidad*** **(CFE)** will co-execute the Project and in coordination with SENER will be responsible for structuring the La Venta III IPP solicitation, evaluating responses and executing a Power Purchase Agreement (PPA) with the winning wind power entity. The PPA will contain incentive allocation provisions that will be the basis for disbursement of GEF funds on an output-based aid basis against verified wind energy deliveries to the CFE grid. Finally, CFE will procure system modeling software, training, technical studies and goods related to the enhanced integration of wind energy in the CFE grid system.

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

*Other Institutions:*

*The* ***Ministry of Environment and Natural Resources (SEMARNAT)*** will ensure that the Project complies with the relevant environmental legislation and as such will grant the relevant permits and authorizations for the design, operation and maintenance of the facility.

The ***Comisión Reguladora de Energía (CRE)*** regulates the activities of both public and private energy operators. CRE will be responsible for development of adequate regulation for renewable resources (especially intermittent sources), including setting the basic economic framework for both IPP self-supply projects.

***The State of Oaxaca*** will be responsible for the local environmental, construction, and land use permitting and local stakeholder outreach aspects of the GEF project.

<u>GEF incentive support to La Venta III</u>**.** Execution of the IPP project will require several parallel design and authorization processes, including:

1. The IPP procurement authorization procedure, mandated by the Law for Electricity Public Service (*Ley del Servicio Público de Energía Eléctrica*) and its regulations, as well as by Treasury (SHCP) regulations;
2. The plant definition, its technical and economic assessments, and incorporation procedure;
3. The structuring of GEF incentive payment;
4. The preparation of bid documents; and
5. The IPP project execution in itself.

The first three of the above processes have been completed as of project appraisal. Preparation of bid documents by CFE is taking place in May-June of this year, and will enable issuance of the La Venta III bid solicitation in July, 2006. Adequate bid documents will require the land leasing agreement, the PPA, the incentive allocation provisions, and the bidding documents proper, containing project description and payment mechanisms, as well as required guarantees and all other relevant information for developers to submit their bids. Guidance to CFE for the structuring of the bid package so as to meet wind IPP requirements and assure consistency with the GEF incentive scheme requirements has been provided through a detailed set of guidelines prepared by specialized consultants to SENER (financed from GEF PDF-B funds).

Technical Assistance. Execution of the technical assistance activities under the GEF project will be under the overall management of SENER. Terms of Reference for specific studies and services to be performed by consultants will be developed by technical units within CFE and SENER, or in the case of the business advisory and outreach services, by UPI, and forwarded to NAFIN for review. Contracts for consulting services, following no objection as required by the World Bank, will be issued by SENER and CFE. Payments against delivered services will be requested by the entity receiving the services, authorized by SENER, cleared by NAFIN following no objection by the Bank, and to the contractor by the entity, followed by reimbursement from the relevant GEF-financed Designated Account.

Additional details on the implementation arrangements can be found in Annex 6.

### 2. Monitoring and evaluation of outcomes/results

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. These include completion and operation of the initial wind farm, social impacts (in particular those related to land leasing), greenhouse gas emission reductions and other environmental impacts, and improvements in the Mexican regulatory and policy context for renewable energy (both for Phase I components and as a function of preparing the landscape for a potential Phase II),

This framework identifies required data, information sources and stakeholders, and methods for implementing a monitoring system with specific recommendations on setting baseline data, data collection instruments, frequency of data collection, reporting format, etc., and includes specific indicators related to GEF trigger conditions for an indicative Phase II. The M&E plan describes expertise or training required, a suggested reporting format, and estimates of the total time, human resources and financial costs required.

### 3. Sustainability and Replicability

Borrower commitment has been demonstrated by significant progress during project development of: (a) analysis and implementation of an accelerated depreciation provision applicable to renewable energy capital equipment generating electricity; (b) development of and advancement in the Congress of a draft Renewable Energy Law which, if passed, would strengthen the supporting framework for many of the activities and objectives sought by the project. Critical to achieving project objectives, and particularly for sustaining and replicating renewable energy activity in the long run is continued commitment by the Government of Mexico, and CFE in particular, to engage in pricing on a long-run system basis and to incorporate a broader analysis of costs of benefits of renewable energy generation to create market entry points for renewables in Mexico. Despite significant challenges in addressing analytical issues related to CFE's issuance of its 'reference price' necessary to provide a tariff counterpart to GEF's offer of tariff support, dialogue with stakeholders during final project preparation has resulted in clear agreement on determination of a reference price that is consistent with the principle of 'least-cost' power procurement guidelines expressed in Mexico's Constitution, but is also fair and consistent with long-run marginal cost analysis. On the basis of these agreements, it is expected that the trajectory of the project will bring wind (and other selected renewable energy technologies) into near price parity with conventional sources by the end of the project, making the effort significantly self-sustaining.

It should be noted that additional funds from the proposed Renewable Energy Law (passed by the lower house of Congress in late 2005; pending before the Senate) are considered to be additional to international donor-leveraged funding, and will thus not endanger carbon finance operations in Mexico under Kyoto Protocol 'additionality' considerations. However, the developer of the La Venta III wind farm supported under this project will not be allowed to 'double dip' and use both GEF and carbon revenues. The CFE La Venta II project, however, is expected to receive carbon revenues but not GEF support.

Replicability: The project is designed to create a favorable environment for initial market activity in renewables, to stimulate an initial IPP wind farm investment through targeted incentive support, and to help establish a framework to repeat this process through subsequent renewable power procurements that will result in organizational learning and cost reduction over time. Parallel activities in 'self-generation' markets will build additional experience in project development, finance, and operation, further supporting replicability within Mexico. Further, as a regional technology and market leader, Mexico is well positioned to help effect broader replicability of project experience and cost reductions throughout Latin America.

### 4. Critical risks and possible controversial aspects

The primary risk at both the development objective and component level is that CFE could fail to fully incorporate the analysis used to determine the agreed 'reference price' tariff (used for the Phase I solicitation for 101 MW of wind capacity) in future solicitations for renewable energy generation. This outcome would signal CFE's lack of confidence in the fundamental framework now initially developed to approach the full value of wind in the system (including partial capacity value), and result in slippage to a narrower interpretation of 'least cost' resources where bridging incremental costs with available funds would become much more difficult. This risk is being addressed by a strong technical assistance focus using competent analytical partners.

## Table 1: Risk Mitigation Measures

| Risk to Project Development Objective | Risk Mitigation Measure | Risk Rating |
|---|---|---|
| Loss of political commitment | La Venta III (project supported by this GEF project) is already listed in approved PEF, enabling provisions of 1992 Law on Electricity Public Service; dialogue and commitment surrounding new Renewable Energy Law. | S |
| Difficulty in arriving at agreed base tariff and bridging incremental costs with available funds | Agreed methodology for price determination is a condition of appraisal and will be confirmed at negotiations.<br><br>Strong technical assistance focus, strong analytical partners (e.g. USAID, other bi-lateral partners). Phased approach to recognition of system values. | S |
| Long run sustainability; failure to close cost gap | Phased approach protects level of GEF investment based on performance. | M |
| Self-generation market niche does not develop and grow | Publication of strengthened self-supply project inter-connection regulations. Strong TA to reduce risk and transactions costs to make market viable. | M |
| Adequate project management capacity is not identified and developed at SENER | Backstopping from NAFIN (which is already experienced in key project capacities) and strong experience of CFE. Phased approach stimulates commitment, assisted by clear TA approach to build institutional capacity. | M |
| Insufficient and/or non-competitive bid responses | Knowledge of market, strong dialogue with partners, careful calibration of financial mechanism in a design that is not overly complex, including base tariff and appropriately dimensioned GEF incentive support. | S |
| Failed bid | Strong existing track record of CFE in IPPs; augmented for this project with real time information and experience from La Venta II | S |
| Loss of economic/financial viability (due to wind farm shut down to avoid bird mortality) | Clear guidelines to efficiently manage shut down period; scheduling of annual maintenance during peak migratory period | M |
| Reputational risk to World Bank due to bird mortality | Bird mortality minimized by effective safeguard framework, implementation of agreed protocol overseen by SEMARNAT; effective Bank supervision performed during peak migratory period | M |

**Overall Risk Rating: S**

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

## D. APPRAISAL SUMMARY

### 1. Economic and financial analyses

An Incremental Cost analysis was prepared in order to compare the investment and operating costs of a model 100 MW wind farm with its value to the integrated grid system, as defined by the marginal avoided energy and capacity. Results are summarized as follows:

- Project costs are US$131 million for a 100 MW project, and the incremental benefits represent at a minimum the value of displaced energy;
- The value that can be assigned to displaced energy will vary with the price of oil, but under the SENER "*alto*" forecast (domestic product prices based on $46/barrel equivalent) equals $104 million over the life of the project;
- The other major measurable incremental benefit is capacity displacement, whose value is entirely dependent on whether firm capacity can be attributed to a project of this nature;
- Improved CENACE system management and dispatch will permit CFE to pay a partial capacity credit to the project, approaching 50 percent of the capacity value in effect when the plant is generating; this fractional capacity is worth about $6-12.50 per MWh, with a present value ranging from $15-30 million over the life of the project;
- Present levels of dispatch modeling and control of intermittent wind resources on the CFE system permit a partial recognition of the possible capacity contribution of the project; when combined with full recognition of displaced energy, the indicated incremental cost is approximately $20 million.
- Technical assistance is required to improve the tools available to CFE and CENACE to undertake the types of activities necessary to better manage both intermittent and firm system resources, thereby adding value to both.

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 19 percent (a negative NPV when discount rates of 20 percent or more are applied). The project's return on equity (ROE) is about 18 percent under the assumed financial structure. A sensitivity analysis on key factors of the assumptions of the project shows that the project's important uncertain variables are: (i) capital costs; (ii) avoided costs of energy and (iii) relevant financial structure. The returns are considered within the expectations of international wind energy investors and adequately robust.

An analysis was also made of the cost reduction potential and hence long-run sustainability of wind energy in Mexico. Capital costs for wind power projects in Mexico are presently around $1200/MW, but based on organizational learning and scale effects, are expected to decline to under $1000/MW by 2009. Under such capital costs at the best wind sites in Mexico it is reasonable to anticipate wholesale electricity prices from wind at less than 4.0 US¢/kWh by 2009. Actual costs will be a function of the effective learning rate of the local wind energy industry and how fast the local, and will also be influenced by technology and organizational learning  level at the international level as well as other incentive programs that will affect total demand, supply, and thus prices of turbines.

## 2. Technical

CFE has prepared a range of engineering studies for the La Venta III project: Evaluation of the wind resource, topography, and ground mechanics. One of the important factors for the technical feasibility of the project has been the analysis of data related to the direction and velocity of the wind. Driven by trade winds in the Caribbean, air flows south from the Gulf of Mexico, through a gap in the Sierra Madre Mountains, to the Pacific Ocean. The winds are channeled and accelerated through the mountain pass ('venturi' effect), across the coastal plains of the Isthmus of Tehuantepec. CFE has been monitoring the area with anemometers since 1993 and has collected data on various heights. The database of the resource has been analyzed and it shows, with a good degree of confidence, that sites in the selected area are exceptionally well suited for wind project development.

Choice of wind turbine sizing and layout is up to the bidder. However, based on International Electrotechnical Commission Class 1 turbine availability (recommended for areas with high winds where the average annual wind speed at hub height is up to 10 m/s), individual turbines are expected to range from 850 kW to 1.6 MW capacity each. The issue of logistics (transport of the wind turbines' blades) has been examined and it is expected that the port of Salina Cruz could handle the equipment; cranes for the wind turbines installation are available in the region.

## 3. Fiduciary

Procurement: The main item under the project is a 101 MW wind farm that will be procured following CFE international bidding procedures reviewed and found acceptable to the Bank under the provisions of paragraph 3.13 (a) of the Procurement Guidelines. The GEF financing will applied towards of the purchase by CFE of output power of the plant in the form of fixed amount subsidy regardless of the contract price resulting of the bidding. The subsidy is a financial transaction with no other procurement aspects involved. There would be purchase of software and wind measuring systems using ICB and NCB procedures.

Consultant services to be contracted under this Program include studies for SENER, CENACE and CFE; and development of a national wind map and training. Consultant services would be procured in accordance with "Guidelines: Selection and Employment of Consultants by World Bank Borrowers" and the agreements in the procurement plan. The prior review of procurement actions will be defined in the annual procurement review and will not exceed the thresholds determined by the Bank for low risk clients as CFE or average risk clients as SENER. A Procurement Plan covering the project implementation is under preparation by CFE and SENER. NAFIN and CFE will present a procurement plan (PAC) for the first 18 months of project implementation; this Plan will be updated at least once a year.

Financial Management. The Bank's regional financial management team (LCSFM) has carried out 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 the work carried out, the FM team has the following conclusions: (i) the financial management risk is modest considering the following mitigation measures; (ii) although neither the overall coordinator *Secretaria de Energía* (SENER) nor the *Comisión Federal de Electricidad* (CFE) have experience managing Bank-financed projects, their financial management systems and their key financial management staff is considered acceptable to the Bank; (iii) prior to negotiations certain actions will be required to strengthen program financial management, especially in terms of written procedures e.g. project Operational Manual (OM), audit arrangements, and assignation of new responsibilities to the administrative staff of SENER and CFE; (iv) *Nacional Financiera* (NAFIN) will provide implementation support and oversight based on its many years of experience as financial agent; (v) for disbursement purposes, the recognition of expenditures will be for all components upon the payment to suppliers of goods and services; (vi) the accounting records of the project will be prepared by the financial management staff of each entity (SENER and CFE), and SENER will then consolidate and validate all the information; (vii) at least two financial management supervision missions will be conducted each year, and a Bank FMS will review the annual audit reports and the semi annual Interim Financial Reports (IFRs); and more intensive supervision will be needed prior to effectiveness and in the first year of implementation.

The written procedures and reporting formats should reflect the simplifications proposed in the Financial Management and Disbursements section of the Bank's Review of Country Systems in Mexico, which was delivered to the federal government in July 2005. The mitigation actions included (a) the use of CFE and SENER resources to strengthen their internal control environment, (b) the agreement that the financial agent will strongly supervise project implementation, and (c) the Bank will closely supervise project implementation to allow earlier detection of financial management issues and ensure the proper use of project funds. The Bank will carry out at least two FM-supervision missions during the first year, and starting the second year will carry out at least one FM-supervision mission per year. Additional to this, audited annual financial statements and semiannual IFRs will be reviewed.

### 4. Social

In Phase I the Project will only support La Venta III, a 101 MW grid connected wind based power generation plant that will operate under the scheme of independent power production. La Venta III will be located in the Southeastern region of the Isthmus of Tehuantepec (possibly in the *Ejido* La Venta, municipality of Juchitán de Zaragoza, State of Oaxaca); Annex 10 provides a detailed description of the social and economic characteristics of *Ejido* La Venta[1].

Since CFE will start the bidding process of La Venta III in November 2006, it is expected that the project site will not be specified until after the bid has been awarded (February-March 2007)[2]. For this reason, no social consultation has taken place in relation to the construction and operation of La Venta III.

CFE has however already conducted participatory consultation activities in *Ejido* La Venta as the 85 MW wind based power facility La Venta II, a state-owned carbon finance project has already started construction. In this case, CFE has been responsible for assessing the social impacts and for conducting a formal social consultation. This process has resulted in the *Ejido* approval for

[1] Mexican land tenure has unique characteristics in that since 1916, indigenous communities *"ejidatarios"* and other community members *"comuneros"* have legally recognized rights or titles to their land and the natural resources on them.

[2] The bidding package will be however advertised from July 1, 2006.

the construction and operation of the plant and derived a detailed compensation scheme agreed between the CFE and the land owners or *ejidatarios* (see Annex 10 for a detailed description of this process).

The social assessment and consultation for La Venta II demonstrated the capacity of CFE to conduct and resolve in a participatory manner a formal process to reach *Ejido* agreement on a specific intervention. This process also demonstrated the willingness of *Ejido* authorities to participate in consultation processes and their capacity to reach agreements that result in positive compensation schemes and the community approval.

CFE is in the process of developing, reporting and disclosing a formal indigenous people plan for La Venta II in accordance with the recommendations established in OP 4.10.

For the particular case of IPP projects, CFE proposes a site (denominated "optional site") which is well described in the bidding documents. For this site, CFE conducts all relevant studies including the Environmental Impact Assessment (EIA), social consultation, social assessment and obtains the necessary permits (construction permit, environmental license and other). These assessments and permits are then transferred, together with responsibilities, to the bid winner.

However, the bidders have also the option of choosing a different project site within a pre-determined area or region, the restrictions being (i) the distance to the point of interconnection with the grid (the "optional site" is located close or at the interconnection point), and (ii) that the site be within an area defined by CFE's Regional Environmental Impact Assessment as being environmentally suitable for development. In this case, the bid winner is responsible for conducting the environmental impact assessment, social impact analysis, consultation process and for obtaining all permits in accordance with national and local social and environmental laws and associated regulatory frameworks.

For La Venta III (Phase I) and also for the introduction of subsequent projects (Phase II), a manual has been created to ensure compliance with Bank's social safeguard policies: "Guidelines and Specifications for Compliance with Social Safeguard Policies" (included in the Project Files).

To qualify for the green incentive, the winner of the bid will have to agree and comply with both the Mexican and Bank's social safeguard policies, as established in the guidelines and specifications.

**Continuous Consultation Process**

The public consultation activities launched at *Ejido* La Venta with the Project La Venta II are really the beginning of a continuous process.

While the general nature of agreements reached with community and *Ejido* leaders in the region are solid, the bidding of La Venta III and subsequent projects will proceed with additional consultations, new negotiations on land acquisition and more information campaigns.

With the experience of La Venta II and La Venta III, communities and *ejidatorios* will understand better what are the costs and benefits associated with the siting of this type of projects and will be able to have a more informed participation in subsequent public consultations.

At the same time, project sponsors and operators will consult with community members, *ejidatarios* and other relevant stakeholders at different stages of project preparation and implementation.

For instance, for La Venta II, a 30 year contract was signed between the CFE and *ejidatarios* for specific compensation measures. This 30 year contract allows for annual adjustments which will require periodic meetings between the project operator and the beneficiaries to such contract. A similar contract is expected to be signed between the project operator and *ejidatarios* for La Venta III.

### 5. Environment

Annex 10 provides a description of the environmental impacts associated with the state-owned plant la Venta II, as it is expected that the IPP project La Venta III will result in similar impacts.

The key environmental impact expected for La Venta III concerns the potential collision of birds (native and migratory) with the wind turbines. Specifically, the Oaxaca portion of the Isthmus of Tehuantepec (where the La Venta III project would be located) is recognized as one of the world's most important corridors for migratory birds. As noted in the Environmental Assessment (EA) report for the generally similar La Venta II project (included in the Project Files), a large number of birds (representing a wide diversity of species) funnel through this area, especially during the autumn (southbound) migration that takes place late August to November. The general La Venta region is particularly noteworthy for the high number of raptors (hawks and other birds of prey) that pass through the area.

The Project has established a number of measures to avoid and/or minimize impacts on bird and bat populations including: i) public consultation with relevant stakeholders and bird specialists to discuss prevention and mitigation measures, ii) the development of a Regional Environmental Assessment (REA) before the bidding process starts to ensure appropriate siting and avoid most sensitive areas, iii) the development of an Strategic Environmental Assessment (SEA) to avoid and/or minimize potential cumulative impacts in the area, iv) the implementation of guidelines and specifications to ensure appropriate turbine design and arrangements as well as implementation of rules for turbine shutdown during migration season, and v) the recommended structuring of a scientific review and committee for oversight and technical advice. The status of these measures is described in Annex 10.

For La Venta III (Phase I) and also as a guide for the planning of subsequent projects (Phase II), a manual has been created to ensure compliance with Bank's social and environmental safeguard policies: "*Manual de Cumplimiento de las Normas Ambientales*" (included in the Project Files).

### Monitoring and Compliance with Bank's Safeguard Policies

In order for the La Venta III Project to qualify for the green incentive, SENER must, through independent accredited senior social and environmental specialists retained on their behalf, verify that the conditions included in the guidelines and specifications have been implemented, and that the project complies with both Mexican and the Bank's safeguard policies and regulations. NAFIN, the Project's financial agent, will then certify to the Bank that this verification has occurred.

On an annual basis, the project sponsor and operator will prepare a report describing the evolution of activities as indicated in the program of activities. An independent accredited specialist will have to produce a letter confirming that the project sponsor and operator is complying with all pre-established social and environmental conditions as well as Bank and national policies, laws and regulations.

## 6. Safeguard policies

The number and type of safeguards triggered by the proposed project will depend on the type and location of renewable source based power generation projects benefited by the Financial Mechanism incentive during both Phase I and II.

For the wind based power generating project La Venta III (Phase I), it is expected that the following safeguards will be triggered:

| **Safeguard Policies Triggered by the Project** | Yes | No |
|---|---|---|
| Environmental Assessment (OP/BP/GP 4.01) | [X] | [ ] |
| Natural Habitats (OP/BP 4.04) | [X] | [ ] |
| Pest Management (OP 4.09) | [ ] | [X] |
| Cultural Property (OPN 11.03, being revised as OP 4.11) | [X] | [ ] |
| Involuntary Resettlement (OP/BP 4.12) | [ ] | [X] |
| Indigenous Peoples (OD 4.20, being revised as OP 4.10) | [X] | [ ] |
| Forests (OP/BP 4.36) | [ ] | [X] |
| Safety of Dams (OP/BP 4.37) | [ ] | [X] |
| Projects in Disputed Areas (OP/BP/GP 7.60)[3] | [ ] | [X] |
| Projects on International Waterways (OP/BP/GP 7.50) | [ ] | [X] |

## 7. Policy Exceptions and Readiness

No policy exceptions are anticipated for the proposed project.

Conditions of Negotiation: (a) Presentation of a standard wind IPP Power Purchase Agreement including Incentive Allocation provisions (the relevant provisions for the GEF incentive) satisfactory to the Bank; (b) Presentation of a draft Project Operational Manual, satisfactory to the Bank; (c) Presentation of a draft Subsidiary Agreement, satisfactory to the Bank.

Conditions of Board Presentation: None.

Conditions of Effectiveness: (a) The GEF Grant Agreement and the Project Agreement have been signed and duly authorized or ratified; (b) The Subsidiary Agreement has been executed and duly authorized or ratified.; (c) The Legal Opinions satisfactory to the Bank have been issued.

[3] By supporting the proposed project, the Bank does not intend to prejudice the final determination of the parties claims on the disputed areas.

Conditions of Disbursement: (a) Power Purchase Agreement and Incentive Allocation provisions satisfactory to the Bank; (b) Evidence that relevant land and lease agreements have been executed with the owners of the land where La Venta III will be located; (c) Evidence of approval by *Ejido* Assembly (pursuant to local law) of *Ejido* land compensation and lease agreements; and (d) Certification by the independent party (retained by SENER) of social and environmental compliance, satisfactory to the Bank.

## Annex 1: Country and Sector or Program Background

## MEXICO: Large-Scale Renewable Energy Development Project

### The Energy Sector

The energy sector is critically important in Mexico's development, accounting for more than one-third of total public revenues and over 50 percent of the total public sector investment budget. The state-owned monopolies, CFE and PEMEX, dominate the electricity and oil and gas sectors respectively. The energy sector faces major challenges:

- PEMEX is heavily taxed and thus serves as the government's "cash cow." Yet this drain on internal finances, coupled with very limited private sector participation, heavily constrains the oil and gas sector's investment requirements.
- Limitations on public and private investment similarly plague the electricity sector. Despite reasonably efficient electricity services, high supply costs relative are impacting competitiveness. Some 40 percent of CFE's installed capacity is old and is due for replacement, and CFE has put out tenders to import LNG to fuel their new power stations at increasingly higher costs.
- While Mexico enjoys 95 percent electricity coverage, the benefits are distributed inequitably: Providing energy for basic lighting, water pumping, food processing and telecommunications will require new public-private partnership arrangements to serve isolated areas.
- The energy sector is a leading source of air, water and ground contamination, and has major impacts on the severity of transport emissions due to fuel quality issues; this pollution disproportionately affects the poor. As a developing country under the UN Framework Convention on Climate Change, Mexico is not subject to greenhouse gas emissions limitations under the Kyoto Protocol. However, as a member of OECD and NAFTA, Mexico may accept some form of emissions constraints under a future "son-of-Kyoto" regime.
- 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).

<u>Electric Power Sector</u>

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 capacity (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: 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.[4] 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.[5] A look at the 2000 *Prospectiva*

4 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.

5 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 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 *Carboelectrica del Pacifico* 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.

Reform plans will necessarily have to address the underlying constitutional issues. In September, 2002, the Fox administration tabled before the Mexican Congress an electricity sector reform bill that would amend the Constitution. The reform would create a wholesale electricity market and unbundle transmission and distribution. Leading private sector representatives have stated that this is the single most important reform in Mexico for growth. However, the reform plan has been stalled since its presentation, and the Fox administration has been unable to push the reforms through a divided Congress. Press reports indicate that Congressional resistance would ease if percentage limits were placed on the volume of foreign ownership allowed in the electricity sector. The issues remain controversial in the context of the current presidential election campaign.

<u>Oil and Gas Sector</u>

Oil and gas exploration, production and refining activities are controlled by state-owned PEMEX, which provided about $50 billion (or 40 percent) toward government revenues in 2004 Until the past few years Mexico's abundant energy reserves were sufficient to provide self-sufficiency in all forms of energy, as well as significant export earnings and relative isolation from world market events. The reliance on the hydrocarbons sector for government revenues, coupled with a low level of re-investing these revenues in exploration and production and refining capacity has resulted in a 30–40 percent reduction in the country's proven oil reserves over the past decade, to less than 30 billion barrels. Natural gas reserves have also stagnated over the past decade, and stand at 26 trillion cubic feet (Tcf), about 22 years of production at current rates. Efforts to bring in outside companies to conduct exploration and field development of non-associated natural gas fields have failed to dramatically restructure the sector, and their constitutionality has been questioned.

Oil. Mexico produces about 3.8 million barrels/day, and reserves, which once stood above 40 billion barrels, are now rated at 15-18 billion bbl (end 2004)[6]. Of the current production total, about 2.1 million b/d, or 55 percent of total output, is consumed domestically. The country is still a major exporter of oil, but those exports represented less than 20 percent (~$32 billion) of the country's total exports of $165 billion in 2004.

Gas. Both the industrial and power sectors are increasingly dependent on natural gas. By 2020 the IEA expects Mexico to increase gas use in the power sector five-fold, to 44 percent of all generation.[7] The country has seen a rapid rise in gas imports from the U.S., now running at over 820 million $ft^3$/day, equal to about 20 percent of total use in the country and expected to rise to 25 percent in the next decade. This level of gas demand for electricity would be equivalent to the entire current gas production of the country. Indeed, one of the current drivers of policy is the impact of the country's linkage with the U.S. market and the consequent price impacts from hurricanes and other events. To meet projected demand for electricity and gas to fuel new generating capacity, the country is currently building one LNG regasification complex, and three more are being designed. [8]

Gas reserves currently stand at 15.0 Tcf, down from 17.3 Tcf in December 2000. PEMEX's budget problems in gas exploration are similar to the oil market situation, and gas reserves are being used up annually without significant replacement efforts. Unlike the oil sector, Mexico appears to making some real effort to bring additional resources into the upstream gas industry, particularly for non-associated gas reserves. The Government has permitted private firms to enter the transmission and distribution segments of the gas industry, but these modest initiatives in the gas industry are not expected to yield dramatic short-term results.

Coal. Coal currently provides almost 7 percent of electric power system capacity and about 15 percent of total generation. Current annual output of 11 million tons falls short of consumption of 20 million tons. One new coal-fired power plant is now listed as under development by CFE. Nevertheless, the *Prospectiva* shows coal declining from 12 to 11 percent in 2014.

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6 Total liquids production of 3.8 million barrels/day includes about 0.4 million barrels/day of condensates and gas liquids.

7 The *Prospectiva* shows gas-fired generation already at 55 percent of total output by 2014.

8 Mexico has announced plans for five LNG terminals, three on the Pacific coast and two on the Gulf. Two of the terminals will be built very close to the U.S. border in order to facilitate the sale of natural gas to the U.S. (California). Large electric power complexes will be constructed near the regasification facilities.

## 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. (This figure includes primarily the next five 'La Venta' or equivalent wind farms expected to be built largely as a function of a Phase II of this GEF project and are therefore not considered to be 'baseline' activities for the purpose of Kyoto Protocol carbon revenues).

**Table 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 6,600 $km^2$ 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 combined-cycle gas. 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. Under a GEF project, the country is also considering a large-scale solar thermal generation facility to augment a future gas generation plant, and this project is currently planned for implementation in 2009. While 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 for peak-shaving, these applications are not considered likely to receive investment attention from Phase II of this GEF project.

## 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.[9]

## 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):

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[9] 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.

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 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 being sought in 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.

Finally, the Law would create a *“Fondo Verde”* (Green Fund), with the purpose to provide incentives to renewable energy sources to help them reach financial viability. Congressional appropriations for this vehicle would be *in addition to* international donor-leveraged funding, and therefore will not endanger carbon revenues under the ‘additionality clause’ under the Kyoto Protocol.

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

## MEXICO: Large-Scale Renewable Energy Development Project

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.

- A 30 MW solar thermal hybrid/gas combined cycle electric project, supported by a $49 million GEF grant and first-of-kind in the developing world, has been delayed due to certain incompatibilities between CFE private power bidding procedures and Bank rules. However, agreement has been reached with CFE on an alternative implementation plan: A public sector demonstration project. Appraisal is targeted for early FY'07.

- 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:

- China Renewable Energy Scale-up (PSR: Development Objective = S, Implementation Progress = S)

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

## MEXICO: Large-Scale Renewable Energy Development Project

| **Mexico Large-scale Renewable Energy Development Project Results Framework** | | |
|---|---|---|
| **Sector-related Country Assistance Strategy Goals** | | |
| Contribute to stability and economic growth through expansion of clean energy sources.<br>Promote economic/social development for low-income populations (including through land-lease arrangements with project developers) | | |
| **Project Global Objective** | **Project Outcome Indicators** | **Use** |
| 1. - To reduce greenhouse gas emission reductions (GHGs) and remove barriers to the development of renewable energy technologies and markets, per the Global Environment Facility' Operational Program 6. | 1a. Increased electricity supplied to national system from renewable energy sources, over baseline. (GWh/yr)<br><br>1b. Increased total installed renewable capacity, over baseline (MW)<br><br>1c. Emissions reduced (tons/year), over baseline ($CO_2$, $NO_x$, $SO_x$, and particulates)<br><br>1d. *'Barrier Removal' results described below under PDO.* | 1a through 1d: Gauge progress toward reaching program objectives. |
| **Project Development Objective** | **Project Outcome Indicator** | **Use** |
| 2. - To assist Mexico in developing initial experience in commercially-based grid-connected renewable energy applications by supporting construction of a 101MW IPP wind farm, while building institutional capacity to value, acquire, and manage such resources on a replicable basis. | 2a. Established CFE system short-run marginal cost-based Reference Price combined with agreed maximum U.S. 1.1 cent GEF tariff support (per kWh for 5 years) sufficient to attract bids, investment, construction and operation of 70-100MW wind farm.<br><br>2b. Subsequent POISE include plans for additional wind IPP procurement at higher reference price and/or lower incentive support level (subject to availability of subsidy funds – GEF or other)<br><br>*Also, see intermediate outcome indicators below by project component* | 2a; 2b: Gauge progress toward reaching project objectives. |

| Mexico Large-scale Renewable Energy Development Project Results Framework | | |
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| **Intermediate Outcomes** | **Intermediate Outcome Indicators** | **Use** |
| 3. A **Financial Mechanism** to provide electricity tariff support of US$20.4 million on an Output-Based Aid basis (1.1 US cents per kWh for the first 5 years of generation), opening an avenue for IPP project sale to CFE at a price that reflects the value of renewable resources to the integrated grid system. | *Pre-bid*<br>3a. Functioning mechanism for the auctioning of tariff subsidy support through competitive bidding established, with incremental tariff support provided by GEF.<br>3b. Operational Manual for the auctioning mechanism finalized with CFE sign-off, and adopted by CFE<br>3c. Regional Environmental Assessment is completed and made available for the La Venta III bidding package.<br>*Bid process*<br>3d. CFE base solicitation allowing for locations other than that currently identified for La Venta III, including those that would require a change in transmission lines<br>3e. Number of qualified bids received from tender<br>3f. IPP solicitation for at least 70MW of wind power.<br>3g. Only those bids proposing development in sites identified as environmentally suitable for development are accepted as eligible.<br>*Project Implementation*<br>3h. Co-financing provided by private entities and export credit agencies by way of capital investments<br>3i. Mechanism for payments to *ejidos*, indigenous communities, and small landowners, with established process through which landowners or *ejidos* can verify revenue and requisite payments.<br>3j. Funds disbursed to *ejidos*, | 3a. Gauge readiness for bid solicitation and subsequent subsidy payments to project developers. Trigger for Phase II funds release.<br>3b. Gauge efforts toward and preparedness for a smooth bidding process.<br>3c. Assess CFE compliance with the project environmental safeguards<br>3d. Gauge CFE willingness to accommodate proposed projects by inclusive factors of wind resource and social environment over pre-determined location siting, to inform any need for further support in Phase II.<br>3e. Gauge interest of the private sector in program activities and success of tariff development, to inform any need for further support in Phase II.<br>3f. Gauge success of bidding process. Trigger for Phase II funds release.<br>3g. Gauge environmental compliance of bids.<br>3h. Gauge interest of private sector in program activities, to inform any need for further support in Phase II.<br>3i. Gauge effectiveness and fairness of process for landowner/*ejido* payments, to inform any need for further support in Phase II.<br>3j. Gauge effectiveness of land-lease structure and payment |

| Mexico Large-scale Renewable Energy Development Project Results Framework | | |
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| | indigenous communities, and small landowners<br>3k. Significant avian/bat mortality is avoided. | information dissemination among landowners/*ejidos*, and their success in negotiating favorable terms, to inform any need for further support in Phase II.<br>3k. Gauge effectiveness of mitigation and prevention measures for avian/bat mortality. |
| 4. **Technical Assistance** activities valued at US$3.9 million (plus CFE and BMZ/GTZ co-financing of approximately US$0.37 million) to address analytical and policy barriers, and provide business development assistance to stimulate and facilitate project investment in both IPP and renewable energy self-supply markets. | 4a. CFE purchase tariff proposed for Phase II which reflects SRMC plus RE capacity value and energy portfolio diversification value.<br>4b. CFE purchase price tariff proposed for Phase II which requires reduced GEF subsidy from Phase I<br>4c. Least-cost methodology for calculation of renewable energy procurement reflecting System Marginal Cost developed<br>4d. Planning and dispatch model installed and used in CFE to incorporate intermittent sources<br>4e. Strategic Environmental Assessment is developed and accepted as basis permitting scale-up of wind energy in Oaxaca region.<br>4f. Publishing of new intermittent energy connection contract by CRE including RE capacity recognition<br>4g. Strengthening of SENER Investment Promotion Unit business development services addressing marketing, permitting issues, financing facilitation, and business advisory services to sponsors of renewable energy projects, including for self-supply projects. | 4a. Gauge SENER and CFE willingness and ability to meet longer-term tariff goals, and gauge readiness for transition to Phase II. Trigger for Phase II funds release.<br>4b. Gauge CFE willingness and ability to meet longer-term tariff goals, and gauge readiness for transition to Phase II. Trigger for Phase II funds release.<br>4c. Demonstration of CFE willingness to provide transparency.<br>4d. Gauge CFE interest in technical assistance to further promote RE.<br>4e. Gauge effectiveness of SEA component, and assess environmental risk factors and mitigation considerations in regional wind development.<br>4f. Gauge improvements in Mexican regulatory context for renewable energy. |

| Mexico Large-scale Renewable Energy Development Project Results Framework | | |
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| 5. **Project Management** support in the amount of US$0.7 million to assist SENER, in coordination with NAFIN, in the management of both of the above substantive components, and to fulfill oversight, monitoring and evaluation, and reporting responsibilities. | 5a. Institutional capacity sufficient to issue and manage tenders for additional wind farms/other RE resources | 5a. Gauge GOM readiness for transition to Phase II. Trigger for Phase II funds release. |

## Arrangements for Results Monitoring

| | Data Collection and Reporting | | | | | |
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| **Program Outcome Indicators** | **Baseline** | **Midterm (end Y3)** | **Project End (end Y8)** | **Frequency and Reports** | **Data Collection Instruments** | **Responsibility for Data Collection** |
| 1a. Renewable electricity generation over baseline (GWh/yr) | 7.36 | n/a | 367.9[10] GWh annually (257.5 min) | Six-month progress reports, midterm and end of phase reports | CFE recording of generation for payment to IPPs | SENER |
| 1b. Renewable capacity over baseline (MW) | 2 (wind) | 101 (70 min) | 101 (70 min) | At wind farm commissioning at end of year 3 | CFE PPAs | SENER |
| 1c. Emissions reduced over baseline (tons/yr)<br>$CO_2$ (M tons/yr)<br>$NO_x$[11]<br>$SO_x$<br>Particulates | [TBD] | n/a | 247,000 tons per year of operation<br><br>Tons/day for first partial yr. | Midterm and end of phase reports | Calculations based on a combination of average system generation emissions and avoided source emissions. SENER currently has in-house methodologies for $CO_2$ and $NO_x$ calculations. | SENER/ Third party for $SO_x$ and PM calculations, and updated $CO_2$ and $NO_x$ methodologies |
| 2a. Established CFE system short-run marginal cost-based Reference Price combined with agreed maximum U.S. 1.1 cent | None | IPP contract issued to winning bidder for construction | n/a | Midterm report | Announcement of IPP bid award | CFE |

10 Assumption of 42 percent capacity in Oaxaca, so 100MW installed capacity = 367.9 GWh/yr. Generation is presumed to commence at wind farm commissioning at end of Year 3, and to operate for 25 years. Tariff support would be paid from commissioning for the first five years of operation.

11 Emission reductions of CO2 and NOx, will be calculated based on planning model runs. SOx, and Particulates emissions estimation will require external technical assistance.

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| GEF tariff support (per kWh for 5 years) sufficient to attract bids, investment, construction and operation of 70-100MW wind farm. | | and operation of ≥70MW wind farm | | | | |
| 2b. Subsequent POISE include plans for additional wind IPP procurement at higher reference price and/or lower incentive support level (subject to availability of subsidy funds – GEF or other) | None | POISE includes ≥1 such plant | POISE includes ≥1 such plan | Midterm and Project End reports | POISE publication | CFE |
| 3a. Functioning mechanism for the auctioning of tariff subsidy support through competitive bidding established (Financial Mechanism), with funds provided by GEF, and $20M committed to private sector investors | None | Full | n/a | Initial evaluation performed pre-bid and reported in midterm and end of phase reports, with updates in six-month progress reports as warranted by any changes in level of function | Verification with NAFIN, SENER, WB, including receipt of funds by NAFIN | SENER |
| 3b. Operational Manual for the auctioning mechanism finalized with CFE sign-off | None | Full | n/a | One-time submission and subsequent revision as required by CFE; reporting in midterm and end of phase reports | Protego report, verification from CFE | SENER |
| 3c. Regional Environmental Assessment is made available by CFE for the La Venta III bidding package. | None | Full | n/a | One-time confirmation at release of solicitation. | CFE solicitation | SENER |

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| 3d. CFE base solicitation allows for locations other than that currently identified for La Venta III, including those that would require a change in transmission lines | None | Full | n/a | Six-month progress reports, and end of phase reports | CFE solicitation | SENER |
| 3e. Number of qualified bids received from tender | None | 3 | n/a | Reporting in appropriate six-month progress report, midterm and end of phase reports | CFE bidding process documentation | SENER |
| 3f. CFE commitment to acquire RE capacity through PPAs (MW) | None | IPP wind solicitation for ≥70MW published | n/a | Six-month progress reports, and end of phase reports | CFE bidding process documentation, and PPAs (or equivalent contract) | SENER |
| 3g. Winning bid is to develop wind turbine site within area identified as suitable by CFE's REA | None | Full | n/a | One-time confirmation at award of bid. | CFE bidding process documentation | SENER |
| 3h. Financing plans presented by bidders as part of pre-qualification accepted as adequate by CFE. | None | ≥ 1 bidder pre-qualified | n/a | Midterm report | CFE announced outcome of pre-qualification | CFE |
| 3i. Mechanism for payments to *ejidos*, indigenous communities, and small landowners executed. | None | Executed | n/a | Midterm report | CFE status reporting on La Venta III project execution | CFE |
| 3j. Funds disbursed to *ejidos*, indigenous communities, and small landowner | None | Payments received in accordance with negotiated land | Payments received in accordance with | Midterm and end of phase reports | IPP reporting, discussions with *ejidos*, indigenous communities, small | SENER |

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| | | leases. | negotiated land leases. | | landowner | |
| 3k. Level of turbine-associated bird and bat mortality | None | n/a | Number of turbine-associated bird and bat mortalities established by monitoring exercise. | Ongoing assessment, beginning when the plant commences operation. | Semi-annual reports produced by IPP operator submitted to CFE and SEMARNAT, and made available to SENER and interested members of the public. | SENER |
| 4a. CFE purchase tariff proposed for Phase II which reflects SRMC plus RE capacity value and energy portfolio diversification value as defined by SENER | None | Appropriate multi-component tariff proposed. | As midterm. | One-time submission with revision as required by GEF/SENER; reporting in appropriate six-month progress report and end of phase reports | SENER report on diversification valuation, CFE reporting | SENER |
| 4b. CFE purchase price tariff proposed for Phase II which requires reduced GEF subsidy from Phase I | None | n/a | GEF subsidy for Phase II ≤1.1US¢/kWh | One-time submission with revision as required by GEF; reporting in appropriate six-month progress report and end of phase reports | CFE reporting | SENER |
| 4c. Least-cost methodology for calculation of renewable energy procurement reflecting Full System Marginal Cost developed | None | Full | | Completion of methodology; reporting in appropriate six-month progress | CFE reporting | SENER |

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| | | | | report, midterm and end of phase reports | | |
| 4d. Planning and dispatch model installed and used in CFE to incorporate intermittent sources | None | Installed and used | Installed and used | Six-month progress reports, midterm and end of phase reports | CFE reporting, consultant technical assistance activities reports | SENER |
| 4e. Strategic Environmental Assessment is developed and accepted as basis permitting scale-up of wind energy in Oaxaca region | None | Full | | One-time event | CFE reporting | SENER |
| 4f. New intermittent energy connection contract published incorporating capacity | None | Full | | One-time event; reporting in appropriate six-month progress report, midterm and end of phase reports | Will be published on CRE website | SENER |
| 4g. Strengthening of SENER Investment Promotion Unit business development services, including for self-supply projects | None | UPI's business development services judged adequate | UPI's business development services judged adequate | Midterm and end of phase reports | SENER Investment Promotion Unit reporting, external survey (part of industry analysis) including of potential bidders, consultant technical assistance activities reports | SENER |
| 5a. Institutional capacity sufficient to issue and manage tenders for additional wind farms/other RE resources | None | Assessed as adequate | Assessed as adequate | Assessment of quality of management of Phase I, conducted at midterm and end | Assessment by SENER in consultation with CFE, CRE, and other stakeholders based on timeliness | SENER |

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| | | | | of phase. | and adequacy of reporting, adherence to procurement guidelines, adequacy of financial management and accounting procedures, and maintenance of qualified staff. | |

**Results Framework and Monitoring Plan**

The project aims to develop initial experience in acquiring independent power (IPP) renewable energy sources as a source of economically least-cost electricity, as part of a larger program objective of promoting renewable energy and carbon emission reduction by removing barriers and reducing implementation costs. This monitoring and evaluation (M&E) plan outlines program outcome indicators, intermediate outcome indicators, and the means with which to measure them, in order to evaluate the success of the project in meeting its objectives.

**Timeframe and reporting expectations**

It is anticipated that Phase I will begin in late 2006, with an initial tender issue in July 2006, generation beginning in late 2008, and with tariff support payments continuing for a period of 5 years. While most Phase I GEF-supported activities related to successful auction for a wind farm tariff support and delivery of technical assistance will be complete within approximately 36 months after project initiation, tariff support commitments will continue for 5 years after wind-farm commissioning. Thus, the project is defined as having an 8 year duration, and some benefits may overlap with an anticipated Phase II.

Target values for program and project outcome indicators are defined for Baseline (start of Phase I), end of Phase I, and trigger conditions for Phase II. Target values for Phase I intermediate outcome indicators are defined for Baseline (start of Phase I), Midterm, and Phase I end.

Reporting for Phase I will include six-month progress reports, a midterm report, and a final end-of-phase report. Phase II reporting will include six-month progress reports, a midterm report mid-way through the five-year phase, and an end-of-phase report.

**Program and Project Indicators**

Program indicators reflect a project focus on grid-tied renewable energy excluding large hydro and geothermal. In Phase I, renewable energy will be supplied exclusively by wind power. Renewable energy sources for Phase II will likely continue to include wind, and may also incorporate small hydro, and/or other renewable sources. Draft baselines for wind for only some of the three program and three project indicators are listed in the Arrangements for Results Monitoring table above. Phase I targets are listed for increased generation and capacity (1a-b); Phase I targets for reduced emissions (1c), establishment of a system short-run marginal cost-based reference price combined with agreed maximum GEF tariff support sufficient to attract bids, investment, construction and operation of the wind farm (2a), and that subsequent CFE CFE planning includes plans for additional wind IPP procurement at higher reference price and/or lower incentive support level (subject to availability of subsidy funds – GEF or other). All Phase II targets will be developed before the end of Phase I.

Increased renewable generation and capacity (1a, 1b) will be reported through regular project activities, namely through recording of electricity generation for payment purposes and power-purchase agreements, respectively. Reduced emissions (1c) will be calculated based on generation reporting. SENER currently has in-house emissions reduction calculation methodologies for $CO_2$ and $NO_x$, which combine emissions reductions based on both avoided source emissions and average system generation emissions. SENER has expressed interest in receiving technical assistance to update these methodologies, which they estimate could be done through a consultancy of US$50k-$100k. Given that there is no need for separate data collection on these indicators, SENER can likely track most of the information above with little additional cost. Exceptions are $SO_x$ and Particulate emissions reductions, calculations of which may need to be undertaken by an external party unless the technical assistance noted above could also include development of $SO_x$ and Particulate emissions reduction calculation methodologies for SENER in-house use.

The project implementation plan recommends that an external party be contracted to perform an analysis of advances in local capacity of the wind industry in Mexico, ideally at the end of each phase, and two years beyond project completion. This study would assess factors including potential reductions in the cost of installed wind capacity ($/MW); training courses and other capacity-building opportunities available; and improvements made or needed in the Mexican regulatory context for renewable energy. This activity could potentially be undertaken by a local consultant for around US$30k, depending on the depth of the study.

**Intermediate outcome indicators**

Most intermediate outcome indicators gauge readiness for the project to move on to Phase II; several are triggers for Phase II funds release (3a, 3b, 3f, 3j). As listed in the Arrangements for Results Monitoring table, indicators address target tariff calculations, preparation for Tender Issue, the solicitation itself and bid response, resulting agreements and installed capacity, private investment, land lease arrangements, policy improvements, and business development, including for self-supply projects.

As is the case with program and project indicators, most of the data required for intermediate outcome monitoring and evaluation will be collected through the course of regular program activities, including regular interaction with and provision of data by CFE, as well as input from consultant technical assistance activity reports. Exceptions include land-lease indicators 3i and 3j, which may include additional resource requirements for SENER or an external party, and an evaluation of the strengthening of SENER Investment Promotion Unit business development services for self-supply projects (indicator 4g), which would be included in the wind industry analysis proposed above.

The project implementation plan anticipates that a position will be created within SENER to oversee the day-to-day management of this project. Specific monitoring and evaluation responsibilities for SENER outside of regular program activities for this project will likely require less than a day per month of this person's time.

**Additional indicators**

Additional indicators include those to monitor turbine-associated avian and bat mortality. Data for this effort will come from the ongoing monitoring activities carried out at the site by the project sponsor. The monitoring plan is described in detail in annex 10 and the *Environmental Manual for Wind Projects in Mexico* (in project files).

Results impacts outlined in this M&E plan do not include additional social indicators aimed at cultural property and specific to indigenous peoples, which are included in the Social Assessment Framework. Monitoring of the social impacts will require additional expense, and will likely be undertaken by an external (consulting) body.

The mechanism for sustained replenishment of the Mexican *Fondo Verde* (resulting from the Renewable Energy Law now before Congress) is yet to be conclusively determined. Upon such determination, an appropriate indicator for success may be identified and added to the M&E plan.

**Key Actors**

The Ministry of Energy (SENER: *Secretaría de Energía*) is responsible for policy, regulation, strategy and coordination of the energy sector, and will take the lead role in the development, implementation, management, and coordination of the program. SENER will be the lead entity for data collection required for monitoring and evaluation, including performing necessary calculations for emissions reductions and costs of renewable electricity over time.

The Federal Electricity Commission (CFE: *Comisión Federal de Electricidad*) is the sole Mexican electricity utility, in charge of generating, transmitting, distributing and selling electricity. For this project CFE will play a key input role for monitoring and evaluation, providing SENER with essential data on proposed tariff levels and calculation methodologies, the process of Tender Issue, bids received and power purchase agreements established, subsequent capacity installed, incorporation of planning and dispatch models for intermittent sources, renewable electricity generated, and payments made to IPPs.

National Financing (NAFIN: *Nacional Financiera*) is a Mexican state development bank, which provides financial services, training and technical assistance to stimulate development and competition. For this project, NAFIN is the financial agent designated by SHCP (see below) to request, approve and transfer funds from the WB/GEF to the revolving fund. NAFIN will report confirmation of WB/GEF funds into the revolving fund, in support of indicator 3b.

The Energy Regulatory Commission (CRE: *Comisión Reguladora de Energía*) regulates the activities of both public and private energy operators. In 2006 CRE published a revised interconnection contract incorporating capacity value of intermittent resources, which is expected to help open the renewable self-supply market. SENER will monitor the progress of implementation of these regulations, indicator 4a. CRE does not have a direct role in monitoring and evaluation for this project.

Ministry of Finance and Public Credit (SHCP: *Secretaría de Hacienda y Crédito Público*) will approve CFE's tender issue proposal, and will establish the revolving fund at SENER request, but does not have a direct role in monitoring and evaluation for this project.

National Water Commission (CAN: *Comisión Nacional del Agua*) has no direct role in monitoring and evaluation for Phase 1 of this project, but would be involved in Phase 2 should that phase include small hydro applications.

## Annex 4: Detailed Project Description

## MEXICO: Large-Scale Renewable Energy Development Project

### Program Objective and Phases

The global objective of the project is to reduce greenhouse gas emission reductions (GHGs) and remove barriers to the development of renewable energy technologies and markets, per the Global Environment Facility' Operation Program 6. The development objective is to assist Mexico in developing initial experience in commercially-based grid-connected renewable energy applications by supporting construction of a 101MW IPP wind farm, while building institutional capacity to value, acquire, and manage such resources on a replicable basis.

Phases and Trigger Conditions

To achieve the above objective, the GEF project is structured as the first phase of a proposed two-phase approach to address key policy and tariff issues currently hindering renewable energy development, and facilitate initial investments in grid-connected wind energy with use of GEF support in a Financial Mechanism to overcome initial investment barriers. The $25 Million Phase I – including technical assistance expected to be implemented over three years and tariff support payments for the wind installations spanning five years -- was authorized by the May, 2003 meeting of the GEF Council.

Based on an adequate framework and market entry, the program would continue project replication and cost reduction with both wind and additional renewable energy technologies. At the time of authorizing Phase I, the GEF Council indicated its commitment to review a subsequent request for a US$45 million Phase II on the basis of Phase I success and availability of funding.

Trigger Conditions: The performance indicators used to gauge the success of the first phase and trigger an anticipated second phase, as presented to the GEF Council are:

- Definition of a clear policy, contractual, and market framework for acquiring renewably-generated power by CFE, including introduction of a competitive tariff support function of no more than US 1.5 cents/kWh delivering $ 17 million of GEF funds to private sector investors, resulting in the acquisition of at least 70 MW renewable energy generation capacity in Phase I

- Under GEF supported technical assistance in Phase I, establishment of a pricing and procurement methodology for properly valuing renewable energy additions to the CFE system, shifting from a proxy plant, short-run marginal cost (SRMC) based tariff to an enhanced valuation based on (i) full system SRMC, plus (ii) adjusted capacity value associated with the renewable energy power generation capacity, plus (iii) energy portfolio diversification value of the renewable power generation capacity.

- Decline in the need for subsidies over time, demonstrated by a shift from a maximum GEF grant of 1.5 US cents per kWh of wind energy generation in Phase I to a reduced maximum GEF grant in Phase II. This figure is estimated to be less than 1 US cent per kWh of wind energy generation in Phase II.

A Monitoring and Evaluation program describing measurement of these indicators is described in Annex 3.

Funds for a Phase II operation will be requested from the GEF Council through a new Project Concept Note/Project Appraisal Document to be submitted near the conclusion of Phase I to maintain project continuity. This document will specify progress toward the monitorable indicators summarized above, review the global market situation for renewable energy, and will specify which additional renewable energy technologies will be targeted in Phase II. A study prepared by the *Instituto de Investigaciones Eléctricas* (IIE, the Mexico Electric Power Research Institute) under GEF PDF-B funding confirmed the choice of wind power as the renewable resource having the combination of high potential and proximity to full commercial competitiveness in Mexico, and therefore appropriate for targeting in Phase I. The study, available in the project files, also defines the range of 'near fully commercial' renewable technologies that would be candidates for support under Phase II.

Strategic Choices Underlying the Project Design

The **first strategic choice** has been to not focus renewable energy development efforts primarily on self-generation projects. The September, 2001 enabling environment created under the Law for Public Electrical Energy Service (Article 3 regarding self-generation) has created a nascent 'self-generators' market. Under such arrangements, municipalities and industrials can purchase a share in a renewable project and qualify as 'self-generators', thereby partially avoiding the high cost, 10-18 US cent per kWh tariffs they pay. Currently, the likely realized deal flow includes up to 900 MW of other wind farms in various stages of planning by up to 7 different private sponsors.

While providing an initial opening, the transaction and structuring costs of such self-supply projects are high and some uncertainties remain in the regulatory and wheeling arrangements, limiting their value as a critical mass for a sustainable market. Internal risks remain high, as cross-shareholdings between partners make legal recourse difficult if one party fails to perform. There is also risk that the self-generation market could be closed if a critical mass of such customers (whose high tariffs of 10 to 18 cents per kWh provide a cross-subsidy to other customers in the system) left the CFE system. An April, 2002 Supreme Court action challenged several of the self-generation provisions in the Law for Public Electricity Service, but did not include the renewable self-generation option within its findings.

While this type of self-generation is a real market in Mexico under current law, it is not yet mainstreamed and there is a risk that it may not be permanent. As such, it will continue to be supported as one modality under the GEF program but is not viewed as a substitute for private IPP projects contracted to CFE and fully integrated with grid planning. As a result, Mexico has chosen to also develop the direct contractual and tariff linkages required to establish a sustainable renewable energy IPP market with CFE.

The **second strategic choice** has been on determining the program and financial approach to be used to most pragmatically address Mexico's goal of sector diversification through renewables with available resources available from GEF and other sources (these approaches are described in more detail in Annex 16). Internationally, two main strategic approaches have been developed to stimulate renewable energy:

• Financial and other incentives to stimulate renewables investment, such as capital cost subsidies, tariff-based incentives, tax incentives, subsidized interest rates, and cost-shared demonstration programs.

• Mandated market policies to create a market demand for renewable electricity, typically implemented as 'feed-in laws' that specify an attractive price for renewables, or approaches that define a quantity target of renewable capacity, either through a Renewables Portfolio Standard specifying a percentage of the portfolio to be renewables, or a System Benefit Charge, a small surcharge on electricity consumption whose proceeds are then allocated for renewables deployment through competitive bids.

Increasingly, incentive mechanisms and elements of mandated markets are being used as mutually reinforcing tools, and tailored to suit specific country circumstances and objectives. Further, as the Kyoto Protocol has emerged as an international framework to limit $CO_2$ emissions, new green pricing, Clean Development Mechanism, and/or tradable certificate mechanisms have emerged in response and can provide an important additional source of funds for clean energy development. Mexico has weighed the emergence of these carbon avoidance markets with other lessons learned in financing and implementing renewable energy support programs.

Financial Incentives: Global experience has demonstrated that direct subsidies on a capital cost basis tend to be expensive and often distort incentives to the project developer, resulting in installed capacity but not necessarily the desired outcomes of energy production, sustainable project operation, and continued technology price reduction. As such, this approach is considered more appropriate only in the very early stages of technology development, and is not considered appropriate given the high level of technology experience that Mexico can now access.

Accelerated depreciation is another financial incentive. While high levels can trigger inefficient investment in non-performing assets, with performance verification it can be an effective signal to the market and attract investment.

Mandated markets: In employing such approaches, policy can specify either the price that must be paid for renewable electricity on a unit basis, or the quantity of renewable electricity that must be bought; it cannot do both. Stimulus approaches that dictate levels of clean capacity and specify buyback rates for renewable power typically support costs through a surcharge across ratepayers. Renewable energy portfolio standards, on the other hand, drive utilities to either build renewable energy capacity or buy credits from another entity that builds and operates it, and recover the additional costs through ratepayers. In terms of costs to the government or consumers, both feed laws (with a prescribed price but an indeterminate subscription level) and renewables portfolio standards (RPS) approaches (with set quantity targets but indeterminate costs) can encounter higher than expected total program costs that can threaten their long-term political sustainability.

In Mexico, several strategic considerations readily emerged. First, significant direct government funds were not available, and it was not viewed as politically practical to generate a financial pool for renewables from a ratepayer surcharge, no matter how small. This limited stimulus funds initially to what could be generated from GEF, and indirectly through accelerated depreciation tax concessions. Further, development of a mandated market policy based on a renewable energy portfolio standard (as pursued in the WB-GEF CRESP program for China) proves impractical for Mexico as the existence of only a single utility entity (CFE; *Luz y Fuerza del Centro* serving Mexico City generates less than 2 percent of national supply) leaves only a limited basis for effective trading among different utilities to seek least cost resources. Perhaps most importantly, any incentives need to be accompanied by a clear set of policies, grid access terms and institutional capacity development to facilitate sustainable mainstreaming of renewable technologies into the country's portfolio.

As a result, Mexico has elected to undertake a hybrid approach:

- Based on a version of the competitive solicitation for limited tariff support operated by the California Energy Commission (whose renewables support mechanism is analogous to the Non-Fossil Fuel Obligation program operated in the U.K.);

- Including agreement by CFE to calculate the value of renewable generated electricity based on their system-based long-run marginal avoided costs reflecting the value of renewables in the system, thus serving as a base price in competitive IPP tenders; and

- Augmented by an accelerated investment depreciation scheme. The scheme currently implemented (1 year / 100 percent on equipment; the technologies so supported must remain in operation for at least five years, with verification through CRE and CFE) is considered to be appropriate and represents significant GoM co-financing.

The **third strategic choice** was made in terms of offering the GEF subsidy on a fixed-per-unit basis. The original concept called for operating the initial project tender in such a manner as to simultaneously stimulate competition on both minimizing the level of CFE payment and the required GEF tariff support. While various approaches were explored to efficiently allocate the GEF tariff support element under such a scheme, they proved to be unwieldy and in themselves at odds with CFE legal mandates: CFE must specify a one-time budget authorization from Hacienda to undertake the project. In this budget request, CFE must demonstrate: (a) economic feasibility, and (b) a precise level of maximum contingent liability. In addition, under Mexican federal procurement rules, CFE cannot issue the bid package unless they have legal certainty (i.e., World Bank Board approval) that the GEF grant resources are available. This situation requires fixing the GEF support level on an *ex-ante* basis based on detailed simulations of CFE avoided costs and estimates of technology supply costs (similar to all other GEF grant investments). Appraisal is therefore based not on the winning bid, but on the conformance of the IPP project design, as contained in the officially adopted Least Cost Plan (POISE) and Federal Budget request (PEF), with Bank energy sector and GEF climate change programmatic criteria.

The **fourth strategic choice** concerns the structure of the tendering for projects that will benefit from the Financial Mechanism. Initially multiple bid rounds of smaller projects (e.g., 3 x 30 MW) were considered in order to reduce risks of a failed bid or of a winner failing to complete the project. An evaluation of CFE and CRE (the regulator) screening criteria for participation in CFE bid solicitations and the history of CFE administration of the IPP process for generation acquisition indicated that the risk of such failure was low, opening the way for a larger single bid that is also considered more likely to extract economies of scale in cost, construction, and operation.

The **fifth strategic choice** concerns the continued involvement by the GoM with the assistance of the World Bank in two programmatic environment adjustment loans (the $202.2 million Environment Sectoral Adjustment Loan-I and the $200.5 million Environment Development Policy Loan), and the linkage of the present GEF operation with the IBRD operations. One of the triggers for the second phase of the Environment SAL-I (the DPL) is the design and preparation for implementation of a National Fund for Renewable Energy Promotion (i.e., the Financial Mechanism). Similarly, for the follow-on Environment DPL the proposed GEF-financed Large-Scale Renewable Energy Development Project is fully consistent with the DPL's aims to support the environmental mainstreaming in the energy sector. These GoM commitments demonstrate the linkages they perceive between environmental issues and sustainable economic growth, as well as their commitment to continued development of clean energy sources.

**Project development objective and key indicators**

The global objective of the project is to reduce greenhouse gas emission reductions (GHGs) and remove barriers to the development of renewable energy technologies and markets, per the Global Environment Facility' Operation Program 6. 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 higher level objective of the Phase I GEF intervention is not to simply build an Independent Power Producer (IPP) wind farm, but rather to launch a sustainable private wind farming industry in Mexico with environmental and local development benefits. The wind farm resulting from this project, designated as La Venta III, will demonstrate a continuum of experience with grid connected wind energy in Mexico by taking procurement and operation to the IPP modality. It will build on CFE's initial 2 MW demonstration plant (La Venta I), and the turnkey 85 MW La Venta II project that CFE has successfully tendered and which will be commissioned later this year. Where La Venta II will provide CFE with important operational and technical experience, La Venta III (and the technical assistance associated with the project) will significantly augment this experience as well as provide CFE with the tools to replicate additional wind and other renewable energy projects on a cost-effective IPP basis.
The project's objectives address two primary tracks for developing and sustaining large-scale renewable energy development:

1. To open avenues for direct sale to CFE at prices that increasingly recognize over time the full value of renewable resources - including intermittent resources - to the integrated grid system.
2. To reduce risk and transactions costs barriers currently limiting private projects serving municipals and industrials under provisions of the September, 2001 renewable energy self-supply regulations enacted by CRE, and amended and gazetted on January 30, 2006.

The key performance indicators include:

- Total electricity generated (GWh/yr) from renewable energy

- Total renewable energy generation capacity (MW)
- Emissions reduced (tons/year): $CO_2$, NOx, SOx, Particulates
- Costs of renewable generated electricity ($/MWh) and its level of competitiveness in grid system

Additional indicators and development contributions will include industrial development, local manufacture of some components, employment, and other social benefits resulting from land leasing for wind farms, etc. Details are given in Annex 3.

**Project components**

In its first phase, the GEF project supports three main components to remove policy, financial and transactional cost barriers in order to open IPP markets in renewable energy:

- A **Financial Mechanism** to stimulate organizational learning and cost reduction, that will provide US$20.4 million in energy production incentives on an Output-Based Aid basis (1.1 US cents per kWh for the first 5 years of generation), offered in response to a CFE competitive solicitation for 101 MW of IPP wind power;

- **Technical Assistance** activities valued at US$3.9 million (plus CFE and BMZ/GTZ co-financing of approximately US$0.37 million) to address analytical and policy barriers, and provide business development assistance to stimulate and facilitate project investment in both IPP and renewable energy self-supply markets; and

- **Project Management** support in the amount of US$0.7 million to assist SENER, in coordination with NAFIN, in the management of both of the above substantive components, and to fulfill oversight, monitoring and evaluation, and reporting responsibilities.

**Component 1: Financial Mechanism** (GEF = $20.4 million)

Incorporating lessons from British, Irish and California experiences promoting renewable energy, tariff price support for renewable projects (initially, the La Venta III 101 MW wind farm) will be delivered from a Financial Mechanism on a per kWh production basis for the first five years of operation by the winning La Venta III bidder.

<u>Financial Mechanism Design</u>

This approach would couple CFE competitive procurement for renewable energy IPPs with additional tariff support. Capital for La Venta III would be provided by the private sector through commercial markets, with the IPP contract and tariff support providing key ingredients in obtaining project financing. CFE's willingness to pay would be indicated by a bid reservation price derived from their system long-run marginal avoided cost of energy and capacity contributions from the La Venta III project. An additional payment from the Financial Mechanism, announced as part of the same competitive tender, would be provided to bridge the difference between the reservation price and the generation cost bid by the developer.

The methodology for the determination of CFE's avoided cost is based on differential runs of

CFE's primary generation planning and dispatch operations models, WASP IV and MEXICO, using SENER's official forecasts for fuels prices, and has been agreed between the Bank with CFE. Consistent with CFE procurement regulations, this bid reservation price is only publicly disclosed on the event of a declaration of a failed bid. CFE has disclosed the reservation price for the La Venta III bidding to SENER, which has provided the Bank with assurances that the CFE price, taken in conjunction with the calculated GEF tariff support payment, adequately minimizes the risk of bid failure and is consistent with the Bank's estimates of CFE avoided costs.

The financial mechanism, created through the project, has also provided the basis for its potential replenishment and expansion by the Mexican Government through the Renewable Energy Law draft now being reviewed for passage by the Senate; the Law would create a *Fondo Verde* to be capitalized at an initial level of approximately US$90 million. Other avenues for fund replenishment that will be evaluated by SENER in the course of GEF project implementation include the sale of carbon offsets from renewable energy projects, and (as supported under the Technical Assistance component), green energy schemes and renewable energy certificate trading.

Guidelines for the operation of the Financial Mechanism have been developed for use by SENER and CFE. This document, available in the project file, provides detailed guidance for the CFE wind power bid solicitation, described below.

### Actions and Criteria Specified for the Financial Mechanism Guidelines

#### Bid Solicitation

- qualifying renewable energy facilities/proponents
- funding amounts to individual sponsor
- selection methodology for the facilities
- assignment of emissions reductions
- bid upper limit cap per facility
- funds available to one project in a bid
- incentives/penalties for early/late commissioning
- conditions for projects served
- method for estimating energy generation qualifying for Incentive
- use of performance bonds
- circumstances for canceling/reducing award

#### Communications and marketing

- pre-bid conferences and communication
- pre-qualifications
- notice of auction
- issuance of decisions and clarifications
- proprietary information: types, disclosure, protection,
- Transparency

#### Bid structure and content requirements

- proposal introduction

- technical requirements
- bid performance bond
- site control and land leasing arrangements
- sponsor information
- environmental & social impacts
- project schedule
- financial information survey
- proposal bid price
- project economic performance feasibility

**Bid evaluation**

- bid selection methodology
- award criteria

**Award Agreements and Development timeline**

- preparation and adoption of project award package
- required permits
- approvals obtained
- project funds available
- construction started
- construction progress check
- project completed and on-line
- flow of funds

**Payment of incentives**

- project certification and contracting
- project operation
- invoicing for payments
- payment certification and disbursement
- monitoring and evaluation by financial intermediary

**Other issues**

- reporting and record retention (by sponsor)
- anti-gaming provisions
- land use issues

**Illustrative bid structure and content**

- Requirements
- proposal introduction
- technical requirements
- bid performance bond
- site control and land leasing arrangements
- financial information survey
- sponsor information

- environmental & social impacts
- project schedule
- proposal bid price
- project economic performance feasibility

The specified arrangements do not make significant alterations to CFE's established processes, but augment the CFE bid process while accounting for the unique features of developing a wind generation facility in an IPP structure. The Guidelines are also accompanied by a detailed project implementation plan (available in the project file) which details the range of activities that are required for the winning project to be carried out; when combined with a description of financial management, procurement and disbursement flows, these documents form the basis of the Project Operational Manual.

IPP Wind Project (La Venta III)

The project consists of wind energy power plant of a nominal capacity of 101 MW (+/- 2 percent) and its associated interconnection system. At an estimated net capacity factor of the plant, conservatively estimated as 42 percent, the plant would provide annually about 371.6 GWh on average, resulting in an annual reduction of GHG of about 247,000 tons of $CO_2$ ($tCO_2e$), or some 4.94 million tons over its expected 20 year economic life. The plant will be privately owned and operated and will be the first wind energy plant in Mexico operating under the CFE *Productor Independiente de Energía* (IPP) scheme. Choice of wind turbine sizing and layout is up to the bidder. However, based on International Electrotechnical Commission Class 1 turbine availability (recommended for areas with high winds where the average annual wind speed at hub height is up to 10 m/s), individual turbines are expected to range from 850 kW to 1.6 MW capacity each. The issue of logistics (transport of the wind turbines' blades) has been examined and it is expected that the port of Salina Cruz could handle the equipment; cranes for the wind turbines installation are available in the region.

CFE has identified a suitable site for La Venta III, southeast of the CFE-owned La Venta II wind project now under construction, and expects that the focus of bidding attention will be on this site. The site is located in the *Ejido* La Venta, in the municipality of Juchitán de Zaragoza, in the state of Oaxaca. [12] If the winning bidder selects this site, CFE will build, under the *Obra Publica Financiada* (OPF) scheme, a 230 kV double circuit transmission line augmentation to the line being constructed from the La Venta II wind park to the Juchitán II sub-station. The transmission line runs for approximately 18 km along the existing La Venta-El Porvenir road. CFE has carried out load flow studies for a variety of system conditions and the results indicated that the wind power plant causes no adverse conditions and the transmission system can carry all planned generation capacity to the various load centers in the CFE system. It should be noted that the transmission line is designed to allow for the power transmission of future wind energy plants that are expected in the area.

Alternatively, the La Venta III bidders would be free to propose an alternative site within an economic transmission distance of power evacuation points. In this instance, the points of

[12] The La Venta area is adjacent to the region known as '*La Ventosa*,' directly translated as "the windy place".

interconnection would be the La Venta II site or the Juchitán II substation, and the bidder would be responsible for costs of transmission and connection to these points.

Total overnight investment costs for the La Venta III wind farm is estimated as US$123 million, plus an additional US$5.1 million for the above described transmission reinforcement.

CFE has prepared a range of engineering studies for the project site including: Evaluation of the wind resource, topography, and ground mechanics. One of the important factors for the technical feasibility of the project has been the analysis of data related to the direction and velocity of the wind. Driven by trade winds in the Caribbean, air flows south from the Gulf of Mexico, through a gap in the Sierra Madre Mountains, to the Pacific Ocean. The winds are channeled and accelerated through the mountain pass ('venturi' effect), across the coastal plains of the Isthmus of Tehuantepec. CFE has been monitoring the area with anemometers since 1993 and has collected data on various heights (20, 30 and 40m). The database of the resource has been analyzed and it shows, with a good degree of confidence, that sites in the selected area are exceptionally well suited for wind project development. Annual average wind speeds for the area are over 9 m/s at a height of 40m above ground level (see table below for monthly variability), with the prevailing direction from the north. In comparison with other locations the consistent direction of the wind is unique in the La Venta area.

In regard to wind resource risk, CFE is evaluating how this will be divided between CFE and the developer, based on which entity was responsible for the wind resource measurement at the selected site. For an installation at the already identified site, confirmation of actual wind resource is expected to be made by CFE-installed anemometers on site to confirm output relative to actual wind flows. This information would be used to assess responsibility for shortfalls in output over a given period, with a penalty levied if power deliveries fell below a pre-specified minimum in spite of adequate wind availability. Based on information available to date, it appears that the potential loss of operating time due to migratory bird-induced shutdown periods is likely to present only a modest risk, due to (i) a short migratory season (about three weeks per year), (ii) the fact that migratory raptor species fly only during the day, apparently flying at low altitudes (the time they are potentially at risk from the turbines) only for a few hours during this time, and (iii) the potential for the operator to schedule routine maintenance to coincide with this period.

The tariff paid to the IPP by CFE is expected to be based on a fixed rate, with incremental increases based on inflation in the O&M costs only. (O&M is typically no more than 25 percent of project revenues). A tariff based on fossil fuel prices would not be acceptable to CFE if it resulted in benefits to the wind developer from higher fossil fuel prices, as this would counter the diversification benefit to the utility. Similarly, it would be inequitable to expect the wind developer to face any downside on tariff rates linked to possible falls in fossil prices, without having potential to gain upside benefits from fossil price increases. Thus, the fixed tariff (other than O&M) remains the best way to address risks.

**Table 2: Average Monthly Wind Speed (m/s)**

| | 1996 | 1997 | 1999 | 2000 | 4-yr |
|---|---|---|---|---|---|
| **January** | 11.7 | 11.5 | 12.3 | 13.3 | 12.2 |
| **February** | 10.2 | 12.7 | 11.6 | 11.0 | 11.4 |
| **March** | 10.5 | 10.4 | 9.3 | 6.9 | 9.3 |
| **April** | 8.6 | 9.2 | 7.9 | 8.7 | 8.6 |
| **May** | 8.5 | 9.7 | 6.5 | | 8.3 |
| **June** | 6.3 | 5.6 | 4.7 | | 5.6 |
| **July** | 8.7 | 12.6 | 9.7 | 10.3 | 10.3 |
| **August** | 8.4 | 12.4 | 6.9 | 10.5 | 9.5 |
| **September** | 5.7 | 8.6 | 6.2 | 6.7 | 6.8 |
| **October** | 8.7 | 8.3 | 10.1 | 12.5 | 9.9 |
| **November** | 13.1 | | 14.4 | | 13.7 |
| **December** | 13.7 | | 13.8 | | 13.8 |

*Source: La Venta II Feasibility Study*

At most sites, a slight variation in wind speed results in a large variation in energy output, due to the cubic relationship between wind speed and wind energy. At extremely high wind sites, like those in the La Venta region, this effect is reduced because the wind turbines operate at their rated output much of the time. Even if turbines experience slightly lower winds, they still operate at their rated output, minimizing the impact on the annual energy output. As a result, the variation of the wind across years may not be as important as in other sites.

**Component 2: Technical Assistance** (GEF = \$3.9 million; CFE = \$0.25 million; BMZ/GTZ = \$0.12 million)

The technical assistance activities supported under the GEF project comprise: (a) analytical and methodological activities designed to enhance value recognition of renewable resources within the CFE system, (b) installation of modeling capabilities and associated training within CFE and its dispatch operations arm, CENACE, for the improved technical integration of renewables within the national grid system, (c) strengthening of SENER's *Unidad de Promoción de Inversiones* (UPI) capacity to serve as a "one stop shop" for renewable energy project developers, and implementation of an expanded menu of outreach and advisory services, (d) development of databases and plans required by CFE and developers in order to expand wind development both within Oaxaca and nationally. These tasks are summarized in Table 3 under five categories, and detailed below.

**Table 3: Technical Assistance Tasks**

| TASK | LEAD AGENCY | OTHER INVOLVED AGENCIES | APPROX. COST ($) |
|---|---|---|---|
| **1. System-based Least Cost Determination** | | | |
| 1.1. Evaluation of methodologies and development of operational guidelines to interpret least cost power acquisition mandate and assessment of the value of energy diversification, including the application of the Capital Asset Pricing Model, options analysis, probabilistic simulation and other approaches (SENER). | SENER: DGIDTMA | CFE: SP, CRE | $250,000 [plus GTZ co-financing of $120,000] |
| 1.2. Evaluation of methodologies and development of operational guidelines for the valuation of local/regional environmental and other externalities in power system resource valuation, planning, and dispatch. | SENER: DGIDTMA | CFE: SP, SEMARNAT, SSA, CRE | $250,000 |
| 1.3. Exchange of experiences between CFE/CENACE and other utilities on models and tools capable of analyzing the system impacts, cost/value and emissions impacts of intermittent renewable energy sources. | CFE: CENACE | CFE: SP, CRE | $100,000 |
| 1.4. Analysis on a regular basis of impacts on system expansion of renewable sources and regular estimation of system marginal costs for translation into benchmark or reference prices for acquisition of renewable energy | CFE: SP | CRE | $200,000 CFE co-financing |
| **2. Integration of Renewables in System Operations** | | | |
| 2.1. Acquisition, installation and training for software capabilities to support CENACE's decision-making process to dispatch intermittent facilities by themselves and in combination with non-intermittent resources. Training and technical assistance as the first intermittent facilities are included in the system | CFE: CENACE | CRE | $550,000 |
| 2.2. Acquisition, installation and training for day-ahead and hour-ahead wind forecast models to optimize dispatch | CFE: CENACE | CRE, CFE: GPG | $300,000 |
| 2.3. Detailed load flow analysis and system stability studies | CFE: SP | CFE: CENACE, CRE | $50,000 CFE co-financing |
| 2.4. Development of standardized protocols for the integration of renewably generated power into the grid | CFE: CENACE | CRE | $150,000 |
| **3. Project and Business Development** | | | |
| 3.1. Strengthening of one-stop shop business development services addressing marketing, financing, permitting and planning issues related to both renewable energy IPP and self-supply schemes. Assistance to energy project developers will address information barriers, transmission and wheeling arrangements, and transaction support, including both pre-bid (on a contingent finance/reimbursable basis) and post-bid project development assistance | SENER: UPI | CRE | $400,000 |

| | | | |
|---|---|---|---|
| 3.2. Design of green power and renewable energy tradeable permit systems | SENER: DGIDTMA | SEMARNAT, CRE | $250,000 |
| **4. Wind Potential Assessment** | | | |
| 4.1. Development of a national wind map based on available measurements and remote sensing data, including installation of wind measurement stations | CFE: GPG | CRE | $1,150,000 |
| **5. Regional Planning Activities** | | | |
| 5.1. Development of a strategic environmental assessment for the southern Isthmus of Tehuantepec | CFE: GPG | SENER, CRE | $300,000 |
| 5.2. Development of a regional long-term development plan for the southern Isthmus of Tehuantepec wind energy sources, including environmental assessment, land use regulations, social impacts, and industrial development issues | SENER: DGIDTMA | CFE: GPG<br>CRE | $200,000 |

Task # 1: System-based Least Cost Determination (SENER/CFE/CENACE)
(GEF = $600,000; CFE = $200,000; BMZ/GTZ = $120,000):

'Least cost' as used in Mexico and traditional engineering economics fails to capture a wide range of long term costs implications, fuel price and supply risks, and environmental impacts, and accounts in part for the limited penetration of renewable energy in the Mexican power system. The objective of this task is to analyze the value of renewable energy in the electrical sector from a broader perspective and under a variety of renewables penetration scenarios. The longer-term aim is to develop an energy planning process for Mexico that takes into account the particular conditions of the Mexican energy and electricity sectors, and that incorporates appropriate contemporary technology valuation and decision support tools, including portfolio-based valuation, options analysis, probabilistic simulation and other approaches, the Capital Asset Pricing Model, and other tools as required. In addition, analytical work, complemented by international best practice exchanges, will evaluate and apply tools for the integration of environmental externality factors in power system planning and dispatch, and will build upon recent work involving SENER, CFE and Hacienda on the role of externality valuation in energy investment decision-making.

Task # 2: Integration of Renewables in System Operations (CFE/CENACE)
(GEF = $1,000,000; CFE = $50,000;)

In the course of evaluating potential wind energy projects in Mexico, the project team found that there are significant gaps in knowledge about how wind can best be fitted into the CFE system. The current electricity simulation modeling suite for CFE, CENACE and IIE revolves around versions of WASP (WASP IV and DECADES) and a custom dispatch program (MEXICO). Transmission analysis and modeling is handled separately in CFE, but is included in the CENACE dispatch model. At present, CFE is equipped to simulate a future with the least costly set of power plants that can meet peak system demand at various points in the future. The units of energy account are the peak demand by month and year. The load duration curve is met during each month at the least cost.

For dispatch, CENACE currently uses a purpose-built model of the system. This model is able to handle some transmission constraints and can "see" individual power plants down to the 50 MW size range. CENACE has had some success with "predictive dispatch" wherein the dispatch model is used to predict the operational plant mix under given load conditions. They have simulated at least six months into the future. There is no systematic analytical or data connection between the modeling activities of the CFE generation planning department and the activities of CENACE.

Based on the limitations of these current tools**,** the next generation of system operations simulation for Mexico should include the following key characteristics:

- Improved data and logical linkages between system planning and dispatch;
- Ability to iterate dispatch results with generation planning;
- Endogenous transmission planning and constraint analysis in both generation planning and dispatch;
- Inclusion of IPPs and other marketed power sources in planning;
- Reduced time intervals for generation planning software; and

- Ability to use dispatch and transmission constraint software for detailed system forecast simulation.

The ability to recognize wind energy's contribution to reduction of loss of load probability (LOLP) and greater system reliability will also be improved through the installation and training in day-ahead and hour-ahead wind forecast modeling. These capabilities allow dispatch optimization of the combination of conventional (thermal and hydro) and wind resources, lowering hot standby and spinning reserve generation requirements and costs.

This task will include acquisition of software, training, and application of methodologies to support enhanced system dispatch capable of analyzing the system impacts, cost/value and emissions impacts of intermittent renewable energy sources. Systems modeling would also include load flow analysis and system stability studies. This analytical capability will permit CFE and CENACE to refine system avoided costs (including the reference price initially established for the La Venta III tender) through a heightened recognition of the capacity value offered by intermittent renewable energy generation.

<u>Task #3: Renewable Energy Project and Business Development</u> (SENER/UPI)
(GEF = $650,000)

The aim of this task is to facilitate the development of projects attracted and incentivized by the Financial Mechanism (including in its targeted operation beyond the use of the initial GEF capitalization), as well as to help developers mitigate information and transactions cost barriers associated with renewable energy auto-generation schemes now permitted under the September, 2001 renewable energy self-supply regulations enacted by CRE. These activities include:

(a) Development of standardized protocols and contract forms for CFE purchase of renewably generated power. (CFE/CENACE)

(b) Organization and institutional strengthening required for a "one-stop shop" business development service addressing marketing, financing, permitting and planning issues. (SENER/UPI)

    The activities under (b) above are sub-divided in four categories, and are detailed in Tables 4 to 7 below:

    1. Institutional Development and Training for UPI ($150,000).
    2. Information and Outreach ($160,000).
    3. Transaction Support for Wind Projects in the 'Self Generation' Market ($35,000).
    4. Market Development: Future IPP Projects ($55,000)

(c) Green Power/Export Market Development (SENER = $250,000)

    Willingness to pay for green electricity in Mexico has been investigated by the *Comision National para el Ahorro de Energía* (CONAE – National Energy Savings Commission) in conjunction with the World Resources Institute. Some 94 percent of the 100 largest industrial electricity consumers expressed their willingness to buy green electricity, for which 54 percent would pay a surcharge of up to 11 percent of the regular tariff. This task will aim to design an organizational structure and rules so as to foster the development of a working green power market in Mexico.

In addition to the domestic potential, all the U.S. States bordering Mexico, plus Nevada, have enacted Renewable Energy Portfolio Standards (RPS) incentive mechanisms requiring varying but significant amounts of their future capacity additions to be met with renewable energy. It is expected that these programs will facilitate opening of these markets with elements of tradable renewable energy certificates (or credits – TRECs), with related monitoring and verification protocols to support these markets.

Currently legislated targets in these states are:
California 20 percent by 2017
Arizona 1.1 percent by 2007 (60 percent of which should be solar)
New Mexico 10 percent by 2011
Texas 3 percent by 2009
Nevada 15 percent by 2013

The RPS program in Texas has been a particular boon to wind energy development in the state. Due to a significant wind resources potential, additional customer-driven markets for green power, and favorable transmission rules, this market is expected to continue to grow. California's RPS legislation was passed in September 2002, and this significant requirement provides an important linkage with the California Energy Commission competitive tariff incentive program that the Mexico program is modeled after. This task will investigate the feasibility of cross-border trade in TRECs with U.S. jurisdictions, and develop the framework for trading activities that could be implemented in the future.

**Table 4 – Institutional Strengthening and Training for UPI**

| Activity or Study | Time (months) | Estimated Cost | Responsibility |
|---|---|---|---|
| In-depth training and extensive legal/regulatory knowledge within UPI staff and selected staff within the energy sector to familiarize them with the regulatory and legal environment for renewable energy projects, a grounding in technical and operational issues and interaction of projects with the grid, and exposure to views and needs of private sector developer and investor needs in developing renewable energy projects. The task will assess the background and expertise of UPI's personnel, and develop an extensive training program so UPI personnel skills will be responsive to the market and continue to grow with it. The program will provide to UPI staff information on:<br><br>Technologies available and technical knowledge on renewable generation projects to effectively communicate with developers and discern between good and poor projects from a technical standpoint.<br><br>Legal foundations and permitting processes (including those for water concessions, environmental, and local authorizations) and commercial structures (including financing, taxation, and payment provisions) to better assist developers and discern between good and poor projects from a commercial standpoint.<br><br>Legal, community, environmental, natural resources and other aspects specific to regions that, because of their characteristics, are strong candidates for renewable energy development<br><br>Technical issues with respect to grid interconnection, grids stability, interconnection contracts and other issues in which CFE and the private parties interact. | 12 | $150,000 | * Lead effort: SENER / UPI<br>* External support: Local consultants |
| **Total** | | **$150,000** | |

**Table 5 – Information and Outreach**

| Activity or Study | Time (months) | Estimated Cost | Responsibility |
|---|---|---|---|
| Develop and continuously update a main list of contacts within Government. Organizations (CRE, SEMARNAT, CFE, local authorities) to refer private developers to for permitting and project-specific problem solving and facilitation support. | 1 | $20,000 | * Lead effort: SENER / UPI<br>* External support: Local consultants (if internal capabilities not sufficient |
| Develop and maintain updated and publicly available a database of introductory documents to guide private parties through the permitting and processes required for project development. This database could include, for example, a step-by-step process map for self-generation project permitting and development, as well as other guides developed either by the UPI or other agencies. | 3 | $30,000 | * Lead effort: SENER / UPI<br>* External support: Local consultants |
| UPI to develop a website to direct interested parties into different sites that may contain useful information for project feasibility analysis. | 4 | $40,000 | * Lead effort: SENER / UPI<br>* Other agencies support: IIE, CFE, CRE<br>* External support: Local consultants |
| Assessment of alternative ways to strengthen communication channels between CFE, CRE, selected energy sector institutions and the UPI, and devise a mechanism to maintain an up-to-date information database on bid, technology, and project progress and development information. | 2 | $30,000 | * Lead effort: SENER / UPI<br>* Other agencies support: CFE, CRE |

| | | | |
|---|---|---|---|
| Develop documents and presentations summarizing the capabilities and programs of UPI as a one-stop shop for facilitation services; organize high level meetings with the different government agencies authorities to share UPI's goals to obtain full support from the different authorities. | 2 | $40,000 | * Lead effort SENER / UPI<br>* Other agencies support: CFE, CRE, local governments |
| **Total** | | **$160,000** | |

**Table 6 – Transaction Support for Renewable Energy Self-supply**

| **Activity or Study** | **Time (months)** | **Estimated Cost** | **Responsibility** |
|---|---|---|---|
| UPI to work within SENER and with CRE to create a unified study/document that describes the regulatory status of power generation through private investment schemes in Mexico for renewable energy sources. This will build upon and consolidate the work being performed by IIE under the parallel UNDP/GEF wind project ("Guide for the Development of Wind Energy Projects in Mexico") | 3 | $35,000 | * Lead effort SENER / UPI |
| **Total** | | **$35,000** | |

**Table 7 - Market Development – Future IPP Projects**

| **Activity or Study** | **Time (months)** | **Estimated Cost** | **Responsibility** |
|---|---|---|---|
| Develop a standard PPA for wind/other intermittent projects that CFE can use as a baseline for bids. | 4 | $30,000 | |
| Investigate with the State of Oaxaca the current state of the work performed with respect to a standard framework for land leasing agreements; determine whether technical assistance resources can be deployed to serve this goal, and support local authorities in final development and promotion of the standard contract and leasing structure proposed. | 4 | $25,000 | |
| **Total** | | **$55,000** | |

Task #4: Wind Potential Assessment (CFE)
(GEF = $1,150,000)

National and international attention has been brought to the La Venta area because of its high wind resource potential. Since the area has already been identified as extremely attractive to wind developers, a number of studies have been done evaluating the region from different standpoints; The following is a brief description of each institutions contribution to wind resources in Mexico, and in particular in Oaxaca.

CFE - In 1994 CFE installed 7 wind turbines of 225 kW, totaling a 1.57 MW capacity in La Venta, Oaxaca. Since then, CFE has collected wind data from the site and has studied the region's wind potential to install larger capacity wind farms.

IIE - Though the IIE had evaluated wind potential in Oaxaca in previous years, the creation of the UNDP/GEF wind energy project has resulted in a broader effort evaluate the feasibility of wind power in Mexico. Through GEF funding, IIE has installed 8 anemometric stations throughout the country in the most promising wind regions (including the states of Oaxaca, Hidalgo, Chihuahua, Puebla, Veracruz, Yucatan and Zacatecas). IIE's information compilation is very complete in terms of the quality, quantity and usefulness of the available data. This valuable effort should be considered the starting point to create a more complete wind resource database and wind information platform in general.

CONAE - The Government of Oaxaca provided CONAE preliminary maps of wind potential for the entire state, particularly for the Isthmus of Tehuantepec. The maps were based on satellite readings, which were validated by CONAGUA (National Water Commission) through registered data from 300 anemometric, climatologic and hydrologic stations. The relevant federal government agencies collaborated by providing information from civil and military airports, and private companies

U.S National Renewable Energy Laboratory (NREL) - NREL developed a Wind Energy Resource Atlas of Oaxaca which identifies the wind characteristics and distribution of the wind energy resource in the State. The detailed wind resource maps and other information contained in the atlas facilitate the identification of prospective areas for use of wind energy technologies for utility-scale power generation, village power, and off-grid wind energy applications. The maps portray the wind resource with high resolution grids of wind power density at 50 m above ground. NREL estimates that there are about 6600 $km^2$ of windy land with good-to-excellent wind resource potential in Oaxaca. The windy land represents slightly more than 7 percent of Oaxaca's total land area. Using a conservative assumption of 5 MW per $km^2$, this windy land could support approximately 33,000 MW of potential installed capacity. If only areas with the highest (Class 7) wind resource potential are considered, the estimated total windy land area is about 1,200 $km^2$, and this land could potentially support about 6,000 MW of installed capacity. Most of Oaxaca's windy land area is located in the Isthmus region.

The information resources outlined above are of great usefulness to any planner or wind energy developer making a first estimate of the feasibility of a project. However, some disadvantages arise when considering that they are all distributed in different websites and, while wind data in the form of maps is very useful, it can not be manipulated or thoroughly analyzed.

This task will therefore develop a national assessment that is considered essential to promote national wind power scale-up beyond the La Ventosa region. For CFE in particular, it is necessary to develop wind resources over greater geographical diversity, *inter alia* because overall capacity contribution is a function of geographical diversity. Additional anemometers and measurement systems will be installed to intensify and complement the network operated by IIE, and the results integrated with the on-going measurements and combined with corroborating sources to develop national-level wind mapping and databases that will serve the longer-term development needs of wind energy in Mexico.

Task #5: Plan for the Southern Isthmus of Tehuantepec Region (CFE/SENER)
(GEF = $500,000)

Future development of the areas of high wind potential in the south of the Isthmus of Tehuantepec, with a Class 7 (highest rating) wind resource estimated to harbor some 6,000 MW wind capacity, will require the preparation of a regional long-term wind development plan. A key input into this plan will be the to conduct a strategic environmental assessment (SEA) that will evaluate and zone areas within the southern Isthmus of Tehuantepec as suitable (or not) for wind development based, *inter alia*, on bird migration paths and potential for turbine blade strikes, equipment damage and bird mortality. The plan will also include the development of a transmission expansion and sub-station reinforcement plan for windy areas. Existing land use regulations, complementary infrastructure requirements, industrial development implications and aggregate social impacts will also need to be assessed and incorporated in longer-term planning. This task will assist SENER and CFE, drawing in turn on Oaxaca state government resources, to develop an integrated regional plan for wind development.

**Component 3: Project Management** (SENER)
(GEF = $700,000)

As described in Annex 6, Implementation Arrangements, SENER's management capacities will be augmented through specialized project management consultants financed by the GEF project on an incremental cost basis. These include a Project Manager (full-time local consultant), a Utility and Renewable Energy Expert (part-time local consultant/as needed), and a Procurement Assistant (part-time local consultant). It is estimated that these consultants will be required during the first three years of project life to oversee implementation of the Financial Mechanism and implementation of the various lines of Technical Assistance. Activities in the final five years of the project life primarily consist of processing regular Financial Mechanism payments to the La Venta III owner/operator, and the necessary certification function for payments will be absorbed into regular SENER and CFE staff functions.

In addition to the above SENER-based consultants, existing NAFIN procurement and financial management staff (or consultants) will be detailed on a part-time basis to render assistance to SENER and CFE for processing of the technical assistance procurements and liaison with the World Bank [on financial matters].

Lastly, specialized consultants will be periodically engaged to conduct social, environmental, and monitoring and evaluation assessments in accordance with the project's Environmental Management Plan and M&E Plan.

## Annex 5: Project Costs

## MEXICO: Large-Scale Renewable Energy Development Project

| **Project Cost By Component and/or Activity** | **Local US $million** | **Foreign US $million** | **Total US $million** |
|---|---|---|---|
| Financial Mechanism | - | 20.4 | 20.4 |
| Technical Assistance | 1.5 | 2.4 | 3.9 |
| System-based Least Cost Determination | (0.1) | (0.5) | (0.6) |
| Integration of Renewables in System Operations | (0.3) | (0.7) | (1.0) |
| Project and Business Development | (0.4) | (0.25) | (0.65) |
| Wind Potential Assessment | (0.3) | (0.85) | (1.15) |
| Regional Plan for south Isthmus of Tehuantepec | (0.4) | (0.1) | (0.5) |
| Project Management | 0.6 | 0.1 | 0.7 |
| Total Baseline Cost | 2.1 | 22.9 | 25.0 |
| Physical Contingencies | -- | -- | -- |
| Price Contingencies | 1/ | 1/ | 1/ |
| **Total Project Costs**1 | 2.1 | 22.9 | 25.0 |
| Interest during construction | -- | -- | -- |
| Front-end Fee | -- | -- | -- |
| **Total Financing Required** | 2.1 | 22.9 | 25.0 |

1 Included in project cost estimates.

2 Identifiable taxes and duties are US$0.86m, and the total project cost, net of taxes, is US$ 24.14m. Therefore, the share of project cost net of taxes is 96.5 percent.

## Annex 6: Implementation Arrangements

## MEXICO: Large-Scale Renewable Energy Development Project

The project targets the use of $25 million of GEF funds, aiming at promoting the development of at least 70 MW of installed wind generation capacity through the mobilization of private sector resources and acumen, and the creation of a supportive policy and implementation framework for grid-connected renewable energy development. The resources will be shared between direct incentive support to a the first wind farm operating under the IPP commercial scheme, the CFE "La Venta III" 101 MW project, and a technical assistance program that provides a support service infrastructure to further facilitate the development and operation of renewable facilities, both under the IPP scheme and the self-generation commercial scheme and.

### Organizational Arrangements and Implementation Responsibilities

Implementation of a renewable energy development program, of which this project forms a major part, requires the following competencies:

With respect to private sector projects with CFE (regarding both IPP projects supported under the GEF project and *Obra Publica Financiada* build-transfer projects):

- Set and transmit clear policies guiding CFE generation resource acquisition, including for the development of wind energy projects;
- Design mechanisms to ensure such projects will be economically attractive to Mexico and financially viable to CFE;
- Ensure that such mechanisms will also be attractive to the developers from a technical and financial standpoint.

With respect to private-to-private projects, such as those eligible under the Renewable Energy Self-Supply regulations:

- Promote development of wind projects, with appropriate policies in place
- Ensure overall technical feasibility of projects, especially with respect to grid inter-connection and the economic parameters for integration into the grid system;
- Ensure financial feasibility, by providing regulatory certainty and the adequate mechanisms so that financiers develop confidence and willingness to invest;
- Assist developers through the provision of information on opportunities and guidance for responding to promotional opportunities through the development and execution of projects.

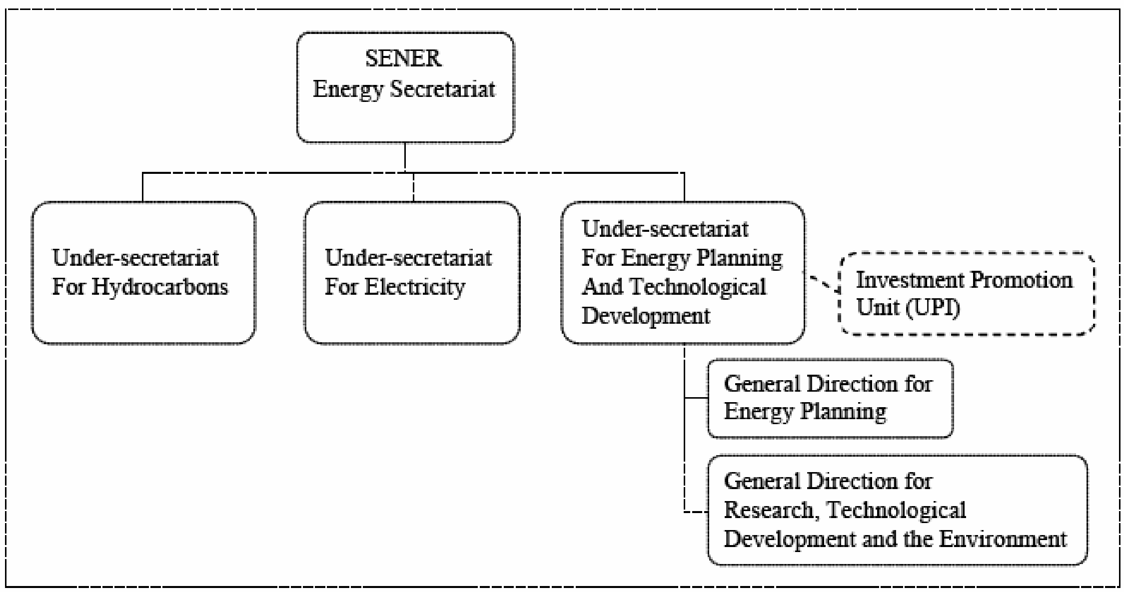
The *Secretaría de Energía* (SENER), through its Research, Technological Development and Environment Directorate (*Direccion General de Investigación, Desarrollo Tecnológico y Medio Ambiente)* within the Undersecretariat for Energy Planning, has the appropriate mandates and general capacities to respond to the above needs, and will assume overall GEF project coordination responsibility. SENER will take the lead role in these actions, and coordinate and the role and work of other institutions involved in the project, such as:

- The *Comisión Reguladora de Energía,* CRE, for interpretation and development of adequate regulation for renewable resources, and in particular intermittent renewable resources such as wind;

- CFE, for the terms, conditions and costs governing the acquisition of renewable power through the IPP mechanism employed in this project, and for the equivalent terms and conditions for the self-supply and wheeling projects as supported through technical and advisory services offered through the GEF project;
- NAFIN, as the designated financial agent for the GEF project;
- State (State of Oaxaca) and local governments for the local environmental and construction permitting and local stakeholder outreach aspects of the GEF project.
- SENER will also be responsible for project monitoring and evaluation, and regular reporting.
- In addition to its overall GEF project management role, SENER will contract for the execution of specific SENER-relevant policy and planning studies under the Technical Assistance Component.

SENER's overall organization is depicted in Figure 1.

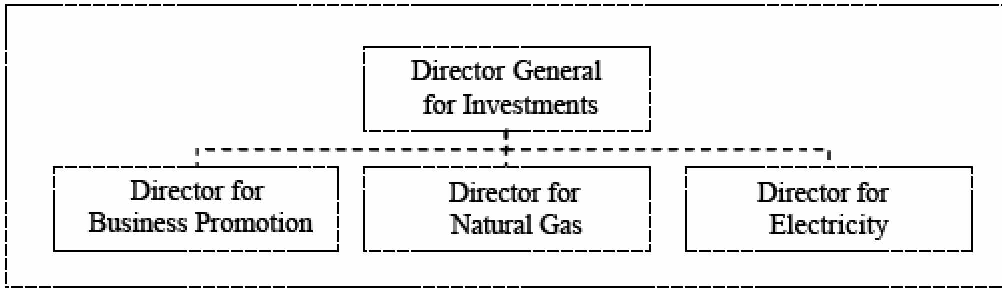
**Figure 1: SENER Organization Chart, by substantive areas**




SENER's Investment Promotion Unit (UPI, *Unidad de Promoción de Inversiones*) will serve as the primary interface with private sector investors regarding the promotional mechanism financed by the GEF and parallel technical assistance. UPI will be responsible for the provision of outreach and business development services through a combination of internal and contracted consultant personnel resources.

UPI was created in 1996 intention of providing the private sector with information and transactional support regarding their power generation initiatives and projects falling within the Mexican energy sector. Amongst other activities, the UPI delivers facilitation services to private projects under development, participates in national and international energy forums in order to promote investment opportunities in private energy projects in Mexico, and provides information related to the expansion of the energy sector and to national energy policy strategies in place. UPI thus stands as the logical organization within SENER as a one-stop shop for business development services for renewable energy projects.. UPI's internal organization is shown in Figure 2.

**Figure 2: Organizational chart within the Investment Promotion Unit**




Source: SENER

While ultimate responsibility for GEF project coordination will be lodged with the management of SENER's Research, Technological Development and Environment Directorate, the Directorate's capacities will be augmented through specialized project management consultants financed by the GEF project on an incremental cost basis:

- Project Manager (full-time local consultant)
  - i. Strong knowledge and familiarity with the Mexican energy sector
  - ii. Sufficient level of seniority to be well-respected among the agencies involved in the project
  - iii. Strong project execution and negotiation capabilities

- Utility and Renewable Energy Expert (part-time local consultant/as needed)
  - i. Utility or electrical engineering technical background, with knowledge of utility planning and the characteristics of grid-connected renewable energy sources
  - ii. Ability to forge solid relations with CFE's planning and power acquisition personnel
  - iii. This consultant would support the Project Manager on the on the technical aspects of GEF project management

- Procurement assistant (part-time local consultant)
  - i. Experienced in procurement activities under Mexico Federal regulations
  - ii. If possible, experienced with World Bank procurement guidelines and procedures, or able to absorb training in these matters.

CFE, through its Directorate for Financed Investment Projects *(Proyectos de Inversión Financiada*) in coordination with SENER will be responsible for structuring the La Venta III IPP solicitation, evaluating responses and executing a Power Purchase Agreement (PPA) with the winning wind power entity. Incentive allocation provisions will be incorporated in the PPA as the basis for disbursement of GEF funds on an output-based aid basis against verified wind energy deliveries to the CFE grid. In parallel, CFE will contract for the construction of an additional 18 km transmission circuit to reinforce the transmission line constructed to evacuate power from the 85 MW La Venta II public sector build-transfer wind project. Lastly, CFE will procure certain system modeling software, training and technical studies, and goods related to the enhanced integration of wind energy in the CFE grid system.

Although SENER's capabilities in the area of energy policy are strong, its capacity remains limited in terms of financial management and procurement. This is being addressed by the Mexican state development bank, NAFIN, which will serve as the GEF project's financial agent and will be responsible for the financial management of the proceeds of the GEF grant. In addition, NAFIN, with its strong knowledge and experience in World Bank financed procurement, will provide procurement support to SENER (e.g., review of terms of reference for correct structure, structuring of consultant tender documents, obtaining No Objections, review of contracts, etc.), and will also serve as the formal channel of procurement-related communications between CFE and the World Bank.

**Key Tasks and Workflow**

GEF incentive support to La Venta III

The execution of an IPP project such as La Venta III will require the successful conclusion of several and parallel design and authorization processes. The most relevant of these are:

i. The IPP procurement authorization procedure, mandated by the *Ley del Servicio Público de Energía Eléctrica* (LSPEE) and its regulations, as well as by Treasury (SHCP) regulations;

ii. The plant definition, its technical and economic assessments, and incorporation procedure;

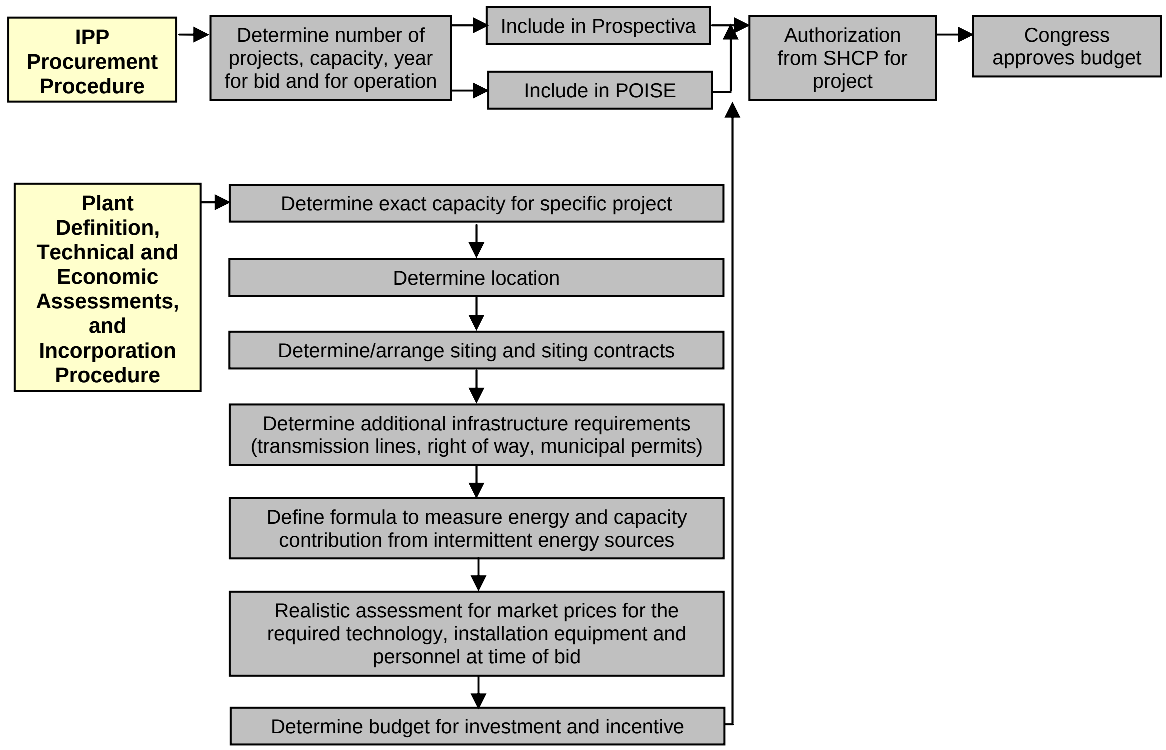
iii. The structuring of GEF incentive payment;

iv. The preparation of bid documents; and

v. The IPP project execution in itself.

The first three of the above processes have been completed as of project appraisal, and comprise the detailed steps shown in Figure 3:

**Figure 3. IPP Procurement Authorization Procedure, and Plant Definition, Technical and Economic Assessments and Incorporation Procedure**




Preparation of bid documents by CFE will take place in May-June, and will enable issuance of the La Venta III bid solicitation in July, 2006. Adequate bid documents will require the land leasing agreement, the PPA, the incentive allocation provisions, and the bidding documents proper, containing project description and payment mechanisms, as well as required guarantees and all other relevant information for developers to submit their bids. Guidance to CFE for the structuring of the bid package so as to meet wind IPP requirements and assure consistency with the GEF incentive scheme requirements has been provided through a detailed set of guidelines prepared by Protego Asesores, Pace Global Energy Services and Global Energy Concepts, consultants to SENER financed from GEF PDF-B funds. Figure 4 illustrates the steps involved in the preparation of the bidding documents.

**Figure 4. Preparation of Bid Documents**

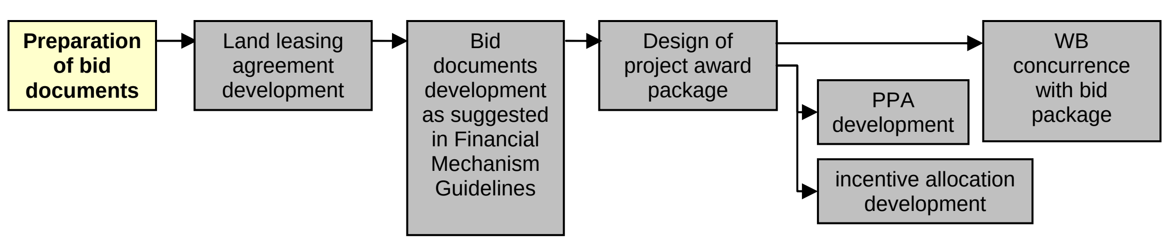
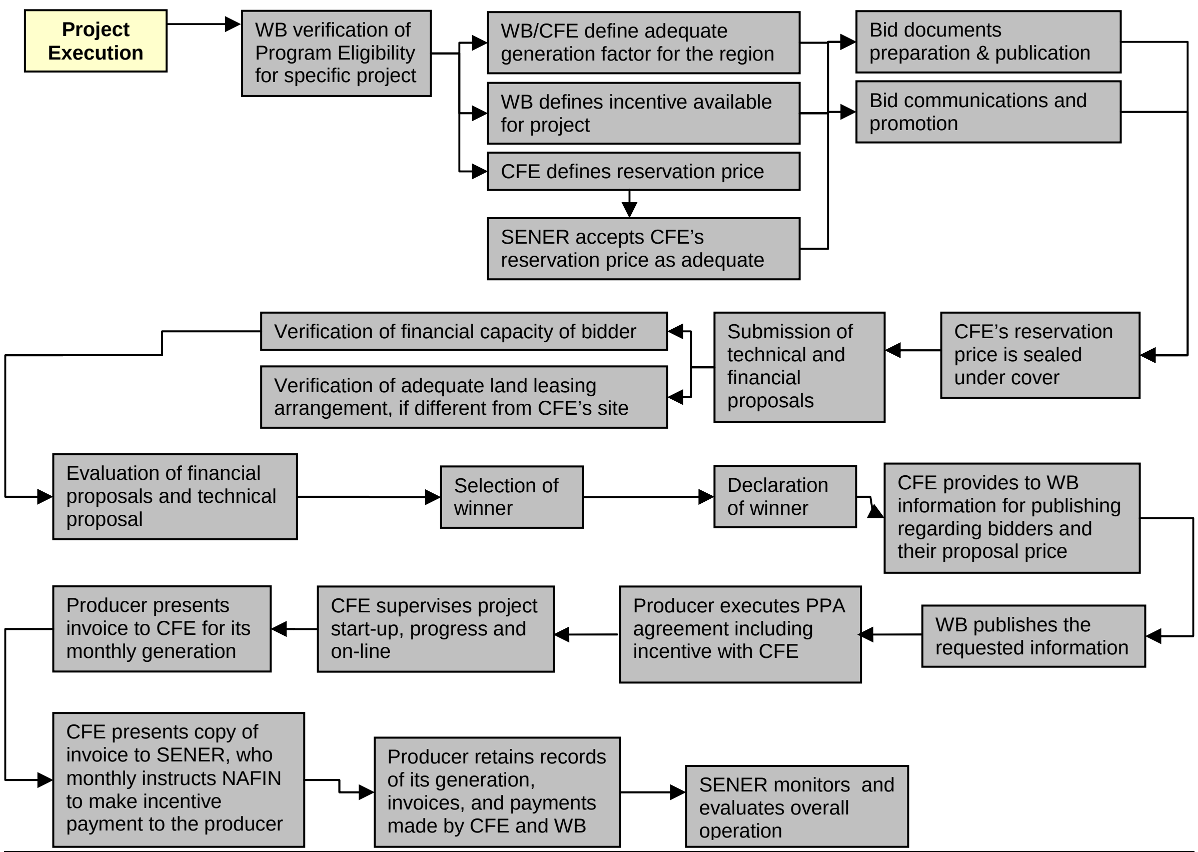


Figure 5 depicts the IPP project execution process, as applicable to La Venta III. This process includes the operations carried out before the publishing of the auction, the publishing of the bid documents, the submittal of bid proposals, their evaluation, and the project award. It follows on the operational phase of the project, and includes the activities of regular power purchase payments made by CFE, the GEF incentive allocation and disbursement, and the monitoring performed by SENER. This set of tasks is primarily CFE's responsibility with respect to IPP project award and payment; while NAFIN will hold responsibility for overseeing the incentive payments based on certified invoices from CFE for wind power deliveries as verified by SENER.

**Figure 5. IPP Project Execution**




## Technical Assistance

Execution of the technical assistance activities under the GEF project will be under the overall coordination of SENER. Terms of Reference for specific studies and services to be performed by consultants will be developed by technical units within CFE and SENER, or in the case of the business advisory and outreach services, by UPI itself. These will be cleared by SENER and forwarded to NAFIN for review and packaging and interaction with the World Bank to obtain no objections (as required). A similar initiation and clearance process will hold for bid packages for the larger competitive procurements.

Contracts for consulting services, following no objection by the World Bank, will be issued by SENER and CFE. Payments against delivered services will be requested by the entity receiving the services, authorized by SENER, cleared by NAFIN following no objection by the Bank, and then disbursed to the contractor by the executing entity, followed by reimbursement from the relevant GEF-financed Designated Account. These processes are represented schematically in Annex 7.

## Annex 7: Financial Management and Disbursement Arrangements

## MEXICO: Large-Scale Renewable Energy Development Project

### 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 (SENER and CFE) and through third parties (winning contractors). 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 Large-Scale Renewable Energy Development Project, 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 the work carried out, the FM team has the following conclusions: (i) the financial management risk is modest considering the following mitigation measures; (ii) although neither the overall coordinator Secretaria de Energía (SENER) nor the Comisión Federal de Electricidad (CFE) have experience managing Bank-financed projects, their financial management systems and their key financial management staff is considered acceptable to the Bank; (iii) prior to negotiations certain actions will be required to strengthen program financial management, especially in terms of written procedures e.g. project Operational Manual (OM), audit arrangements, and assignation of new responsibilities to the administrative staff of all participating entities; (iv) Nacional Financiera (NAFIN) will provide implementation support and oversight based on its many years of experience as financial agent; (v) for disbursement purposes, the recognition of expenditures will be for all components upon the payment to suppliers of goods and services; (vi) the accounting records of the project will be prepared by the financial management staff of each Executing Agency, and SENER will then consolidate and validate all the information; (vii) at least two financial management supervision missions will be conducted each year, and a Bank FMS will review the annual audit reports and the semi annual FMRs; and more intensive supervision will be needed prior to effectiveness and in the first year of implementation.

The FM-related procedures must be described in the corresponding section of 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. The accounting records of the project will be prepared by each participating entity and consolidated by SENER at the central level. Before project negotiations additional visits will be carried out to ensure project readiness.

### Implementing Entities

The proposed project will be co-executed by CFE and SENER. The latter will be the overall coordinator.

- CFE is a public decentralized organism, in charge of the generation and distribution of the electricity in México, which is independent from the country's budgetary system, since it obtains its income 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.

- SENER is a centralized entity of the Executive (a Secretariat), in charge of planning and conducting the country's energy sector. SENER'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.

Annex 6 provides detailed information on implementation arrangements. Mainly two areas impact FM arrangements: (i) the organizational arrangements and implementation responsibilities; and (ii) key tasks and workflow.

**Flow of Funds and Information**

Regarding component 1 (Financial Mechanism), the Bank will finance the incentive payments. All project expenditures for components 2 (Technical Assistance) and 3 (Project Management) will first be funded through the country's budgetary system, and then reimbursed by the Bank when incurred by SENER, but since CFE does not receives its budget from the National Treasury (TESOFE), they will receive advances in a Designated Account in order to make payments to suppliers of goods and services. For disbursement purposes, the recognition of expenditures will be:

(i) For Component 1, upon payments to IPPs. The procedure is that the operational area of CFE *División para la Administración de Contratos de Productores Externos de Energía* will certify the amounts that should be paid to the IPPs. After that certification, CFE's treasury department will ensure that certifications do match with invoices (the certification will trigger payments to IPPs). The treasury department will use the same methodologies and documents required for any other operation involving IPPs within the CFE regular procedures.

(ii) For Component 2 and 3 upon payment to suppliers of goods and services: (a) SENER. Once payments are made, SENER, with NAFIN's assistance, will request disbursements from the Bank (see reporting and disbursements sections below). The Bank will make its disbursement as a reimbursement to the national treasury (TESOFE). (b) CFE. Once payments are made, CFE with NAFIN's assistance, will apply for withdrawals from the Grant Account for deposit of advance amounts into the Project Account. CFE will report the expenditures paid from the Project Account by presenting SOE reports at the intervals specified by the Bank.

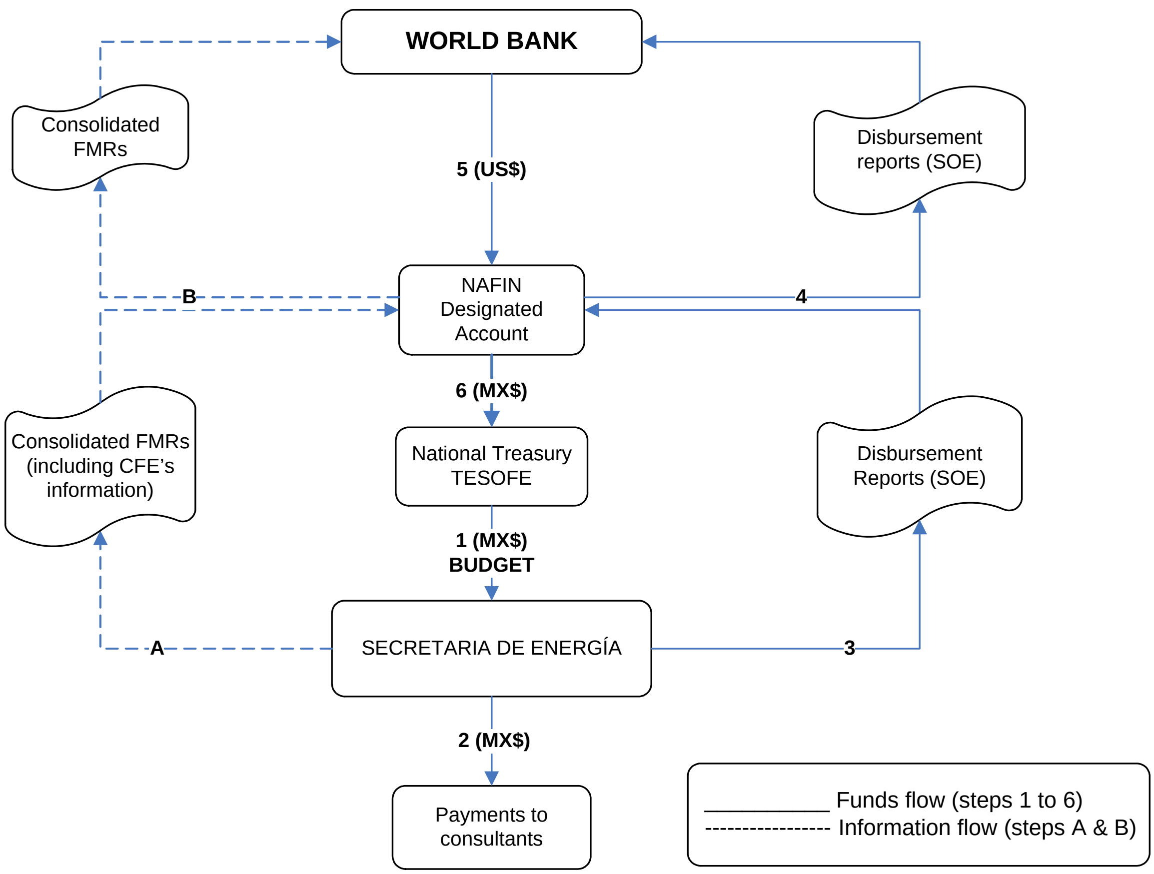
The main text of this PAD (in its section on **Project Description**, specifically in subsections on **Project Phases and key Indicators** and **Project Components**) provides detailed information on the operation of the project e.g. determination of amounts to be paid to IPPs (tariff), information such as factors for CFE's certification in Component 1. Additionally, Annex 4 (**Detailed Project Description**) contains comprehensive information on the technical criteria for (payments) disbursements for Component 1.

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 either

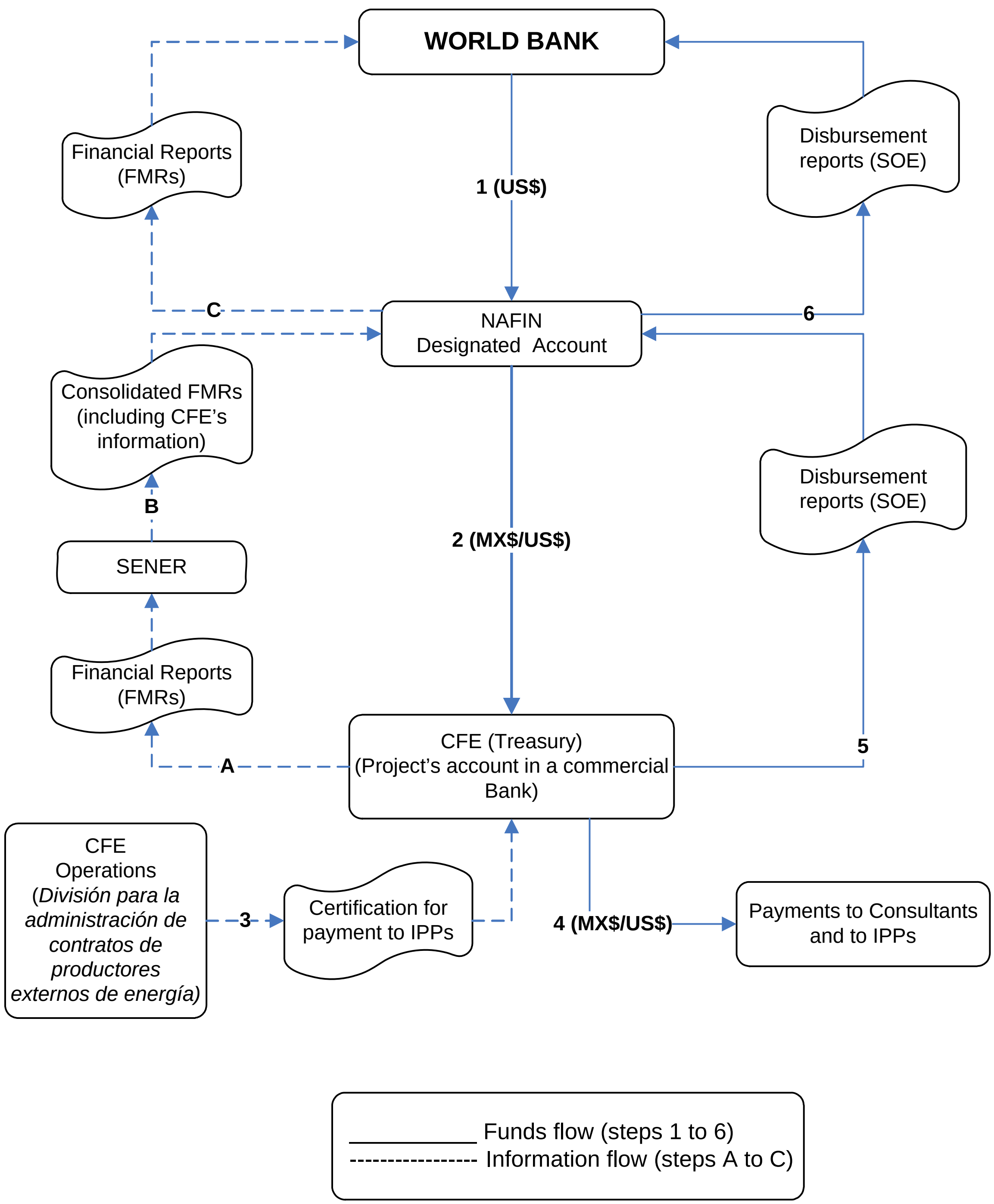
(i) substitute supporting documentation; or (ii) reimburse the entire amount of funds corresponding to ineligible expenditures to the Bank. The Bank prefers the latter.

The following diagrams present the proposed flow of funds for the project (these diagrams are divided by implementing entity):

**FUNDS FLOW - SENER**



# FUNDS FLOW - CFE



**Accounting Policies and Procedures**

Overall. The participating entities will maintain accounts for preparation of project financial reports. SENER will prepare consolidated financial reports with the information provided by CFE.

During its most recent preparation mission LCSFM reviewed the accounting policies and procedures currently in place in CFE and SENER, and considers 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 both entities.

**Information Systems and Staffing (key FM staff)**

The accounting records of the project will be prepared using the existing systems in each participating entity.

- **CFE.** Within CFE, the "Gerencia de Créditos" (Credit Management) will be in charge of the overall coordination of the financial management functions of the project. They are adequate staffed, and have experience in the management of externally financed loans (mainly with the Inter-American Development Bank).

  One of the main responsibilities of this area is reviewing and processing all the invoices supporting payments to IPPs. Although they are not directly responsible for the accounting of the operations, they will coordinate and receive the information from the accounting division in order to prepare the financial reports required by the Bank. For its entire operation CFE uses the SAP system, which is acceptable to the Bank.

- **SENER.** A qualified administrator (experienced FM staff) will join the project team to support project implementation. Given the low volume of operations that SENER will handle, all the accounting records will be input and controlled in an Excel sheet, which will be strengthened with the establishment of some internal control measures in order to protect the integrity of the information (e.g. periodic back ups, definition of passwords for protection against unauthorized access, etc.). These controls will have to be reflected in the OM of the project.

**Financial Reporting**

Interim Financial Reports (IFRs) substituted the Financial Monitoring Reports (FMRs), and will be submitted on a semiannual basis. The IFRs will be prepared by each Executing Agency and will include financial and disbursement information. SENER will consolidate the information and will submit the reports to the Bank through NAFIN. The required format of the IFRs has been agreed with SENER and CFE.

Annual project financial statements will be prepared by the two implementing entities (CFE and SENER) to be used for the financial auditing of the project (see audit section below). The project financial statements should resemble those prepared on a semiannual basis for the IFRs and 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.

### Internal and External Audit

Annual financial audits covering the management of project funds until they reach the final beneficiaries (see Annex 4 on project description) 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 internal and 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; 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.

### Disbursement Arrangements and Retroactive Financing

**Use of Statements of Expenditures (SOEs).** It is contemplated that disbursements will be based on traditional SOE reports, which format has been agreed with SENER, CFE and the financial agent NAFIN. SOE limits will be established by the Disbursements Department of the Bank (LOA), based on their assessment of the project.

**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 reimburse the National Treasury (TESOFE) for the operation of SENER, or to advance funds to CFE for its operation. It would therefore have occasional balances for a brief time until the corresponding transfer is made. CFE will also establish a Project Account in a commercial bank which will be utilized to process payments for suppliers or consultants. See flow of funds and information charts in the corresponding section of this annex.

**Retroactive Financing.** The project will be eligible to submit applications for retroactive reimbursement, based on reports of expenditures eligible for financing, of up to 10 percent of the grant amount (US $ 2,500,000), incurred on or after project appraisal.

**Table: Allocation of Grant Proceeds (US$ million)**

| Category | Amount of the GEF Grant allocated (US$ Million) | % of expenditures to be financed by the Grant |
|---|---|---|
| Subprojects (CFE) | 20.4 | 100% |
| Consultant services (CFE and SENER) | 4.6 | 100% |
| **TOTAL** | **25.0** | |

## Operational Manual (OM) and Written Procedures

The project's Operational Manual includes a chapter which covers all aspects of project financial management (including a fully detailed description of the different areas covered in this annex). The government of Mexico and the Bank agreed that project manual must be satisfactory to the Bank prior to negotiations; however the FM team received the manual two days before negotiations. Therefore, although the review will be concluded before negotiations, the results of this review will be discussed until (during) negotiations. The discussion of this manual will be brief if it is satisfactory to the Bank, however, if some aspects need to be revised, a thorough discussion will be carried out.

Based on the preliminary review carried up to now, the Operational Manual covers all required information in a satisfactory manner e.g. details in narrative sections, flowcharts and as indicated above, covers all needed FM-related areas.

## Supervision Plan

Because of the project's complexity involving multiple Executing Agencies: (i) at least two financial management supervision missions will be conducted each year, (ii) a Bank financial management specialist will review the annual audit reports and the semiannual FMRs; and (iii) more intensive supervision will be needed prior to effectiveness and in the first year of implementation.

## Annex 8: Procurement Arrangements

## MEXICO: Large-Scale Renewable Energy Development Project

### 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. The various items under different expenditure categories are described in general below. For each contract to be financed by the Loan, the different procurement methods or consultant selection methods, the need for prequalification, estimated costs, prior review requirements, and time frame are agreed between the Borrower and the Bank in the Procurement Plan. The Procurement Plan will be updated at least annually or as required to reflect the actual project implementation needs and improvements in institutional capacity.

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.

3. The methods to be used for the procurement of goods and services under the loan are described below with the estimated amounts, and summarized in Table A. Table B suggests thresholds to be used in the Procurement Plan and the Operational Manual for the various procurement methods.

### Procurement Summary

There are three procurement activities under the project: (a) the procurement of a 100 MW wind farm; (b) technical assistance consisting of various studies and business development services; and (c) project management support and monitoring and evaluation studies. The Bank has reviewed the procurement systems of the Federal Government and determined that international procurement is substantially consistent with the Bank's Guidelines and that CFE's procurement performance in particular, is better than the average for federal government agencies in many of the indicators employed for the review.

## Procurement of Works

No civil works will be financed by the GEF grant. CFE will contract an Independent Power Producer (IPP) to construct the 100 MW wind farm and power plant under a specialized Power Purchase Agreement (PPA) that provides for CFE to purchase the power output of the plant after it is built. The GEF grant will be applied only towards the purchase of the power by CFE in the form of a fixed subsidy which will be paid to the IPP regardless of the contract price resulting from the bidding process and based on verified wind energy deliveries (of "green" electrons) to the CFE grid. The GEF involvement with the wind farm construction will thus be limited to the subsidy, as further described in the next section.

## Procurement of Goods and Non-consulting Services

The PPA for the 100 MW wind farm is at the core of this project. Since the Bank does not have SBDs for such contracts, the PPA 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.[13] The subsidy that will be paid by the GEF grant to the winning bidder under this PPA (estimated at US$20.4 million) is essentially a financial transaction which will have little or no impact on the procurement process. Nonetheless, the Bank will closely monitor the process to ensure that it is fully consistent with Bank Guidelines.

In particular, the Bank will continue to be directly involved in the drafting of the bidding documents for the PPA, through its ex-ante review of the documents, which are based on documents used in past by CFE for similar transactions. Although 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, IPP contracts for power are regulated by a different law and regulations that still retain the two-envelope system. Consequently, in order to minimize the risks of disqualification of bidders at the critical technical evaluation stage, the Bank will also review the technical evaluation report before the opening of the financial proposals.

Software and anemometers would also be purchased using ICB and NCB procedures.

## Employment of Consultants

4. Consultant services would be procured in accordance with "Guidelines: Selection and Employment of Consultants by World Bank Borrowers" published in May 2004 and the agreements in the procurement plan. Consultant services to be contracted under this Program include studies for SENER, CENACE and CFE; development of a national wind map and training. The short list of consultants for contracts estimated to cost less than US$500,000 equivalent may comprise entirely national consultants, in accordance with the provisions of paragraph 2.7 of the Consultant Guidelines.

5. **Firms**: All contracts for firms would be procured using QCBS procedures except for small contracts for assignments of standard or routine nature and estimated to cost less than US$100,000

[13] Procurement under BOO/BOT/BOOT, Concessions and Similar Private Sector Arrangements.

equivalent that would be procured using Least Cost Selection or using other procurement methods as defined in the annual procurement plan review.

6. **Individuals**: Specialized advisory services, including staff at the PIU, would be provided by individual consultants selected through comparison of qualifications of at least three qualified candidates. They would be contracted in accordance with the provisions of paragraphs 5.1–5.3 of the Consultant Guidelines as defined in the annual procurement plan review.

7. **Prior Review Thresholds:** The prior review of procurement actions will be defined in the annual procurement review and will not exceed the thresholds determined by the Bank for low risk clients such as CFE, or average risk clients such as SENER. In the case of the wind farm bidding for the selection of the IPP, the Bank and CFE had agreed on a schedule of reviews including the bidding documents, advertisement, and the technical evaluation report.

**Procurement Capacity Assessment**

8. 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 wind farm PPA. SENER is a beneficiary of PHRD and GEF grants and their procurement actions in the project are under US$500,000. Based on experience with the earlier grants further assessment of their capacity is not required at this time and can be carried out through the Bank's ongoing procurement supervision and review. The Bank shall carry out one procurement review annually.

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

| | Procurement Method[1] | | | |
|---|---|---|---|---|
| Expenditure Category | ICB | NCB | Other[2] | Total Cost |
| 1. Goods | 0.3<br>(0.3) | 0.2<br>(0.2) | | 0.5 |
| 2. Non-consultant services, including training | | | 0.3<br>(0.3) | 0.3 |
| 3. Consultant services and technical assistance | | | 3.8<br>(3.8) | 3.8 |
| 4. Subsidy | | | 20.4<br>(20.4) | |
| Total | 0.3 | 0.2 | 24.5 | 25.0 |

[1]Figures in parentheses are the amounts to be financed by the GEF grant. All costs include contingencies.
[2]Includes procurement of goods, training, services, and consultants services required by CFE, SENER and CENACE under the PIU

**Procurement Plan**

9. Procurement Plan covering the project implementation is under preparation by CFE and SENER. NAFIN and CFE will present a procurement plan (PAC) for the first 18 months of project implementation; this Plan will be updated at least once a year.

## Annex 9: Economic and Financial Analysis

## MEXICO: Large-Scale Renewable Energy Development Project

### Financial Analysis of La Venta III IPP Wind Farm Project

This section presents a financial analysis related to specific renewable energy project that will receive support under the project. The case of a wind farm (La Venta III) is formulated based on information and appropriate assumptions applicable to Mexico.

As a GEF project, the economic analysis is detailed in Annex 15 as the Incremental Cost Analysis.

Model Description

In this analysis, a financial spreadsheet model was used, with values in real U.S. dollar. The project is assumed to be located in one of the sites with good wind resources resulting in a net effective capacity factor for the plant of about 42 percent.

Project income is derived by two sources: electricity payments over the project's lifetime (20 years), and subsidy payments (GEF's project contribution for a total of about US$20.4 million) over the first five years. 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, royalty payments for land use, insurance costs, and taxes. The model also accounts for the potential of using accelerated depreciation provisions available in the Mexican tax system for such investments. For project financing purposes, the model presumes a standard limited recourse financing arrangement -- likely to take place for this type of projects in Mexico -- at 30 percent equity and 70 percent debt financing. For the debt portion of the financing plan, a structure of two loans is assumed: 60 percent of the debt is financed at 10 percent for 15 years and the remaining 40 percent is financed at 8 percent for 8 years. Debt service coverage ratios are required to be maintained at over 1.2 during the loan term.

Actual figures and other general assumptions used for the financial model are summarized in Table 1 below.

**Table 1: Financial Analysis Assumptions**

| | | |
|---|---|---|
| **GENERAL** | | |
| Rated Capacity | 100 | MW |
| Net Capacity Factor | 42.0 percent | |
| Start Year | 2007 | Calendar Year |
| Project Lifetime | 20 | Years |
| Capital Cost | 1200 | $/kW |
| Total Project Cost | $ 120,000,000 | |
| **FINANCING** | | |
| Debt Contribution in Financing | 70 percent | |
| | *Loan1* | *Loan2* |
| Amount | $ 50,400,000 | $ 33,600,000 |
| Schedule Type | Level Mortgage | Level Mortgage |
| Debt Percentage (percent) | 60 percent | 40 percent |
| Interest Rate (percent) | 10.0 percent | 8.0 percent |
| Reserve Fund | | |
| Deposit Interest Rate (reserve fund) (percent) | 2.00 percent | |
| Term (years) | 15 | 8 |
| Equity ($) | $ 36,000,000 | |
| Debt ($) | $ 84,000,000 | |
| Minimum Debt Service Coverage Ratio | 1.2 | |
| **EXPENSES** | | |
| Fixed Operation & Maintenance (O&M) | 12.063 | $/kW |
| Variable O&M | 0.0011 | $/kWh |
| Site Owner Royalty (percent of revenues) | 1.5 percent | |
| Tax Rate (percent of Net Income) | 28 percent | |
| Insurance (percent of Equipment and Balance of Station Costs) | 0.1 percent | |
| **DEPRECIATION** | | |
| Percentage that can be depreciated | 70 percent | |
| Depreciation Base | 5 | Years |
| **INCOME** | | |
| Electricity Price (c/kWh) | 4.7 | cents/kWh |
| Tariff Subsidy (c/kWh) | 1.1 | cents/kWh |
| Subsidy Term | 5 | Years |

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 19 percent (a negative NPV when discount rates of 20 percent or more are applied). The project's return on equity (ROE) is about 18 percent under the assumed financial structure.

**Table 2: NPV of the project for the sponsor for various discount rates**

| *Discount Rate* | *Project (Sponsor's) NPV* |
|---|---|
| 8 percent | $99,887,213 |
| 9 percent | $85,411,198 |
| 10 percent | $72,516,842 |
| 11 percent | $61,003,865 |
| 12 percent | $50,700,690 |
| 13 percent | $41,459,910 |
| 14 percent | $33,154,534 |
| 15 percent | $25,674,859 |
| 16 percent | $18,925,864 |
| 17 percent | $12,825,033 |
| 18 percent | $7,300,523 |
| 19 percent | $2,289,630 |
| 20 percent | **($2,262,510)** |

The full cash-flow analysis for the project is presented in the following pages in Table 3.

# Table 3: Cash Flow Analysis

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Calendar Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| | | | | | | | | |
| **Revenues** | | | | | | | | |
| Energy Payment | | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 |
| Tariff Subsidy Payment | | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Interest on Reserves | | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Revenues | | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 |
| | | | | | | | | |
| **Operating Costs** | | | | | | | | |
| Fixed O&M | | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 |
| Variable O&M | | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 |
| Site Owner Royalty | | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 |
| Insurance | | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 |
| Other Costs | | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Operating Costs | | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 |
| | | | | | | | | |
| **Operating Income** | $ (120,000,000) | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 |
| | | | | | | | | |
| **Other Expenses** | | | | | | | | |
| Interest on Loans | | $7,728,000 | $7,316,660 | $6,869,241 | $6,382,539 | $5,853,061 | $5,277,003 | $4,650,215 |
| Depreciation Percentage | | 100% | 20% | 20% | 20% | 20% | 0% | 0% |
| Maximum possible depreciation | | $ 84,000,000 | $ 93,190,156 | $ 101,968,972 | $ 110,300,369 | $ 118,145,063 | $ 108,660,280 | $ 98,599,438 |
| Maximum depreciation without compensation against other activiti | | $ 7,609,844 | $ 8,021,184 | $ 8,468,603 | $ 8,955,306 | $ 9,484,783 | $ 10,060,842 | $ 10,687,630 |
| Actual depreciation | | $ 7,609,844 | $ 8,021,184 | $ 8,468,603 | $ 8,955,306 | $ 9,484,783 | $ 10,060,842 | $ 10,687,630 |
| Pending depreciation | | $ 76,390,156 | $ 85,168,972 | $ 93,500,369 | $ 101,345,063 | $ 108,660,280 | $ 98,599,438 | $ 87,911,808 |
| **Total Other Expenses** | | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 |
| | | | | | | | | |
| Before-Tax Profits | | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Profits x tax rate | | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Income Tax Paid | | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | |
| **After-Tax Profits** | | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | |
| Additions | | | | | | | | |
| Depreciation | | $ 7,609,844 | $ 8,021,184 | $ 8,468,603 | $ 8,955,306 | $ 9,484,783 | $ 10,060,842 | $ 10,687,630 |
| Released from Reserve | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Additions** | | $ 7,609,844 | $ 8,021,184 | $ 8,468,603 | $ 8,955,306 | $ 9,484,783 | $ 10,060,842 | $ 10,687,630 |
| | | | | | | | | |
| Subtractions | | | | | | | | |
| Loan Principal | | ($4,745,174) | ($5,156,514) | ($5,603,933) | ($6,090,636) | ($6,620,113) | ($7,196,172) | ($7,822,960) |
| **Total Subtractions** | | ($4,745,174) | ($5,156,514) | ($5,603,933) | ($6,090,636) | ($6,620,113) | ($7,196,172) | ($7,822,960) |
| | | | | | | | | |
| Before-Tax Cash Flow | $ (120,000,000) | $2,864,670 | $2,864,670 | $2,864,670 | $2,864,670 | $2,864,670 | $2,864,670 | $2,864,670 |
| Taxes Payable (Benefit Received) | | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Tariff Subsidy payment if not taxable | | $ 4,047,120 | $ 4,047,120 | $ 4,047,120 | $ 4,047,120 | $ 4,047,120 | $ - | $ - |
| | | | | | | | | |
| After-Tax Cash Flow | $ (36,000,000) | $6,911,790 | $6,911,790 | $6,911,790 | $6,911,790 | $6,911,790 | $2,864,670 | $2,864,670 |
| | | | | | | | | |
| Cumulative After-Tax Cash Flow | | $6,911,790 | $13,823,580 | $20,735,370 | $27,647,160 | $34,558,950 | $37,423,621 | $40,288,291 |
| ProjectCashFlow | $ (120,000,000) | $ 22,947,689 | $ 23,359,028 | $ 23,806,448 | $ 24,293,150 | $ 24,822,628 | $ 25,398,686 | $ 26,025,474 |
| | | | | | | | | |
| Loan1 | | | | | | | | |
| Beginning Balance | | $ 50,400,000 | $48,813,722 | $47,068,815 | $45,149,419 | $43,038,082 | $40,715,612 | $38,160,895 |
| Interest | | ($5,040,000) | ($4,881,372) | ($4,706,882) | ($4,514,942) | ($4,303,808) | ($4,071,561) | ($3,816,089) |
| Principal | | ($1,586,278) | ($1,744,906) | ($1,919,397) | ($2,111,336) | ($2,322,470) | ($2,554,717) | ($2,810,189) |
| Loan Total | | ($6,626,278) | ($6,626,278) | ($6,626,278) | ($6,626,278) | ($6,626,278) | ($6,626,278) | ($6,626,278) |
| | | | | | | | | |
| Loan2 | | | | | | | | |
| Beginning Balance | | $ 33,600,000 | $30,441,104 | $27,029,496 | $23,344,960 | $19,365,661 | $15,068,018 | $10,426,563 |
| Interest | | ($2,688,000) | ($2,435,288) | ($2,162,360) | ($1,867,597) | ($1,549,253) | ($1,205,441) | ($834,125) |
| Principal | | ($3,158,896) | ($3,411,608) | ($3,684,536) | ($3,979,299) | ($4,297,643) | ($4,641,455) | ($5,012,771) |
| Loan Total | | ($5,846,896) | ($5,846,896) | ($5,846,896) | ($5,846,896) | ($5,846,896) | ($5,846,896) | ($5,846,896) |
| | | | | | | | | |
| Debt Service Coverage Ratio (DSCR) | | 1.23 | 1.23 | 1.23 | 1.23 | 1.23 | 1.23 | 1.23 |

| 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
| $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 |
| $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 | $ 17,292,240 |
| $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 | $ 1,206,300 |
| $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 | $ 404,712 |
| $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 | $ 259,384 |
| $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 | $ 84,000 |
| $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 | $ 1,954,396 |
| $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 | $ 15,337,844 |
| $3,968,174 | $3,225,950 | $2,885,917 | $2,511,881 | $2,100,441 | $1,647,857 | $1,150,015 | $602,389 | $0 | $0 | $0 | $0 | $0 |
| 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| $ 87,911,808 | $ 76,542,138 | $ 64,430,243 | $ 51,978,316 | $ 39,152,352 | $ 25,914,949 | $ 12,224,962 | $ - | $ - | $ - | $ - | $ - | $ - |
| $ 11,369,670 | $ 12,111,895 | $ 12,451,927 | $ 12,825,964 | $ 13,237,403 | $ 13,689,987 | $ 12,224,962 | $ - | $ - | $ - | $ - | $ - | $ - |
| $ 11,369,670 | $ 12,111,895 | $ 12,451,927 | $ 12,825,964 | $ 13,237,403 | $ 13,689,987 | $ 12,224,962 | $ - | $ - | $ - | $ - | $ - | $ - |
| $ 76,542,138 | $ 64,430,243 | $ 51,978,316 | $ 39,152,352 | $ 25,914,949 | $ 12,224,962 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 | $13,374,977 | $602,389 | $0 | $0 | $0 | $0 | $0 |
| $0 | $0 | $0 | $0 | $0 | $0 | $1,962,868 | $14,735,455 | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 |
| $ - | $ - | $ - | $ - | $ - | $ - | $ 549,603 | $ 4,125,928 | $ 4,294,596 | $ 4,294,596 | $ 4,294,596 | $ 4,294,596 | $ 4,294,596 |
| $0 | $0 | $0 | $0 | $0 | $0 | $549,603 | $4,125,928 | $4,294,596 | $4,294,596 | $4,294,596 | $4,294,596 | $4,294,596 |
| $0 | $0 | $0 | $0 | $0 | $0 | $1,413,265 | $10,609,528 | $11,043,248 | $11,043,248 | $11,043,248 | $11,043,248 | $11,043,248 |
| $ 11,369,670 | $ 12,111,895 | $ 12,451,927 | $ 12,825,964 | $ 13,237,403 | $ 13,689,987 | $ 12,224,962 | $ - | $ - | $ - | $ - | $ - | $ - |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $ 11,369,670 | $ 12,111,895 | $ 12,451,927 | $ 12,825,964 | $ 13,237,403 | $ 13,689,987 | $ 12,224,962 | $ - | $ - | $ - | $ - | $ - | $ - |
| ($8,505,000) | ($3,400,329) | ($3,740,361) | ($4,114,398) | ($4,525,837) | ($4,978,421) | ($5,476,263) | ($6,023,889) | $0 | $0 | $0 | $0 | $0 |
| ($8,505,000) | ($3,400,329) | ($3,740,361) | ($4,114,398) | ($4,525,837) | ($4,978,421) | ($5,476,263) | ($6,023,889) | $0 | $0 | $0 | $0 | $0 |
| $2,864,670 | $8,711,566 | $8,711,566 | $8,711,566 | $8,711,566 | $8,711,566 | $8,711,566 | $8,711,566 | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 | $15,337,844 |
| $0 | $0 | $0 | $0 | $0 | $0 | $549,603 | $4,125,928 | $4,294,596 | $4,294,596 | $4,294,596 | $4,294,596 | $4,294,596 |
| $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $2,864,670 | $8,711,566 | $8,711,566 | $8,711,566 | $8,711,566 | $8,711,566 | $8,161,963 | $4,585,639 | $11,043,248 | $11,043,248 | $11,043,248 | $11,043,248 | $11,043,248 |
| $43,152,961 | $51,864,527 | $60,576,093 | $69,287,659 | $77,999,225 | $86,710,791 | $94,872,754 | $99,458,393 | $110,501,641 | $121,544,889 | $132,588,136 | $143,631,384 | $154,674,632 |
| $ 26,707,515 | $ 27,449,739 | $ 27,789,772 | $ 28,163,808 | $ 28,575,248 | $ 29,027,831 | $ 27,013,203 | $ 11,211,917 | $ 11,043,248 | $ 11,043,248 | $ 11,043,248 | $ 11,043,248 | $ 11,043,248 |
| $35,350,706 | $32,259,498 | $28,859,170 | $25,118,808 | $21,004,411 | $16,478,574 | $11,500,153 | $6,023,889 | $0 | $0 | $0 | $0 | $0 |
| ($3,535,071) | ($3,225,950) | ($2,885,917) | ($2,511,881) | ($2,100,441) | ($1,647,857) | ($1,150,015) | ($602,389) | $0 | $0 | $0 | $0 | $0 |
| ($3,091,208) | ($3,400,329) | ($3,740,361) | ($4,114,398) | ($4,525,837) | ($4,978,421) | ($5,476,263) | ($6,023,889) | $0 | $0 | $0 | $0 | $0 |
| ($6,626,278) | ($6,626,278) | ($6,626,278) | ($6,626,278) | ($6,626,278) | ($6,626,278) | ($6,626,278) | ($6,626,278) | $0 | $0 | $0 | $0 | $0 |
| $5,413,793 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| ($433,103) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| ($5,413,793) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| ($5,846,896) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 1.23 | 2.31 | 2.31 | 2.31 | 2.31 | 2.31 | 2.23 | 1.69 | n/a | n/a | n/a | n/a | n/a |

Sensitivity Analysis

A sensitivity analysis on key factors of the assumptions of the project shows that the project's important uncertain variables are: (i) capital costs; (ii) avoided costs of energy and (iii) relevant financial structure. For instance, a 10 percent increase in capital costs (US$1320/kW), keeping all other variable the same, would require access to long-term debt for the full amount of the loan (15 years at 10 percent) for the project to remain financially viable (in this case the project would have a negative NPV for discount rates about 17 percent, and return on equity would be suppressed to 14 percent). On the other hand, if the avoided energy costs are also increased by 10 percent the project returns to financial figures similar to the reference case present above. The following two tables present sensitivity analysis for capital costs and electricity payments.

**Table 4: Sensitivity Analysis of Electricity Price paid** (other assumptions as in Table 1)

| Price (US$cents/kWh) | Return on Equity | Highest Discount Rate for Project NPV>0 |
|---|---|---|
| 4.23 | 13.5 percent | 16 percent |
| 4.7 (reference) | 17.9 percent | 19 percent |
| 5.17 | 22.5 percent | 22 percent |

**Table 5: Sensitivity Analysis of Capital Costs** (other assumptions as in Table 1)

| Capital Cost (US$/kWh) | Return on Equity | Highest Discount Rate for Project NPV>0 |
|---|---|---|
| 1080 | 23.2 percent | 23 percent |
| 1200 (reference) | 17.9 percent | 19 percent |
| 1320 | 14 percent | 17 percent |

It should be noted that when prices are 10 percent less than the reference case a change in the debt financing structure (longer term financing for the full debt amount) is required to maintain adequate debt service coverage ratios. The same is true when capital costs are increased by 10 percent.

The above analysis has been extended to explore the financial viability of future projects under the Phase II, for projects starting in 2009. Assuming the same level of capital costs (i.e. a reduction in real terms equivalent to the compounded rate of inflation, potentially about 8 percent) and all other general characteristics as above, a total of up to 400 MW of wind would be financially viable if the total amount of US$45 million could be available to provide subsidies (the equivalent subsidy would likely be around 0.6 US$ cents/kWh, compared with the Phase I of 1.1 US$ cents/kWh).

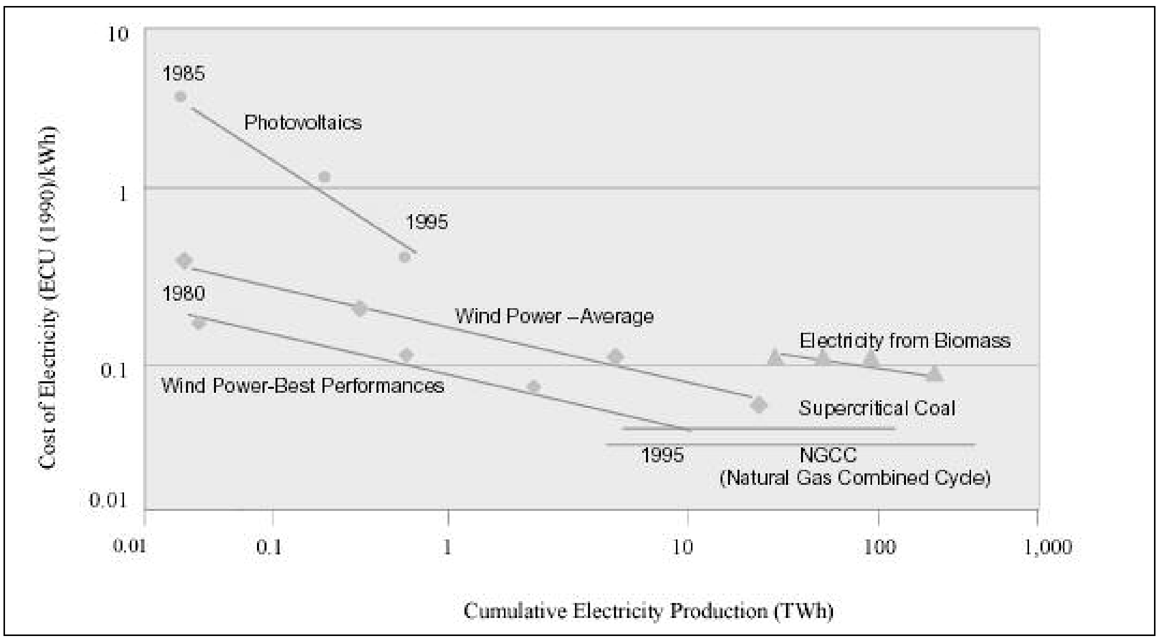
## Cost Reduction and Sustainability in Wind Energy

Summary: *Capital costs for wind power projects in Mexico are around **$1200/MW in 2006**, and are likely to be less than **$1000/MW by 2009**. In nominal figures, assuming a constant inflation rate of about 3.5 percent, the price of one MW of wind energy installed, in 2009 US$, should be about US$1150. Under such capital costs at the* best *wind sites in Mexico it is reasonable to anticipate wholesale electricity prices from wind at less than 4.0 US¢/kWh by 2009. Actual costs* *will be a function of the effective learning rate of the local wind energy industry and how fast the local but also the international wind energy market will grow.*

Introduction – Cost Reductions in Wind Energy Technology

This section aims to provide an estimate for future wind energy costs in Mexico given the proposed support by the GEF project. The analysis presented below is based on the thesis that costs of electricity generation from wind energy will decline with increasing installed capacity. This approach is based on the theory of "learning-by-doing" which is well presented in the earlier economic bibliography (Arrow 1962; Argote and Epple 1990; Solow 1997) and has been empirically verified extensively for a variety of manufacturing industries, as well as the energy and renewable energy sector (Watanabe 1995; IEA 2000; Organisation for Economic Co-operation and Development. and International Energy Agency. 2000; McDonald and Schrattenholzer 2001).

**Figure 1: Experience curves for various electricity technologies (IEA 2000)**




Costs of wind energy technologies have demonstrated a significant decline over the last two decades as shown by a number of surveys that explored experience curves for wind energy technology. These studies invariably demonstrate the effect of the learning-by-doing process, where increased installed capacity of wind turbines is followed by a reduction in installation costs. Where the market conditions are appropriate, these cost reductions have been followed by a drop in final electricity prices. While all of the studies conclude that cost reductions are taking place there are however differences on how fast energy prices have been reduced, and what have been the important factors that influenced the downward cost trend. (Neij 1997; Neij 1999; Junginger 2000).

Learning rates observed in the wind industry over the 1995-2004 show a reduction of about 18 percent in prices for every doubling of cumulative capacity installed. It should be mentioned that rates of learning for the wind energy industry have not been clearly established and validated, but the *range* of the effective learning rate quoted by a variety of authors ranges from a low range of 5 percent to a high range of 20 percent and in some cases to 30 percent (Junginger 2000).

Costs for final electricity produced using wind energy are dependent on: (i) the capital cost of the project; (ii) the technology used (turbine efficiency); (iii) the financing arrangements; (iv) the available wind resource (capacity factor of the wind power plant); (v) the operation and maintenance expenses, and (vi) the lifetime of the project. Learning effects are expected to influence all of the parameters related to costs of electricity from wind technology, however due to the capital intensive nature of wind energy projects this note examines in particular expectations regarding the capital costs of such projects. More specifically, the focus is on the expected cost per MW of wind turbines which (based on international experience) is estimated to comprise about 75-80 percent of the capital costs of wind power projects. Forecasts regarding these capital costs can then be used as main inputs to model levelized costs of electricity produced using wind energy.

International Wind Energy Price Estimation

The global wind power market is expected to grow strongly. The sector has been the fastest growing electricity production technology for the last few years at annual rates of more than 25 percent (see Figures 2 and 3 below). Most experts anticipate this high level of growth to be maintained almost to the end of this decade. Global cumulative capacity installed is expected to more than double by 2010 (from about 50 GW at the end of 2004 to about 110 GW by then end of 2009) (BTM Consult ApS 2005; Flowers 2002; Flowers and Dougherty 2002).

It is important to introduce a number of caveats and assumptions that apply to the above estimates. High rates of growth have been possible due to supporting energy technology policies in Europe and the USA, which either guarantee payments at fixed relatively favorable tariffs for electricity produced from wind, and/or promote renewable electricity supply with other mechanisms (tax credits, green certificates, renewable portfolio standards, etc). Uncertainties about such policies may have significant effects in slowing the global markets. The entry into force of the Kyoto Protocol provides additional incentives in the short-term, while any agreement to extend climate change measures for promotion of renewable energy beyond 2012 should further assist the growing wind energy market. Indeed, the recent increases in fossil-fuel prices render electricity generation from wind increasingly competitive.

In terms of technology, a significant force pushing down the costs of wind energy produced electricity is the steady increase in the size of the wind turbines, combined with electromechanical breakthroughs and the introduction of new materials. Due to economies of scale in energy production and project design and implementation this will almost certainly result in further reductions in the final cost of electricity produced (EWEA 1997; Redlinger, Andersen et al. 2002). In 2005 wind turbines rated at 3.5 MW and 5 MW are already accumulating operating experience, while recent efforts to install wind turbines off-shore are increasing the market share for big turbines.

**Figure 2: Installed and projected annual capacity of wind energy (MW per year)**
(BTM Consult ApS 2005)

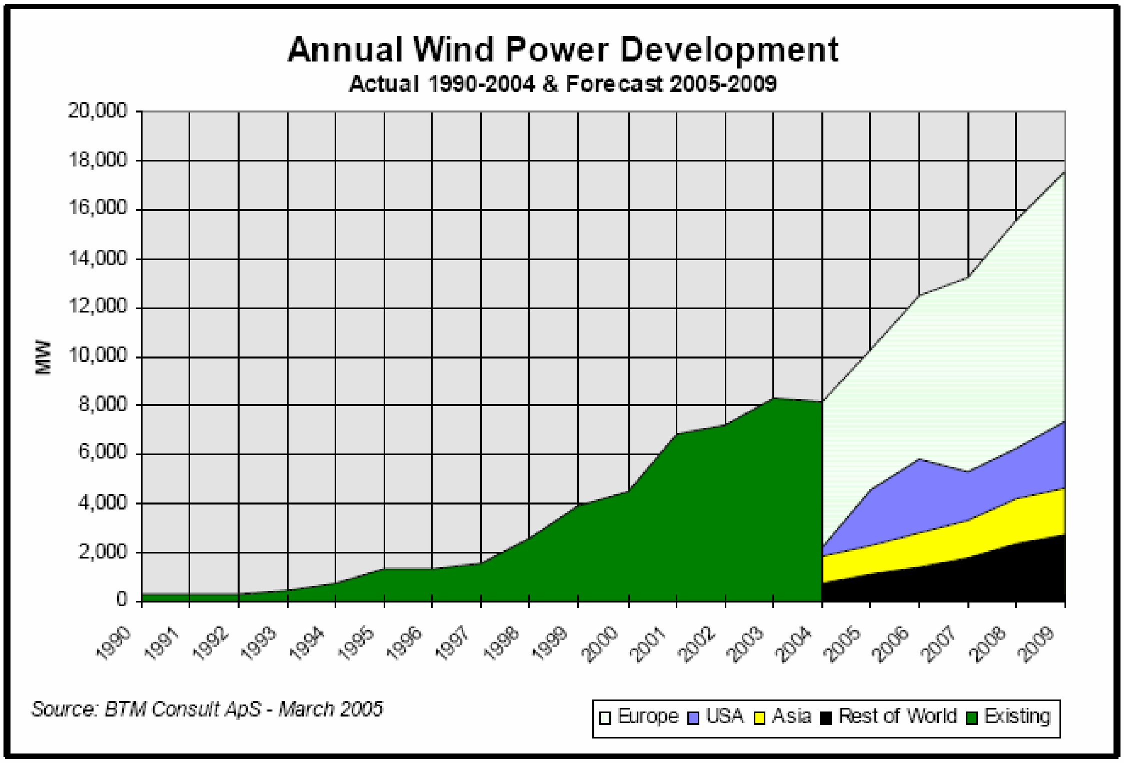
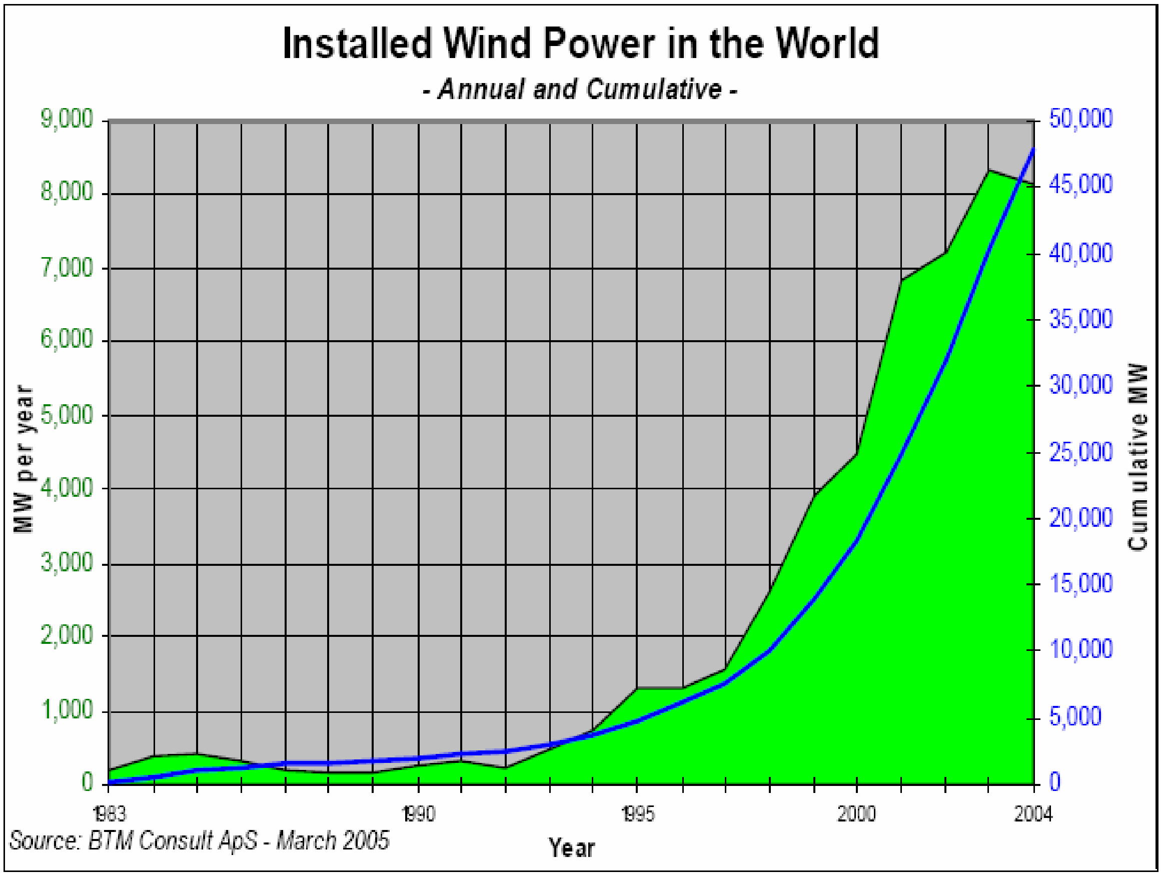



Figure 2 above shows the significant effect that government policies have in determining the actual growth of the wind energy market. In 2004, the rapid growth of wind energy electricity generation came to a halt as the USA government failed to renew the Production Tax Credit (PTC), incentive that provides significant tax benefits for wind power plants in the country. However, as soon as PTC was renewed the market returned to sharp growth. Based on industry reports for the duration of the new approved PTC (2005-2007), demand for wind turbines exceeds supply and prices in 2005 and for the PTC period have increased sharply from a previous industry norm of about US$1000 per MW to about US$1200 or more, reversing the downward trend of costs.

Because of the uncertain nature of the US government's incentives for renewable energy, it appears that investments in new manufacturing capacity did not take place and as a result current production cannot meet demand. However, most wind turbine manufacturers and their suppliers are reportedly considering significant investments in additional manufacturing capacity especially in China. It is expected that by 2008 considerable Chinese production of wind energy equipment will come on line to alleviate supply shortages. Recent policy statements from the Chinese government indicate the country's commitment to strongly support renewable energy in its internal market and to promote lower cost manufacturing.

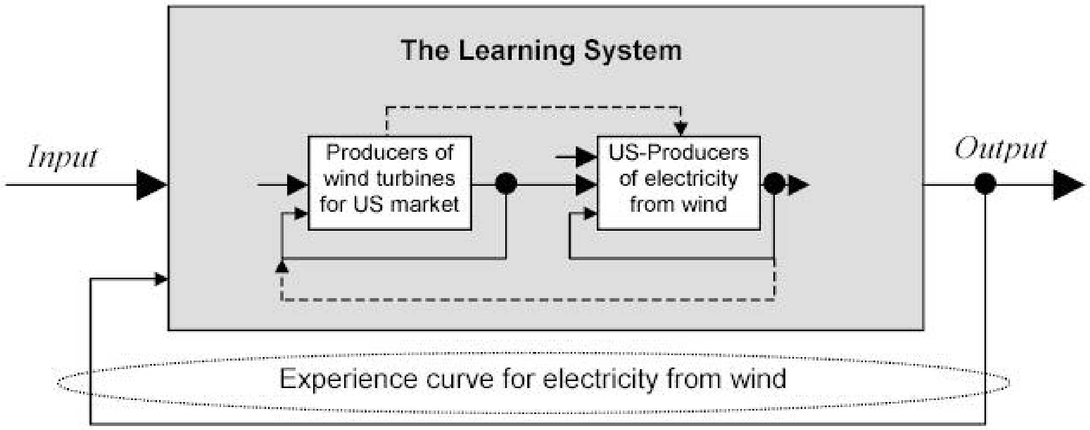
**Figure 3: Cumulative and Annual Capacity of Wind Energy Installed to 2004**




Estimation for Wind Energy Prices in Mexico

The basic theory of learning-by-doing and experience curves is likely to appear in Mexico adjusted for the particular characteristics of the local market. Applying the theoretical models in the case of Mexico, cost reductions can be assumed to be driven by the combination of: (i) experience obtained with increased installed capacity in Mexico, and (ii) manufacturing and technology improvements in wind energy technology internationally. Initial projects will be more expensive than the average international wind energy projects as initial prices from the wind turbine manufacturing industry are likely to be higher. This is normal industrial behavior for companies that enter an uncertain new market, with unknown growth prospects. Furthermore, capital costs for initial projects are often higher due to the costs of specialized engineers and technicians ('soft' costs) needed at the first stages and more expensive financing costs because of early risk perceptions. However, as companies become more experienced in the development and construction of projects, and the manufacturing industry perceives a growing and competitive market for wind energy in the Mexico, costs of wind energy projects are bound to converge with international levels. Any potential emergence of local manufacturing could result in further reductions of the capital costs. A similar theoretical model has been proposed by the IEA to analyze the USA market as presented below:

**Figure 4: Learning System for Production of Electricity from Wind in the USA**.




*The system contains two sub-systems, one producing wind turbines and one producing electricity from wind using wind turbines. Solid lines represent information feed-forward from one subsystem to another and information feed-backward within a (sub)system. Dashed lines represent information feed-forward or feed-backward between the two subsystems. Adopted from (IEA 2000)*

According to the theory, an experience curve can be expressed as:
C(Cum) = a * Cum^ b (1)
log (C(Cum)) = log a + b log Cum (2)
where:
C: Cost per unit
Cum : Cumulative (unit) production
a: learning cost at Cum=1
b: learning index (constant)
Cum : Initial cumulative unit production (at t=0)
C0 : Initial specific cost (at t=0), equals a*Cum0^b

This formula implies a reduction of prices with an increase in installed capacity. In addition, from the learning index, the progress ratio and the learning rate can be calculated:

PR = 2^b (3)
LR = 1- 2^b (4)
PR : Progress ratio
LR: Learning rate
N: The (assumed) maximum number of times the cumulative production will double

Both the progress ratio and the learning rate are parameters that express the rate at which costs decline each time the cumulative production doubles. For example, a learning index of -0.322 results in a progress ratio of 0.8 (= 80 percent) which in turn equals a learning rate of 0.2 (20 percent), and thus a 20 percent cost decrease for each doubling of the cumulative capacity.

To obtain an estimate of projected capital costs for Mexico, the above formula (1) is applied for Mexico, and internationally. In the medium term international and local prices will eventually meet; the point of convergence will be a function of time and installed capacity. Current costs for installed wind power in Mexico are around $1200/kW for project sizes of about 85MW (La Venta II wind energy project).

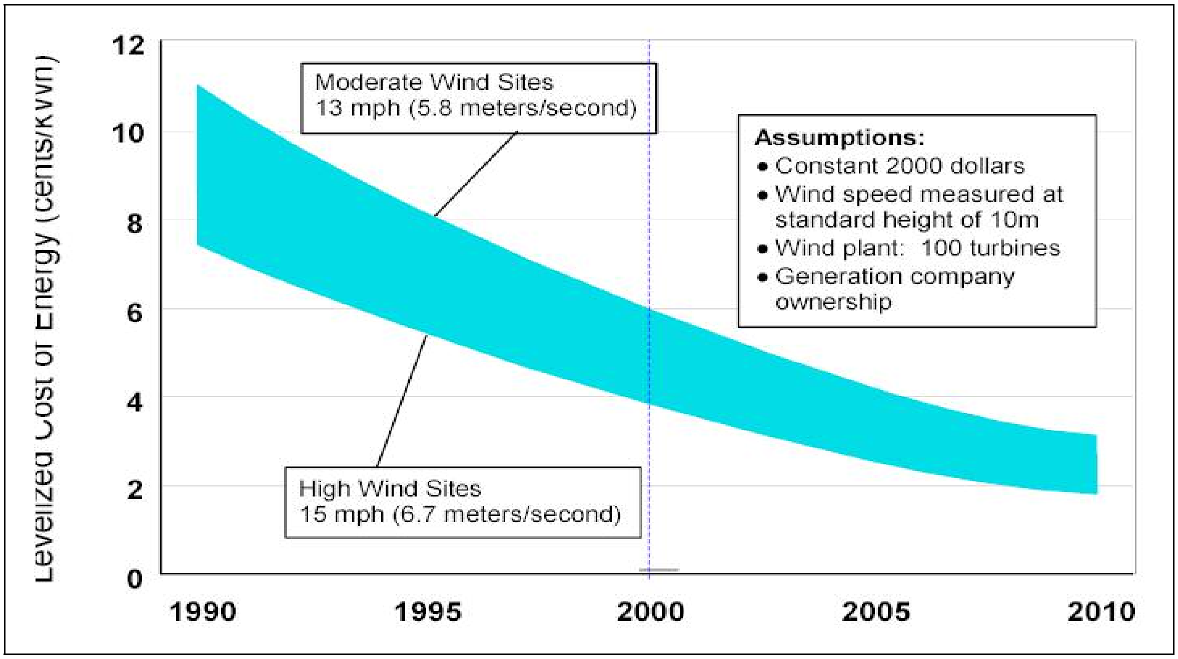
Actual cost reductions for wind energy prices in Mexico will be a function of how fast the market grows, and the expected learning rate for the local wind energy industry. A model assuming an initial capital cost of $1,200/MW, an average price reduction of 20 percent for every doubling of capacity and an annual growth rate of about 30 percent would result in costs for wind energy at a global level of **$1,000/MW by 2009**. In nominal figures assuming an inflation rate of about 3.5 percent, these would be **US$1150 in 2009**. Given the experience with the La Venta II plant in Mexico, and potentially other private sector power plants, it is reasonable to expect that by 2009 capital costs will be in line with international costs reflecting the industry's learning-by-doing effect in prices.

Review of Projected Estimates for Electricity Costs from Wind Energy

Final electricity costs from wind energy can only be calculated on a project-by-project basis taking into account specific characteristics of the project. This section presents some results based on the previous section and compares them with other studies. In addition, some 'rules-of-thumb' as quoted by experts in the literature are outlined as useful inputs to estimate levelized electricity costs.

Accumulated experience in producing and using wind turbines has not only resulted in a reduction in the cost of wind turbines, but also improved wind capture, and reduced operating and maintenance (O&M) costs. This, in turn, has resulted in a reduction in the cost of wind generated electricity. In Denmark, the average cost of wind-generated electricity was reduced by 60 percent in the period 1979–1994. Moreover, wind turbines installed at windy sites were already generating electricity at a cost lower than 4.5 US cents/kWh in 1998 (quoted in (Neij 1999). New projects (2002) were *selling* electricity in the USA at 4.0 US cents/kWh, without any price subsidy (Flowers 2002). Moreover, Mexican project developers seem to be ready to sell electricity at 4.5 US cents/kWh today (personal communications).

**Figure 5: Wind resource is a critical factor for the final cost of electricity produced by wind energy** (Flowers 2002)




As mentioned earlier the cost of the wind turbine accounts for approximately 75 percent of the total installation cost. Lifetime of wind turbines is estimated about 20 to 25 years. The O&M costs, including insurance, administration, service, and repair, have been shown to decrease with size and increase with age. The *average* O&M costs of installed wind turbines is approximately 2–3 percent of the investment cost per year. However, the O&M cost of a *new* wind turbine is estimated to be approximately 1 percent of the investment cost. The reduction in O&M costs will be the result of advanced control systems and a reduction in the insurance cost, which is likely to decrease due to experience in use of wind turbines. Moreover, the availability of wind power plants has recently reached 98 percent (EWEA 1997).

The site of wind projects has a decisive influence on the cost of the electricity generated. For example, an average 600 kW wind turbine (with a turbine cost of 820 US$/kW) will generate electricity at a calculated cost of 3.3 US cents/kWh in roughness class 0, 4.9 US cents/kWh in roughness class 1, 6.1 US cents/kWh in roughness class 2, and 8.7 US cents/kWh in roughness class 3 (using a discount rate of 6 percent and an economic lifetime of 25 years) (as quoted in (Neij 1999). It is estimated that an increase of average wind speed by 1 mph usually reflects about 0.5 US cents/kWh.

Assuming a robust rate of growth of installed capacity in Mexico, at the *best* wind sites in Mexico it is not unreasonable to anticipate electricity prices from wind at less than 4.0 US cents/kWh by 2009. Whether these prices will actually materialize will crucially dependent on the electricity system becoming able to absorb wind energy plants of a few hundred MW and the development of projects that can capture economies of scale with capacities per project of at least 100 MW.

REFERENCES

Argote, L. and D. Epple (1990). "Learning Curves in Manufacturing." Science 247: 920-924.

Arrow, K. J. (1962). "The economic implication of learning by doing." Review of Economic Studies 29:155-173.

BTMConsultApS (2005). World Market Update 2005.

DeMeo, E. and J. Galdo (1997). Renewable Energy Technology Characterizations. Washington, DC and Palo Alto, CA, EPRI and USDOE.

EWEA (1997). Wind Energy - The Facts. London, European Wind Energy Association
European Commission - Directorate General for Energy.

Flowers, L. (2002). Wind Power Update, NREL. 2002.

Flowers, L. and P. Dougherty (2002). Wind Powering America: Progress, Plans and Perspectives. Windpower 2002, Portland, OR, NREL/DOE.

IEA (2000). Experience curves for energy technology policy. Paris, OECD/IEA.

Junginger, M. (2000). Experience curves in the wind energy sector. Use, analysis and recommendations, Department of Science, Technology and Society, Utrecht University.

McDonald, A. and L. Schrattenholzer (2001). "Learning rates for energy technologies." Energy Policy 29 (4): 255-61.

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

Neij, L. (1999). "Cost dynamics of wind power." Energy 24(5): 375-389.

Organisation for Economic Co-operation and Development. and International Energy Agency. (2000). Experience curves for energy technology policy. Paris, OECD/IEA.

Redlinger, R. Y., P. D. Andersen, et al. (2002). Wind energy in the 21st Century: economics, policy, technology, and the changing electricity industry. New York, Palgrave.

Solow, R. M. (1997). Learning from "Learning by Doing": Lessons for economic growth, Kenneth J. Arrow Lectures. Stanford: Stanford University Press.

Watanabe, C. (1995). "Mitigating global warming by substituting technology for energy; MITI's efforts and new approach." Energy Policy 23(4-5): 447-461.

## Annex 10: Safeguard Policy Issues

## MEXICO: Large-Scale Renewable Energy Development Project

### Brief Project Description

The project proposes a two-phase approach to address key policy and tariff issues currently hindering renewable energy development, and facilitate initial investments in grid connected wind energy with use of GEF support in a competitive Financial Mechanism to overcome initial investment barriers[1].

In its first phase, the GEF project supports two main components to remove policy, financial and transactional cost barriers in order to open IPP markets in renewable energy:

- A "Financial Mechanism" to stimulate organizational learning and cost reduction, that will provide 1.1 cents per kWh for the first 5 years of generation, offered in response to a CFE competitive solicitation for IPP wind power; and
- Technical Assistance activities to address analytical and policy barriers, and provide business development assistance to stimulate and facilitate project investment

In the proposed Phase II the project would support different types of IPP grid connected renewable source based electricity generation projects (e.g. wind, bio-electricity, run-of-river hydro, solar based plants or other).

### Project Location and Scale

In Phase I, the Project will only support La Venta III, a 101 MW grid connected wind based power generation plant that will operate under the scheme of independent power production (IPP). CFE will launch the bidding process in July 2006 and the winner to the bid is expected to start the construction on December 2007 to initiate operations by May 2009.

La Venta III will be located in the Southeastern region of the Isthmus of Tehuantepec (possibly in *Ejido* La Venta, Municipality Juchitan de Zaragoza, State of Oaxaca) where the wind resource and the potential for electricity generation is high.

The U.S. National Renewable Energy Laboratory (NREL) estimates that there are about 6600 $km^2$ of windy land with good-to-excellent wind resource potential in Oaxaca. The windy land represents slightly more than 7 percent of Oaxaca's total land area (91,500 $km^2$)[2]. According to NREL, using a conservative assumption of 5 MW per $km^2$, this windy land could support approximately 33,000 MW of potential installed generation capacity.

Considering only the areas with the highest wind potential (power Class 7), the estimated total windy land area is about 1200 $km^2$, which could potentially support about 6000 MW of installed capacity.

[1] At their May, 2003 meeting, the GEF Council authorized US$25 million for Phase I of the project, and indicated its commitment to review a subsequent request for a US$45 million Phase II on the basis of Phase I success. The first phase is expected to be 36 months, and the second phase will be approximately five years.

[2] The highest resource (power Class 7) occurs near the foothills, ridges, and coast area of the Isthmus (including *Ejidos* La Mata and La Venta).

La Venta III will only occupy a maximum of 20 $km^2$ or 1.6 percent of the area with the highest wind potential.

The location and type of renewable energy projects for Phase II will be determined after Phase I success is demonstrated (2009).

### Environmental and Social Appraisal Responsibilities in IPP Schemes

As indicated before, the proposed Financial Mechanism will support the introduction of renewable source based power generation projects operating under the scheme of independent production (IPP), where the private sector participates under the conditions established in a power purchase agreement (PPA). This type of projects are included in the capacity expansion plan (known as POISE) and awarded through a competitive bidding process.

In IPP projects, CFE proposes a site (denominated "optional site") which is well described in the bidding documents. For this site, CFE conducts all relevant studies including the Environmental Impact Assessment (EIA), social consultations, social assessment, indigenous people development plan and obtains the necessary permits (construction permit, environmental license) which are then transferred, together with responsibilities, to the bid winner.

However, the bidders have also the option of choosing a different project site within a pre-determined area or region, the restrictions being (i) the distance to the point of interconnection with the grid (the "optional site" is located close or at the interconnection point), and (ii) that the site be within an area defined by CFE's Regional Environmental Impact Assessment as being environmentally suitable for development. In this case, the bid winner is responsible for conducting the environmental impact assessment, social impact analysis, consultation process and for obtaining all permits in accordance with national and local social and environmental laws and associated regulatory frameworks.

In Phase I the Financial Mechanism will only support one IPP project: La Venta III.

### Environmental Legal and Regulatory Framework

The institution in charge of environmental policies and regulation in Mexico is the Ministry of Environment and Natural Resources (SEMARNAT, *Direccion General de Impacto y Riesgo Ambiental*). SEMARNAT has also offices at the State level.

The national legal and regulatory framework is established in the General Law for Ecological Equilibrium and Environmental Protection (LGEEPA, *Ley General del Equilibrio Ecologico y Proteccion al Ambiente*) and associated regulations.

There are other laws that apply depending on the type of project and location:

- Law of Ecological Balance State of Oaxaca (or other States)
- General Law for Waste Prevention and Integrated Management
- General Law for the Sustainable Development of Forests
- Law of National Waters
- Federal Law of Water Rights

- Wild Life Law

These legal instruments are complemented by a set of standards that provide technical details, specifications and guidelines (*Normas Oficiales Mexicanas*, NOM). The standards that apply to energy activities in general are listed in the table below:

| ENVIRONMENTAL STANDARDS APPLYING TO ENERGY ACTIVITIES | | |
|---|---|---|
| NORMA (NOMENCLATURA ACTUAL) DOF 2003 | REGULACIÓN | NOMENCLATURA ANTERIOR Y AÑO DE PUBLICACIÓN EN DOF |
| NOM-113-SEMARNAT-1998 | Que establece las especificaciones de protección ambiental para la planeación, diseño, construcción, operación y mantenimiento de subestaciones eléctricas de potencia o de distribución que se pretendan ubicar en áreas urbanas, suburbanas, rurales, agropecuarias, industriales, de equipamiento urbano o de servicios y turísticas. | NOM-113-ECOL-1998 26-OCTUBRE-1998. |
| NOM-114-SEMARNAT-1998 | Que establece las especificaciones de protección ambiental para la planeación, diseño, construcción, operación y mantenimiento de líneas de transmisión y de subtransmisión eléctrica que se pretendan ubicar en áreas urbanas, suburbanas, rurales, agropecuarias, industriales, de equipamiento urbano o de servicios y turísticas. | NOM-114-ECOL-1998 23-NOVIEMBRE-19980 |
| NOM 051-SEMARNAT-1993 | Que establece el nivel máximo permisible en peso de azufre, en el combustible líquido, gasóleo industrial que se consuma por las fuentes fijas en la Zona Metropolitana de la Ciudad de México. | NOM-051-ECOL-1993 22-OCTUBRE-1993 |
| NOM 075-SEMARNAT-1995. | Que establece los niveles máximos permisibles de emisión a la atmósfera de compuestos orgánicos volátiles provenientes del proceso de los separadores agua-aceite de las refinerías de petróleo. | NOM-075-ECOL-1995 26-DICIEMBRE-1995. |
| NOM 085-SEMARNAT-1994. | Contaminación atmosférica-fuentes fijas-para fuentes fijas que utilizan combustibles fósiles sólidos, líquidos o gaseosos o cualquiera de sus combinaciones | NOM-085-ECOL-1994 02-DICIEMBRE-1994. |
| NOM 086-SEMARNAT-1994. | Contaminación atmosférica-especificaciones sobre protección ambiental que deben reunir los combustibles fósiles líquidos y gaseosos que se usan en fuentes fijas y móviles. | NOM-086-ECOL-1994. 02-DICIEMBRE-1994 |
| NOM 115-SEMARNAT-2003. | Que establece las especificaciones de protección ambiental que deben observarse en las actividades de perforación de pozos petroleros terrestres para exploración y producción en zonas agrícolas, ganaderas y eriales. | 27-AGOSTO-2004 |
| NOM 116-SEMARNAT-1998. | Que establece las especificaciones de protección ambiental para prospecciones sismológicas terrestres que realicen en zonas agrícolas, ganaderas y eriales. | NOM-116-ECOL-1998 24-NOVIEMBRE-1998. |
| NOM 117-SEMARNAT-1998. | Que establece las especificaciones de protección ambiental para la instalación y mantenimiento mayor de los sistemas para el transporte y distribución de hidrocarburos y petroquímicos en estado líquido y gaseoso, que realicen en derechos de vía terrestres existentes, ubicados en zonas agrícolas, ganaderas y eriales. | NOM-117-ECOL-1998 24-NOVIEMBRE-1998. |
| MODIFICACION A NOM-120 SEMARNAT-1997 | ACUERDO que modifica la Norma Oficial Mexicana NOM-120-SEMARNAT-1997, publicada el 19 de noviembre de 1998. | 06-MAYO-2004 |
| NOM-137-SEMARNAT-2003. | Que establece las especificaciones y los requisitos del control de emisiones de las plantas desulfuradoras de gas y condensados amargos, así como los métodos de prueba para verificar el cumplimiento de la misma. | 30-MAYO-2003 |
| NOM-138-SEMARNAT/SS-2003 | Limites máximos permisibles de hidrocarburos en suelos y las | 30-MARZO-2005 |

| | | |
|---|---|---|
| | especificaciones para su caracterización y remediación. | |
| NOM-141-SEMARNAT-2003. | Que establece el procedimiento para caracterizar los jales, así como las especificaciones y criterios para la caracterización y preparación del sitio, proyecto, construcción, operación y postoperación de presas de jales. | 13-SEPTIEMBRE-2004 |
| NOM-143-SEMARNAT-2003 | Que establece las especificaciones ambientales para el manejo de agua congénita asociada a hidrocarburos. | 03-MARZO-2005 |
| NOM-145-SEMARNAT-2003. | Confinamiento de residuos en cavidades construidas por disolución en domos salinos geológicamente estables. | 27-AGOSTO-2004 |

Other specific standards may also apply to wind and other renewable source based power plants, including the following:

- NOM-001-ECOL-1996: maximum allowed limits for wastewater discharges.
- NOM-041-SEMARNAT-1999: maximum allowed limits for emissions of polluting gases from motor vehicles using gasoline.
- NOM-50-SEMARNAT-1993 and NOM-045-SEMARNAT-1996: maximum allowed limits for emissions from motor vehicles using diesel
- NOM-052-SEMARNAT-1993: on hazardous waste management.
- NOM-053-ECOL/93: on hazardous wastes testing and toxicity.
- NOM-054-SEMARNAT-1993: on lack of compatibility between two or more materials established in NOM-052-SEMARNAT-1993.
- NOM-059-SEMARNAT-2001: protection of native species of flora and fauna.
- NOM-080-SEMARNAT-1994: maximum allowed limits of noise pollution from motor vehicles.
- NOM-081-ECOL-1994: maximum allowed limits of noise pollution from fixed sources

SEMARNAT has recently issued the draft of a new standard specific for wind projects:

- NOM-XXX-SEMARNAT-2005, that establishes technical specifications for environmental protection during construction, operation, and retirement of wind project installations located in agricultural and other sensitive zones.

However, it is still unknown when this standard will come into force.

International treaties and conventions are applied through existent Mexican legal and regulatory frameworks. In particular, the Migratory Bird Treaty Act Mexico-Canada-USA is observed through applicable environmental laws including those concerning environmental impact assessments, and wild life. The conditions established in environmental permits also include provisions for compliance with international treaties and conventions.

In addition, the issuance of environmental permits may require public consultations with relevant stakeholders and communities inhabiting the area of influence associated with the project.

**Environmental Assessment La Venta III**

Although the specific project site for La Venta III within *Ejido* La Venta or the Muncipality of Juchitan Zaragoza is yet to be determined, CFE has conducted several technical studies to estimate the wind potential in the Tehuantepec Isthmus and conducted environmental assessments for wind plants installed before 2005 in the region.

The most recent environmental impact assessment (EIA) has been conducted for the State owned 85 MW wind farm La Venta II, the first large scale wind based power generation plant with connection to the grid in Mexico[3].

It is expected that La Venta III project will be located within the same area as La Venta II: Municipality of Juchitan de Zaragoza, State of Oaxaca.

The project site of La Venta III within this municipality will be selected as either the "optional site" proposed by CFE before the bidding starts or a different site upon selection of the winning bid in February 2007 (for the case when the bid winner selects a site other than the "optional site"), as explained before.

This section briefly describes the environmental impacts associated with the state-owned plant La Venta II, as it is expected that the IPP project La Venta III will result in similar impacts.

In accordance with the Mexican legal and regulatory framework, CFE presented to SEMARNAT the complete environmental impact assessment for La Venta II which was conducted by the Instituto Nacional de Ecologia A.C. (INE-COL), (document available in Project files). The document was approved by SEMARNAT on August 3, 2004. The expected environmental impacts for La Venta II are summarized in the Table below:

[3] In particular, CFE is entering into a Emissions Reduction Purchase Agreement (ERPA) with the Carbon Finance Unit of the World Bank to participate in the international carbon market and transact carbon emissions reductions (ERs) during the operations of La Venta II. The PAD of this project can be found in the IRIS system and in the project files.

| General Description of Environmental Impacts La Venta II | |
|---|---|
| **Phase** | **Expected Impact** |
| **AIR QUALITY** | |
| Site preparation, construction operation and decommissioning | Vehicle use and machinery increase the concentration of CO, HC, NOx<br>Increase of dust due to vehicle traffic, transport of materials, civil works for ground leveling, |
| **NOISE** | |
| Site preparation, construction operation and decommissioning | Vehicle use, machinery and operation of wind turbines will increase the noise level |
| **SOIL – GROUND** | |
| Site preparation, construction operation and decommissioning | Civil works for site preparation, in particular ground leveling, could result in loss of soil. Movement of heavy equipment could result in compacting and loss of soil quality. Discharges of oils during construction works from vehicles and wind turbines could contaminate the soil. |
| **WATER** | |
| Operation | The opening of access roads could affect water drainage |
| **VEGETATION** | |
| Site Preparation | Civil works for the construction of the power plant and access roads will result in loss of vegetation coverage |
| **FAUNA** | |
| Site preparation, construction operation and decommissioning | Civil works, the use of machinery and vehicles and the presence of personnel could affect the mortality of fauna inhabiting or passing through the project site. This could take place primarily during the phases of preparation and construction when the number of workers will be higher. During operation and commissioning such impacts will be negligible.<br><br>During operation there is a high risk of birds and bats (resident and migratory) colliding with the wind turbines.. |
| **LANDSCAPE** | |
| Operation and Maintenance | The presence of wind turbines will have a visual impact on the landscape. |
| Source: Environmental Impact Assessment, Eolic Plant La Venta II, CFE, INE A.C. (December 2003) | |

The Environmental Management Plan (EMP) for La Venta II includes the following general measures:

- Program of Environmental Safeguarding (*Programa de Vigiliancia Ambiental*) that integrates all measures for prevention, reduction and/or compensation of adverse environmental impacts identified for every stage of the project, specifying the applicable activities and procedures.
- Reforestation program that will consider the use of native species in the project's area of influence and in proportion similar to those affected by the project.
- Works to control erosion and reconstitute the ground in all areas where organic ground is removed during clearing for civil works.

- Program to monitor resident and migratory birds in the project's area of influence.

**Key Environmental Safeguards Issues for La Venta III**

The key environmental impact expected for La Venta III concerns the potential collision of birds and bats (resident and migratory) with the wind turbines.

Specifically, the Oaxaca portion of the Isthmus of Tehuantepec (where the La Venta III project would be located) is recognized as one of the world's most important corridors for migratory birds. As noted in the Environmental Assessment (EA) report for the generally similar La Venta II project (*Manifestacion de Impacto Ambiental: Proyecto Eolico La Venta II, Oaxaca*, December 2003), millions of birds (representing a wide diversity of species) funnel through this area, especially during the autumn (southbound) migration that takes place late August to November. The general La Venta area is particularly noteworthy for the high numbers of raptors (hawks and other birds of prey) that pass through the area.

Some proportion of these birds may fly below the height that the La Venta III rotor blades would reach. The possibility thus exists that a substantial number of flying birds will be killed by the spinning blades.

Although a considerable diversity of raptors migrate through the project area, three species which breed in North America and winter in Central and/or South America appear most vulnerable to having their world populations measurably reduced (because more than 90 percent of the total population passes through the Isthmus of Tehuantepec, twice every year): Swainson's Hawk *Buteo swainsoni*, Broad-winged Hawk *Buteo platypterus*, and Mississippi Kite *Ictinia mississippiensis*. Aside from these day-flying migrants, a high number of songbirds (such as warblers and orioles) also fly through the general project area each year, mostly by night.

The La Venta III wind turbines are likely also to cause some mortality among resident and migratory species of bats, although with perhaps a lower impact on their overall populations. Although all proposed wind farm sites need to be assessed in terms of possible bird and bat mortality, the general La Venta area (Pacific side of the Isthmus of Tehuantepec) appears to be within the top five percent worldwide, in terms of the numbers of birds (especially raptors) that could be potentially affected.

There is however a number of international best practice measures that can be implemented to prevent and mitigate impacts on birds and bat populations, including:

- Improve visibility of wind turbines and blades: minimizing night lighting, use of colored blades and other modifications to the design or arrangement of turbines
- Prevent collision by ensuring a maximum or appropriate turbine height (e.g. 150m)
- An appropriate wind farm layout to facilitate bird migration
- Prevent the use of structure and blades for nesting or rest (e.g. use of tubular structures)
- Monitoring and registering of bird migratory paths and number of dead birds
- Quick removal of any dead birds to avoid attracting scavenging birds

- Decision rules for turbine shutdowns during migratory bird seasons

According to the EIA for La Venta II, since 2004 CFE has been implementing a monitoring program to gather information on the types of birds which are native to the zone of influence of the project (Tehuantepec). In addition, CFE is planning to implement a radar system to detect the frequency passage and paths of migratory birds, (i.e. so that it can temporary suspend the rotation of wind turbines and avoid bird collisions) in accordance with the guidelines established in the Project's '*Environmental Manual for Wind Projects in Mexico*' (included in the *Project files*). This manual, and its recommendations, will be attached as a binding annex to the bidding documents for the La Venta III solicitation.

SEMARNAT will use the experience of operations with La Venta II to evaluate impacts on migratory birds in the zone of influence and issue appropriate guidelines and/or regulations for future similar projects in the country.

Without question, the experience of La Venta II will be essential to improve the design of La Venta III and specify effective measures to avoid and minimize impacts on bird and bat populations. These measures will be considered in the Environmental Management Plan (EMP).

If the bid winner does not chose the "optional site" recommended by CFE in the bidding package in which case the CFE prepares and transfers the EIA, EMP and environmental permits to the bid winner, the IPP will have to prepare the EIA and EMP. The adequacy of the EIA and EMP will be verified by an independent environmental consultant retained by SENER, and certified to the Bank through NAFIN.

In all cases, since la Venta III will operate under the scheme of independent power production (IPP), the private company in charge of construction and operation will be responsible for implementing an environmental management plan (EMP) that includes appropriate prevention and mitigation measures. Compliance with the EMP will be verified by an independent environmental consultant maintained by SENER, and certified to the Bank through NAFIN.

**Social Legal and Regulatory Framework**

There are two institutions in charge of social development and protection in Mexico, the Secretary of Social Development (SEDESOL), and the Indigenous People Development Commission (CDI). SEDESOL is in charge of implementing a broad spectrum of social programs aiming at poverty reduction, regional development, rural infrastructure, youth development, protection of specific vulnerable social groups, and other. CDI is the institution responsible for coordinating, designing and implementing strategies and programs focused on indigenous people development.

The legal and regulatory framework on social issues is mainly established in two legal instruments:

The *Law of Indigenous People Culture and Rights* passed in 2001, which guarantees the rights of indigenous people to decide and organize their social, economic, political and cultural development and establishes requirements for a formal public consultation

The *General Law on Social Development* enacted in 2004, which has established the concept of social participation as the right of people and organizations to intervene individually and collectively in the evaluation of policies, strategies and programs associated with social development. This law also introduced the concept of transparency and public disclosure, which is considered an essential milestone to social participatory processes in Mexico.

In addition, some States have issued their specific laws on indigenous people rights (e.g. *Ley de Derechos Indigenas del Estado de Oaxaca*) and established State level offices for indigenous peoples affairs (*Secretaria de Asuntos Indigenas*) and institutions to defend their rights (*Procuraduria para la Defensa del Indigena y el Poder Judicial*).

Finally, it is important to note that Mexico is a signatory to the Convention 169 (1989) of the International Labor Organization, which establishes that:

> "Governments shall…consult the peoples concerned, through appropriate procedures and in particular through the institutions that represent them, whenever consideration is being given to legislative or administrative measures with the possibility to affect them directly". The Convention also requires that "the peoples concerned shall have the right to decide their own priorities in development processes as they affect their lives, beliefs, institutions, spiritual well being and the lands they occupy or otherwise use….and the right to exercise control –to the extent of possible- over their own economic, social and cultural development. In addition, they shall participate in the formulation, implementation and evaluation of plans and programs for national and regional development which may affect directly".

**Social Assessment La Venta III**

La Venta III will be located in an area were the system of *ejidos*[4] (communal land) is in place. The *ejido* land in La Venta was established in 1951 with 5,815 hectares where each *ejidatario* was granted a maximum of 10 Ha. According to the National Institute of Geography and Statistics (INEGI), *La Venta* has a population of 1,814 people. The inhabitants of the *ejido* la Venta belong to the ethnic group Zapoteco, one of the largest ethnic groups of the State of Oaxaca. Although the *ejido's* population does not speak Zapoteco any more, they maintain the regional festive traditions and identify themselves as Zapotecos and Mexicans.

More than half of *ejidatarios* (55 percent) in La Venta are employed in primary sector of the economy (agriculture, livestock, fishing), 12 percent in the secondary sector (manufacturing, construction), and about 30 percent in the tertiary sector (services, commercial activities). In *Ejido* La Venta, *zapoteco* peasants have traditionally been dedicated to agriculture, mainly sugar cane crop and other products for family consumption such as corn, beans and pumpkin. With the fall of sugar prices, sugar cane based agricultural activities are no longer the main economic activity; and has been replaced for cattle raising and agriculture of sorghum crop , watermelons, peanuts, melons, cucumbers and sesame which are sold in regional markets. Because of the strong winds, land is being cultivated only during the spring/summer cycle, and even on irrigated land the crop output is below the national performance average. The land where the air

[4] Mexican land tenure has unique characteristics in that since 1916, indigenous communities *"ejidatarios"* and other community members *"comuneros"* have legally recognized rights or titles to their land and the natural resources on them.

generators are to be installed is being used for extensive cattle-raising, although in the past it has also been used for agricultural purposes (INEGI 2001).

According to INEGI the economic conditions of *Ejido* La Venta, in terms of percent employed population and wages are as follows:

**Table 1: Employed Population in Ejido La Venta**

| Locality | Empl Population | Less than mw | Between and 2 mw | Between 2 and 5 mw | Between 6 and 10 mw | More than 10 mw | Population without job | Population not receiving remuneration |
|---|---|---|---|---|---|---|---|---|
| La Venta | 486 | 33 | 273 | 107 | 18 | 3 | 4 | 42 |
| Percent of Total | 1814 | 26.8 | 1.8 | 15 | 6 | 1 | 0.2 | 2.3 |

mw= minimum wage

*Community Organization*: The E*jido* is organized under the regulation established in the Agrarian Law. The management and decision making on land is exercised by the *ejidatario*'*s* assembly. Every three years, 326 *ejidatarios* elect representative authorities (a total of 12 representatives). These functions are performed without salary or other compensation; representation is a duty of all citizens that belong to the *ejido*. A municipal delegate is elected by the assembly to act as a link with the municipality for official purposes. For matters that have to do with deciding the usufruct of land, the highest authority is the *ejidal* commissioner. The following table describes the community organization for matters related to land ownership and rights.

| **Organizational Structure** | |
|---|---|
| Communal Property Commission | President<br>Secretary<br>Treasurer |
| Oversight/ Council | |
| Auxiliary Judge | |
| Municipal Delegate | Link between the *ejido* and the municipality. |

### Community and Stakeholders Consultation for Wind Based Power Generation Projects[5]

No social consultation has taken place in relation to the construction and operation of La Venta III, as the specific project site within La Venta, or neighboring *ejidos,* is yet to be determined. However, CFE has already conducted participatory consultation activities in *Ejido* La Venta for the wind based power facility La Venta II. This section describes the process and nature of these activities.

Based on interviews with the *ejidal* commissioner and 20 *ejidatarios* of la Venta (April 2005), it has been determined that the *ejidatario*'*s* perception on La Venta II and the installation of air

[5] This section is mainly extracted and adapted from the Project Appraisal Document of the Carbon Financed Project La Venta II (available in the *Project files*).

generators in their land is positive as it is seen as a good opportunity to obtain additional income or compensation. The *ejidatarios* interviewed exposed in detail the negotiations that have been taking place with the CFE since 2001.

The majority of *ejidatarios* participated in early meetings with the CFE. During the initial negotiations with CFE the *ejidatarios* requested free electricity service, treatment of a contaminated nearby river, schools rehabilitation, water drainage works, and paved streets.

In 2002, in response to the concerns of community leaders and members regarding the lack of information on wind energy project developments, the State Government of Oaxaca, through the Secretariat of Industrial and Commercial Development (SEDIC) requested support from USAID to conduct a study on wind energy. The study would provide *ejidos* and others communities in the Isthmus of Tehuantepec region with information on the typical magnitude of payments, structure of agreements, and means of verifying actual generation or power sales revenues, and types of contracts typically used in the US and internationally between wind power projects developers and landowners. The study has been prepared for USAID Mexico and the State Government of Oaxaca and SEDIC by Winrock International, Global Energy Concepts, the American Wind Energy Association (AWEA), and the Mexican Rural Development Foundation (FMDR). This relevant document is available in the project files.

CFE continued negotiations with land owners and *ejidatarios* for the rights to construct the plant on the basis of international practices. As a result of these negotiations, *ejidatarios* will receive payments for the energy generated and be invoiced by project sponsor (in this case, the CFE) --in line with international practices. It should be noted that the *ejidatarios* will receive the compensation from the energy plant and will also be able to continue with farming activities in their land.

La Venta II will directly benefit the *ejidatarios* that own land in the project's area of influence and indirectly all the *ejidatarios* of La Venta II according to a social compensation negotiated between CFE and the local authorities of the *ejido*. The plan includes: (i) the creation of a trust fund (created in December 2005 and capitalized with 7 million Mexican Pesos) to provide public lighting, paving of main streets in the *ejido* and computers for the secondary school; and (ii) the creation of an employment agency that would give priority to the *ejidatarios* for works during the installation of the wind turbines. The plan will be executed by the authorities of the *ejido* with the support of CFE, the Ministry of Social Development (Secretaría de Desarrollo Social, SEDESOL) and the Ministry of Agriculture, Rural Development, Fishing and Food (*Secretaría de Agricultural, Ganadería, Desarrollo Rural, Pesca y Alimentación*).

Two hundred *ejidatarios*, out of a total 326, are participating in the project. The project will benefit 1,300 out of 5,815 hectares in the *ejido*. The land has also been registered in the National Agrarian Registry.

In July 2004, most *ejidatarios* with rights to the *ejido* La Venta signed an agreement for the construction of the 100 MW wind power project La Venta II which will occupy a surface of 2088.54 hectares (copy of the notarized agreement is available in project files of La Venta II).

The contract will last 30 years and will be reviewed annually for any necessary adjustments. The agreed payments are as follows:

| Payment Criteria | Annual in Mexican pesos |
|---|---|
| Piece of land (*parcela*) within the polygon lot of influence without road construction, wind generators, offices or substations, payment by hectare. | 1000 |
| Road constructed by hectare | 13,100 |
| Payment by wind generator *minimum 850 Kw | 8000 |
| Piece of land (*parcela)* out of the polygon lot project influence with a surface smaller than 10 ha., total payment | 18,880 |
| Piece of land (*parcela*) out of the polygon or building lot of influence with more than 10 hectares, payment by hectare. | 100 |

There are, however, eight *ejidatarios* that have not signed the assembly agreement. The design of the project and the execution of the civil works have been modified to ensure that the land of the non-signatories is not affected by the project.

*Cultural Property*: On 2004 the *ejidal* authorities of la Venta asked the National Institute of Anthropology and History (INAH) to visit the area in order to establish the non-existence of archeological remains. INAH prepared a report on the exploration findings indicating that archeological remains were found in the Rastro Tolistoque site, (which is distant from the location of La Venta II). INAH extended to the *ejido*'*s* authorities the report of the findings and the location of the archeological site. The Protected Natural Areas Commission (CONANP) authorizes the *ejido* to keep and maintain the area called Ojo de Agua (1,306 ha) located in the Tolistoque hill.

The project sponsor of La Venta III will therefore implement all the necessary measures before construction to ensure the protection of cultural property in the region (e.g. chance finding procedures).

### Continuous Consultation Process

The public consultation activities launched at *Ejido* La Venta with the Project La Venta II are really the beginning of a continuous process.

While the general nature of agreements reached with community and *Ejido* leaders in the region are solid, the bidding of La Venta III -and subsequent projects- will proceed with additional consultations, new negotiations on land acquisition and more information campaigns.

With the experience of La Venta II and La Venta III, communities and *ejidatorios* will understand better what are the costs and benefits associated with the sitting of this type of projects and will be able to have a more informed participation in subsequent public consultations.

At the same time, project sponsors and operators will consult with community members, *Ejidatarios* and other relevant stakeholders at different stages of project preparation and implementation.

For instance, the 30 year contract signed with *Ejidatarios* allows for annual adjustments. This will require periodic meetings between the project operator and the beneficiaries to such contract.

### Key Social Safeguards Issues for La Venta III

The introduction of La Venta III will trigger the indigenous people operational policy (OP 4.10) and possibly, depending on the specific project site, the cultural property policy (OP 11).

The social assessment and consultation for La Venta II demonstrated the capacity of CFE to conduct and resolve in a participatory manner a formal process to reach *Ejido* agreement on a specific intervention. This process also demonstrated the willingness of *Ejido* authorities to participate in consultation processes and reach agreements that result in positive compensation schemes and the community approval.

CFE is in the process of developing, reporting and disclosing a formal indigenous people plan or planning framework for La Venta II in accordance with the recommendations established in OP 4.10.

For La Venta III, it is expected that the winner to the bid (a private company) will consider the precedent set by the CFE in relation to the negotiations with *Ejido* authorities and the implementation of an indigenous people plan or planning framework for the region. In this case, it is possible that CFE, along with SEDESOL and CDI authorities, will accompany the private company in charge of constructing and operating La Venta III during the social consultation process, in order to ensure minimum or similar compensation measures and best practice.

### Environmental and Social Impact of Technical Assistance Activities

Technical assistance activities will focus on addressing analytical and policy barriers to the development of grid connected renewable energy, and on providing business development assistance to stimulate and facilitate project investment.

The initiative will promote the future development of different types of renewable source based power generation projects, which may be located in different regions of the country. The aggregated impact is expected to result in the reduction of greenhouse gas emissions as well as increased technology diversification and security of supply in the electricity system.

### Description of Safeguards

The number and type of safeguards triggered by the proposed Project will depend on the type and location of renewable source based power generation projects benefited by the Financial Mechanism incentive during both Phase I and II.

For the wind based power generating project La Venta III (Phase I), it is expected that the following safeguards will be triggered:

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

**Framework to Ensure Compliance with Social and Environmental Safeguards**

A number of measures have been or will be implemented to ensure compliance with Bank's social and environmental policies before and after the bidding process. These are described below.

1. Public Consultation on the impacts of La Venta III on bird and bat populations.

On April 20, 2006, the Federal Commission of Electricity conducted a one day public consultation with relevant stakeholders, bird specialists, NGOs and the academia to discuss the characteristics of La Venta III and its potential impacts on bird and bat populations. More than 40 people attended the consultation and in general terms it has been reported that the event resulted in a constructive dialogue which led to substantive conclusions. CFE had left an open e-mail address for further questions and answers about the project.

2. Regional Environmental Assessment (REA)

The CFE will conduct an abbreviated regional environmental assessment before the launching of the bidding process July 4, 2006. The REA will include an analysis of environmentally highly sensitive areas (such as those windy areas known—due to previous monitoring—to have especially high migratory bird concentrations) to ensure an appropriate project siting and the identification of zones or areas ineligible for bidding (considering that IPPs are free to chose a project site within a pre-determined area).

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

3. Strategic Environmental Assessment (SEA)

La Venta III will be the third wind farm on the Pacific side of the Isthmus of Tehuantepec, but not necessarily the last. Because of the area's rather consistent high winds, there is the future potential for a much larger number of turbines, with the possibility of cumulative impacts on migratory birds.

During implementation the project will finance a strategic environmental assessment (SEA) to (i) assess the overall wind turbine "carrying capacity" of the Pacific Tehuantepec region, in terms of acceptable levels of interference with bird migrations; (ii) within this general wind resource area, identify bird migration "hot spots" (to a scale of one square kilometer or finer) where wind turbines should not be installed; and (iii) identify other possible wind resource areas in Mexico that are less sensitive in terms of migratory bird conservation or other biodiversity issues, where future wind power investments could ideally be channeled.

The SEA will be part or linked to other studies including (i) wind potential assessments and (ii) regional plan for southern Isthmus of Tehuantepec region.

Also, the development of a national wind resource map should take into account the relative importance of bird collision risks (as well as other biodiversity conservation issues, where relevant) in the different wind resource areas. The SEA will try to integrate wind energy resources data with bird data.

4. Guidelines and Specifications for Compliance with Bank's environmental safeguards

For La Venta III (Phase I) and also for the introduction of subsequent projects (Phase II), a document including a set of guidelines and specifications has been created to ensure compliance with Bank's environmental safeguard policies: "*Environmental Manual for Wind Projects Mexico*" (included in the *project files*).

The set of guidelines includes recommendations and specifications for sub-project site selection, design, screening, pre-bidding specifications and environmental compliance.

A similar document has been created for compliance with social safeguard policies "*Guidelines and Specifications for Compliance with Social Policies*" (also included in the *Project files*). This document also includes guidelines and specifications for public consultations, social assessments, the development of indigenous peoples development plans and social action plans.

These two sets of guidelines and specifications will be included as an annex in the bidding documents and as such will be legally binding. To qualify for the green incentive, the winner to the bid will have to agree and comply with both the Mexican and Bank's social and environmental safeguard policies as well as with the recommendations and specifications included in the guidelines.

The SENER will be in charge of verifying compliance with local and Bank's social and environmental safeguards through independent expert environmental and social safeguard consultants retained for this purpose. NAFIN will then certify this verification to the Bank before disbursing the incentive.

As specified in the guidelines and specifications, the beneficiary - the independent power producer or project sponsor - will conduct the necessary assessments and consultations including an independent verification that confirms compliance with Bank's social and environmental safeguards. NAFIN will request the confirmation by an independent party or consultant retained by SENER that the specific project complies with these policies.

As an additional check on the compliance with the environmental safeguards, the Bank will schedule its own supervision missions for the La Venta III Project to coincide with the peak fall migration season (late September and October), in order to thoroughly monitor the efficacy of the system and adherence to the shutdown protocols. The Bank will also hire a local consultant to observe the implementation of the project environmental manual throughout the peak migratory period.

5. Scientific Review Committee (SRC)

It has been suggested that a Scientific Review Committee (SRC), responsible for overseeing the bird and bat monitoring during the project's lifetime would be extremely useful in advising CFE on what measures are most appropriate to minimize impacts before and after construction (e.g. shutdown rules, turbine design and arrangement, other).

### Institutional Capacity Assessment for Safeguard Compliance

*Independent Power Production:* For IPP projects, as explained before, the private company (winner of the bid) will have to comply with local and Bank's policies as established in the social and environmental guidelines and specifications included in the bidding package. As explained before, an independent party will have to confirm compliance with national and Bank's safeguard policies.

*Nacional Financiera (NAFIN):* It has been assessed that the financial intermediary has the capacity to manage the Financial Mechanism incentive and to disburse it against pre-defined conditions. One of such conditions as indicated before is to comply with national, local and Bank's social and environmental policies. Although NAFIN will not be in charge of reviewing environmental or social impact assessments, it will have the responsibility of ensuring that a qualified independent party confirms projects' compliance with these policies and associated requirements. NAFIN is qualified to undertake this duty.

The Mexican environmental and social legal and regulatory frameworks are sophisticated and solid. Mexico is also a signature of all major international treaties and conventions including the Kyoto Protocol and the Convention 169 (1989) of the International Labor Organization.

In addition, SEMARNAT, SEDESOL and CDI are strong institutions with a good track record of consistent oversight and solid performance. Yet, national monitoring and evaluation activities at the State and local levels may need strengthening[6]. The Project will therefore ensure that both social and environmental management plans are well implemented and compensation schemes honored. This will require a annual audit or periodic independent verification by a third

[6] PROFEPA is in charge of auditing activities however its capacity to reach all facilities is limited.

independent accredited party (as described in the social and environmental guidelines and specifications referenced above, and available in the project files).

## Annex 11: Project Preparation and Supervision

## MEXICO: Large-Scale Renewable Energy Development Project

| | Planned | Actual |
|---|---|---|
| PCN review | 3/10/03 | 3/10/03 |
| Initial PID to PIC | 6/25/03 | 6/25/03 |
| Initial ISDS to PIC | 5/30/03 | 5/30/03 |
| Appraisal | 5/11/06 | 5/15/06 |
| Negotiations | 5/18/06 | 5/1906 |
| Board/RVP approval | 6/29/06 | |
| Planned date of effectiveness | 8/30/06 | |
| Planned date of mid-term review | 12/1/07 | |
| Planned closing date | 6/30/14 | |

**Key institutions responsible for preparation of the project:**

*Secretaría de Energía* (SENER), with advice and cooperation from the *Comisión Federal de Electricidad* (CFE) and the *Comisión Reguladora de Energía* (CRE).

**Bank staff and consultants who worked on the project included:**

| Name | Title | Unit |
|---|---|---|
| Charles Feinstein | Team Leader | LCSFP |
| Demetrios Papathanasiou | Energy Economist | LCSFE |
| Gabriela Elizondo Azuela | Energy Specialist | LCSFE |
| Victor Ordonez | Financial Management Specialist | LCSFM |
| Efraim Jimenez | Procurement Specialist | LCSFM |
| Anna Marti-Kiemann | Counsel | Consultant - LEGLA |
| Daniel Farchy | Environmental Specialist | LCSFE |
| Tania Carrasco | Social Specialist | Consultant - LCSES |
| Ted Kennedy | Renewable Energy Specialist | Consultant - ENVCC |
| Donald Hertzmark | Energy Economist | Consultant |
| Fabio Arjona | Environmental Specialist | Consultant |
| Carl Thelander | Environmental Specialist | Consultant |
| Smriti Goyal | Junior Professional Associate | LCSFE |

**Bank funds expended to date on project preparation:**

1. Bank resources: $419,000
2. Trust funds: $350,000 - GEF Project Preparation Grant ‘PDF B’
3. Total: $769,000

**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

## MEXICO: Large-Scale Renewable Energy Development Project

- WB/GEF Project Concept Document (Brief) for GEF Council (May, 2003)

- UNDP/GEF: Action Plan for Removing Barriers to the Full-Scale Implementation of Wind Power in Mexico (Phase 1), October 15, 2002

***Instituto de Investigaciones Eléctricas* (IIE); Non-Conventional Energy Unit**

a) A Portfolio Approach to Energy Planning in Mexico. (Shimon Awerbuch and Martin Berger)
b) Task A: Background Information for Project Preparation
c) Task B: Preliminary Assessment of the Potential for Electricity Generation in Mexico with Renewable Energy other than Wind July 2005

**Project Preparation Studies** (prepared by Protego Asesores, S.A. de C.V.; Pace Global Energy Services, LLC; and Global Energy Concepts, LLC)

d) Task 1: Financial Mechanism and Operational Manual for GEF Incentive Support (3/7/05)
e) Task 2: Work Plan for Business Development and Financing Facilitation Services (4/27/05)
f) Task 3: Project Implementation Plan (5/31/05)

**SENER Key Policy and other documents:**

- Renewable Energy Law (as tabled before the Mexican Senate; April 19, 2005)

**Other Reports and Studies:**

- Social Assessment Manual for the Large-Scale Renewable Energy Development Project: "Guidelines and Specifications for Compliance with Social Safeguard Policies"
- Environmental Assessment Manual for the Large-Scale Renewable Energy Development Project: "*Manual de Cumplimiento de las Normas Ambientales"*
- *Instituto de Investigaciones Eléctricas* (IIE) – Study on the benefits from the integration of wind and hydro technologies
- Lawrence Berkeley National Laboratory: Accounting for Fuel Price Risk: Using Forward Natural Gas Prices Instead of Gas Price Forecasts to Compare Renewable to Natural Gas-Fired Generation (LBNL-53587); Mark Bolinger, Ryan Wiser, and William Golove, August 2003
- Results of Dispatch and Avoided Cost Simulations – memo, Donald Hertzmark
- Future Generation Costs for CFE System, memo, Donald Hertzmark

# Annex 13: Statement of Loans and Credits

## MEXICO: Large-Scale Renewable Energy Development Project

| Project ID | FY | Purpose | Original Amount in US$ Millions | | | | Cancel. | Undisb. | Difference between expected and actual disbursements | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | IBRD | IDA | SF | GEF | | | Orig. | Frm. Rev'd |
| P074755 | 2005 | MX State Judicial Modernization Project | 30.00 | 0.00 | 0.00 | 0.00 | 0.00 | 30.00 | 0.00 | 0.00 |
| P085851 | 2005 | MX Basic Education Dev Phase III | 300.00 | 0.00 | 0.00 | 0.00 | 1.50 | 251.72 | -46.78 | 0.00 |
| P088080 | 2005 | MX Housing & Urban Technical Assistance | 7.77 | 0.00 | 0.00 | 0.00 | 0.00 | 7.77 | 1.14 | 0.00 |
| P035751 | 2004 | MX Community Forestry II (PROCYMAF II) | 21.30 | 0.00 | 0.00 | 0.00 | 0.00 | 19.90 | 2.90 | 0.00 |
| P035752 | 2004 | MX Irrigation & Drainage Modernization | 303.03 | 0.00 | 0.00 | 0.00 | 0.00 | 264.02 | 25.49 | 0.00 |
| P087152 | 2004 | MX (CRL1)Savings & Rurl Finance(BANSEFI) | 75.50 | 0.00 | 0.00 | 0.00 | 0.38 | 59.66 | -10.96 | 0.00 |
| P080149 | 2004 | MX Decentralized Infrastructure Development | 108.00 | 0.00 | 0.00 | 0.00 | 0.00 | 108.00 | 6.00 | 0.00 |
| P059161 | 2003 | GEF MX-Climate Measures in Transport | 0.00 | 0.00 | 0.00 | 5.80 | 0.00 | 3.04 | 5.13 | 0.00 |
| P074655 | 2003 | MX Rural Finance Develop Struct Adj Loan | 505.06 | 0.00 | 0.00 | 0.00 | 0.00 | 150.01 | 0.01 | 0.00 |
| P070108 | 2003 | MX Savings & Credit Sector Strengthening | 64.60 | 0.00 | 0.00 | 0.00 | 0.00 | 23.01 | 3.91 | 0.00 |
| P077602 | 2002 | MX Tax Admin Institutional Development | 52.00 | 0.00 | 0.00 | 0.00 | 0.00 | 40.17 | 27.98 | 0.00 |
| P065988 | 2002 | GEF MX Consolidat.Prot Areas (SINAP II) | 0.00 | 0.00 | 0.00 | 16.10 | 0.00 | 5.13 | 12.83 | 0.00 |
| P060908 | 2001 | GEF MX-MESO AMERICAN CORRIDOR | 0.00 | 0.00 | 0.00 | 14.84 | 0.00 | 12.84 | 9.02 | 0.00 |
| P063463 | 2001 | METHANE CAPTURE & USE AT A LANDFILL | 0.00 | 0.00 | 0.00 | 6.27 | 0.00 | 0.08 | 6.05 | 5.52 |
| P065779 | 2001 | MX FEDERAL HIGHWAY MAINTENANCE PROJ. | 218.00 | 0.00 | 0.00 | 0.00 | 0.00 | 19.70 | 19.70 | 0.00 |
| P066674 | 2001 | GEF MX-Indigenous&Community Biodiversity | 0.00 | 0.00 | 0.00 | 7.50 | 0.00 | 5.46 | 5.65 | 0.00 |
| P066321 | 2001 | MX: III BASIC HEALTH CARE PROJECT | 350.00 | 0.00 | 0.00 | 0.00 | 0.00 | 318.07 | 126.57 | 2.08 |
| P066938 | 2000 | MX GENDER (LIL) | 3.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.42 | 0.42 | -0.13 |
| P060718 | 2000 | GEF MX ALTERNATIVE ENERGY | 0.00 | 0.00 | 0.00 | 8.90 | 0.00 | 2.44 | 8.90 | 0.00 |
| P007610 | 1999 | MX FOVI RESTRUCTURING | 505.50 | 0.00 | 0.00 | 0.00 | 0.00 | 18.63 | 18.63 | 0.00 |
| P049895 | 1998 | MX HIGHER ED. FINANCING | 180.20 | 0.00 | 0.00 | 0.00 | 0.00 | 48.89 | 48.89 | 0.00 |
| P044531 | 1998 | MX KNOWLEDGE & INNOV. | 300.00 | 0.00 | 0.00 | 0.00 | 0.00 | 19.68 | 19.68 | -36.42 |
| P007713 | 1996 | MX WATER RESOURCES MANA | 186.50 | 0.00 | 0.00 | 0.00 | 65.67 | 12.01 | 77.68 | 23.68 |
| | | Total: | 3,210.53 | 0.00 | 0.00 | 59.41 | 67.55 | 1,420.65 | 368.84 | - 5.27 |

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 | 4.29 | 0.00 | 0.00 | 0.00 | 4.29 | 0.00 | 0.00 | 0.00 |
| | BBVA-Bancomer | 20.75 | 0.00 | 0.00 | 0.00 | 20.75 | 0.00 | 0.00 | 0.00 |
| 1995/99 | Baring MexFnd | 0.00 | 1.88 | 0.00 | 0.00 | 0.00 | 1.88 | 0.00 | 0.00 |
| 1998 | CIMA Mexico | 0.00 | 4.80 | 0.00 | 0.00 | 0.00 | 4.80 | 0.00 | 0.00 |
| 1998 | CIMA Puebla | 6.75 | 0.00 | 0.00 | 0.00 | 3.25 | 0.00 | 0.00 | 0.00 |
| | Chiapas-Propalma | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| 2001/04 | Compartamos | 24.85 | 0.00 | 0.00 | 0.00 | 5.83 | 0.00 | 0.00 | 0.00 |
| 2002 | Coppel | 30.00 | 0.00 | 0.00 | 0.00 | 30.00 | 0.00 | 0.00 | 0.00 |
| 1999 | Corsa | 5.57 | 3.00 | 0.00 | 0.00 | 5.57 | 3.00 | 0.00 | 0.00 |
| 2005 | Credito y Casa | 20.92 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2004 | DTM | 34.87 | 0.00 | 0.00 | 0.00 | 21.30 | 0.00 | 0.00 | 0.00 |
| 2001 | Ecomex | 4.50 | 0.00 | 1.50 | 0.00 | 2.50 | 0.00 | 1.50 | 0.00 |
| 2000 | Educacion | 5.96 | 0.00 | 0.00 | 0.00 | 4.36 | 0.00 | 0.00 | 0.00 |
| 1997 | Fondo Chiapas | 0.00 | 3.35 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 | 0.00 |
| 1998 | Forja Monterrey | 6.50 | 3.00 | 0.00 | 6.50 | 6.50 | 3.00 | 0.00 | 6.50 |
| 2001 | GFNorte | 50.00 | 0.00 | 0.00 | 0.00 | 50.00 | 0.00 | 0.00 | 0.00 |
| 1996 | GIBSA | 8.11 | 0.00 | 0.00 | 27.29 | 8.11 | 0.00 | 0.00 | 27.29 |
| 1996/00 | GIRSA | 32.14 | 0.00 | 0.00 | 42.86 | 32.14 | 0.00 | 0.00 | 42.86 |
| 1998/04 | Grupo Calidra | 22.00 | 0.00 | 0.00 | 0.00 | 21.26 | 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 |
| 1997 | Grupo Minsa | 10.38 | 0.00 | 0.00 | 15.58 | 10.38 | 0.00 | 0.00 | 15.58 |
| 1996/99 | Grupo Posadas | 0.00 | 0.00 | 10.00 | 0.00 | 0.00 | 0.00 | 10.00 | 0.00 |
| 1998 | Grupo Sanfandila | 5.00 | 0.00 | 0.00 | 1.72 | 5.00 | 0.00 | 0.00 | 1.72 |
| 2004 | HipNal | 103.15 | 0.00 | 0.00 | 0.00 | 103.15 | 0.00 | 0.00 | 0.00 |
| 2000 | Hospital ABC | 19.71 | 0.00 | 0.00 | 6.79 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2000 | ITR | 9.00 | 0.00 | 0.00 | 2.33 | 9.00 | 0.00 | 0.00 | 2.33 |
| 2000 | Innopack | 0.00 | 15.00 | 0.00 | 0.00 | 0.00 | 15.00 | 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 | 51.23 | 0.00 | 20.00 | 104.03 | 49.94 | 0.00 | 20.00 | 104.03 |
| 1998 | Merida III | 26.55 | 0.00 | 0.00 | 59.48 | 26.55 | 0.00 | 0.00 | 59.48 |
| 2003 | Mexmal | 0.00 | 0.00 | 10.00 | 0.00 | 0.00 | 0.00 | 10.00 | 0.00 |
| 1995/99 | Mexplus Puertos | 0.00 | 1.41 | 0.00 | 0.00 | 0.00 | 1.41 | 0.00 | 0.00 |
| 1996/99/00/01 | NEMAK | 0.00 | 0.00 | 0.76 | 0.00 | 0.00 | 0.00 | 0.76 | 0.00 |
| 2003 | Occidental Mex | 28.95 | 0.00 | 0.00 | 38.60 | 28.95 | 0.00 | 0.00 | 38.60 |
| | Occihol | 0.00 | 9.99 | 0.00 | 0.00 | 0.00 | 9.99 | 0.00 | 0.00 |
| 2003 | POLOMEX S.A. | 6.00 | 0.00 | 0.00 | 0.00 | 6.00 | 0.00 | 0.00 | 0.00 |
| 2000 | Pan American | 0.00 | 4.34 | 0.00 | 0.00 | 0.00 | 4.34 | 0.00 | 0.00 |
| 2002 | Puertas Finas | 11.38 | 0.00 | 0.00 | 0.00 | 11.38 | 0.00 | 0.00 | 0.00 |
| 2002 | Qualita | 0.00 | 2.50 | 3.50 | 0.00 | 0.00 | 2.50 | 3.50 | 0.00 |
| 2000 | Rio Bravo | 46.12 | 0.00 | 0.00 | 52.33 | 46.12 | 0.00 | 0.00 | 52.33 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2004 | SSA Mexico | 45.00 | 0.00 | 0.00 | 0.00 | 45.00 | 0.00 | 0.00 | 0.00 |
| 2000 | Saltillo S.A. | 32.61 | 0.00 | 0.00 | 37.96 | 32.61 | 0.00 | 0.00 | 37.96 |
| 2000 | Servicios | 7.50 | 1.90 | 0.00 | 6.67 | 7.50 | 1.90 | 0.00 | 6.67 |
| 2001/04 | Su Casita | 16.24 | 0.00 | 0.00 | 0.00 | 16.24 | 0.00 | 0.00 | 0.00 |
| 1997 | TMA | 1.53 | 0.00 | 2.96 | 5.30 | 1.53 | 0.00 | 2.96 | 5.30 |
| 2003 | TMWC | 3.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2003 | Valle Hermoso | 52.00 | 0.00 | 20.00 | 107.09 | 46.63 | 0.00 | 18.09 | 96.84 |
| | ZN Mexico II | 0.00 | 10.00 | 0.00 | 0.00 | 0.00 | 6.30 | 0.00 | 0.00 |
| 1998 | ZN Mxc Eqty Fund | 0.00 | 13.87 | 0.00 | 0.00 | 0.00 | 13.87 | 0.00 | 0.00 |
| | Total portfilio: | 752.56 | 76.07 | 68.72 | 514.53 | 661.84 | 69.13 | 66.81 | 497.49 |

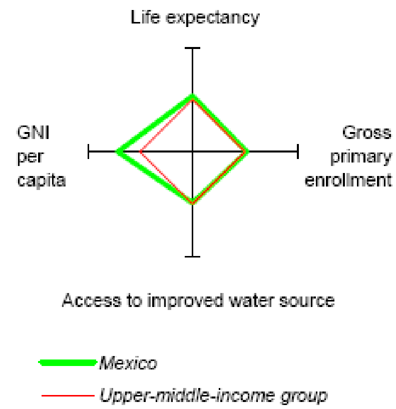
| | | Approvals Pending Commitment | | | |
|---|---|---|---|---|---|
| FY Approval | Company | Loan | Equity | Quasi | Partic. |
| 1998 | Cima Hermosillo | 0.01 | 0.00 | 0.00 | 0.00 |
| 2003 | Copamex | 0.00 | 0.00 | 0.00 | 0.00 |
| 2001 | Ecomex | 0.00 | 0.00 | 0.00 | 0.00 |
| 2000 | Educacion | 0.00 | 0.00 | 0.00 | 0.00 |
| 2001 | GFNorte-CL | 0.05 | 0.00 | 0.00 | 0.10 |
| 2005 | GMAC WHL | 0.10 | 0.00 | 0.00 | 0.12 |
| 2003 | Mexmal | 0.00 | 0.00 | 0.01 | 0.00 |
| 2003 | Polomex | 0.00 | 0.00 | 0.00 | 0.00 |
| | Total pending committment: | 0.16 | 0.00 | 0.01 | 0.22 |

## Annex 14: Country at a Glance

## MEXICO: Large-Scale Renewable Energy Development Project

| 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*

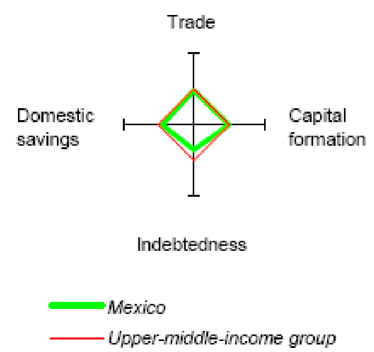



**KEY ECONOMIC RATIOS and LONG-TERM TRENDS**

| | 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 | .. |

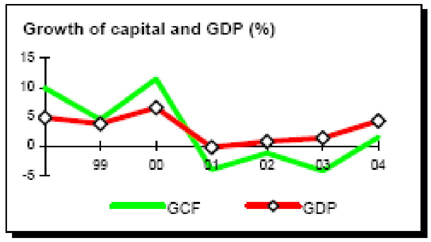
| | 1984-94 | 1994-04 | 2003 | 2004 | 2004-08 |
|---|---|---|---|---|---|
| *(average annual growth)* | | | | | |
| GDP | 2.7 | 3.3 | 1.4 | 4.4 | 3.0 |
| GDP per capita | 0.8 | 1.8 | -0.1 | 2.9 | 1.6 |
| Exports of goods and services | 6.0 | 9.6 | 2.7 | 11.5 | 4.1 |

Economic ratios*

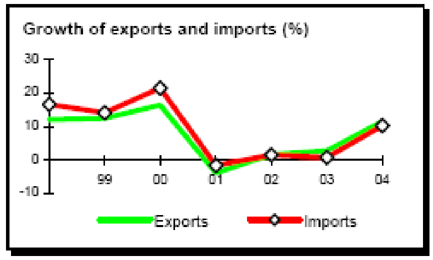


STRUCTURE of the ECONOMY

| (% of GDP) | 1984 | 1994 | 2003 | 2004 |
|---|---|---|---|---|
| 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 |



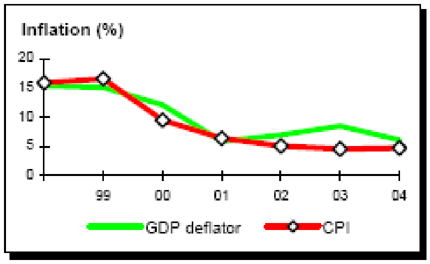

| (average annual growth) | 1984-94 | 1994-04 | 2003 | 2004 |
|---|---|---|---|---|
| Agriculture | 0.8 | 1.9 | 3.5 | 4.0 |
| Industry | 3.3 | 3.3 | -0.2 | 3.8 |
| Manufacturing | 3.5 | 3.6 | -1.3 | 3.8 |
| Services | 2.7 | 3.3 | 1.9 | 4.6 |
| Household final consumption expenditure | 3.6 | 3.7 | 2.3 | 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 |




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.

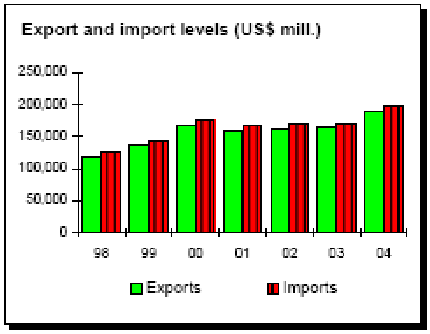
## PRICES and GOVERNMENT FINANCE

| | 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 |



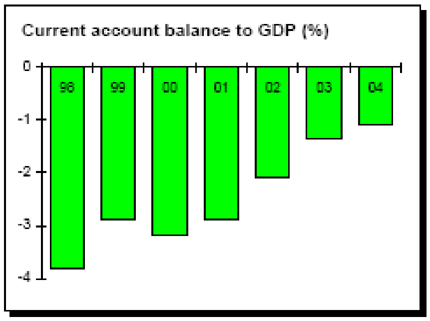

## TRADE

| | 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 |



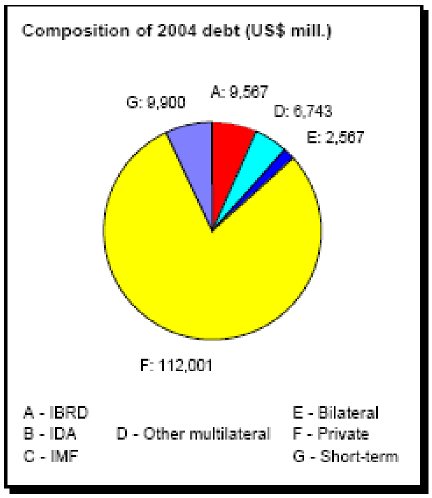

## BALANCE of PAYMENTS

| | 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 |




## 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 |




The World Bank Group: This table was prepared by country unit staff; figures may differ from other World Bank published data. 9/8/05

## Annex 15: Incremental Cost Analysis

## MEXICO: Large-Scale Renewable Energy Development Project

### Global Environmental Objective

This analysis of the incremental costs of adding 100 MW of wind to the Mexican interconnected system highlights the potential for fuel savings and greenhouse gas reduction. The proposed first phase of the GEF project would be commissioned in 2008, constructed at a cost of $123 million (in 2005$, per CFE estimate). GEF proposes to support the initial development of this energy source with tariff support subsidies to the wind energy producer of some $20.4 million over a period of five years. The goal of the GEF support is three-fold:

1. Support financially the development and installation of renewable energy in Mexico;
2. Assist in the creation of a larger market for local wind machine manufacturers and installers, thereby bringing down the investment cost of wind energy; and
3. Improve the ability of CFE and the dispatch agency, CENACE, to manage both intermittent and firm power sources in a manner that provides enhanced reliability to the wind energy producers through new system simulation and management software.

There are two important measures of merit for this analysis. The first is the incremental cost of the wind generation in the system. The second is the economic rate of return for the proposed wind generation plants, given the alternatives to those plants in the Mexican system.

### Broad Development Goals and Baseline

The energy sector is critically important in Mexico's development, accounting for more than one-third of total public revenues and over 50 percent of the total public sector investment budget. The state-owned monopolies, CFE and PEMEX, dominate the electricity and oil and gas sectors respectively. The energy sector faces major challenges:

- PEMEX is heavily taxed and thus serves as the government's "cash cow." Yet this drain on internal finances, coupled with very limited private sector participation, heavily constrains the oil and gas sector's investment requirements. The macroeconomic costs in terms of forgone oil export opportunities and natural gas imports are increasingly unaffordable.
- Limitations on public and private investment similarly plague the electricity sector. Although electricity services are today reasonably efficient, high supply costs relative to industrial competitors are impacting competitiveness. Concerns about the future loom: Some 40 percent of CFE's installed capacity is old and is due for replacement, and CFE has put out tenders to import LNG to fuel their power stations at increasingly higher costs. Foreign investment decisions in Mexico's industry already suffer to some degree from these concerns and problems.
- While Mexico enjoys some 95 percent electricity coverage, the benefits are distributed inequitably: The majority of the non-electrified population is indigenous and found in the poorest states. Providing energy for basic lighting, water pumping, food processing and telecommunications will require new public-private partnership arrangements to serve isolated areas.

- The energy sector is a leading source of air, water and ground contamination, and has major impacts on the severity of transport emissions due to fuel quality issues; the incidence of this pollution disproportionately affects the poor. As a developing country under the UN Framework Convention on Climate Change, Mexico is not subject to greenhouse gas emissions limitations under the Kyoto Protocol. However, as a member of OECD and NAFTA, Mexico may accept some form of emissions constraints under a future "son-of-Kyoto" regime.

Electric Power Sector

Mexico generated about 210 Terawatt hours (TWh) of electricity in 2004, 21 percent of which was geothermal and hydropower. About 73 percent of Mexico's installed power generation capacity of 51 GW is fossil-based, with oil-fired plants, including combustion turbines, responsible for the largest share of both capacity (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.

The sector is organized around two state enterprises, CFE and *Compañia Fuerza y Luz*, with 92 percent and 4 percent of generating capacity, respectively. PEMEX controls another 2 percent of generation capacity and the remaining 2 percent is in private hands. There are three distinct grid systems in the country. One system covers the northern end of the Baja peninsula, and the second covers the southern end of the Baja peninsula. The remaining national interconnected system (SEN) covers the rest of the country, with interconnections to the USA and to Belize and Guatemala.

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

**Table 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 | 52,027 | 51,735 | 54,336 | 56,264 | 56,876 | 58,729 | 59,856 | 61,185 | 64,717 | 67,598 | 70,241 |
| **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 | 236,427 | 247,595 | 259,310 | 271,455 | 284,238 | 297,693 | 314,107 | 330,765 | 346,454 | 362,967 | 380,348 |

Source: SENER *Prospectiva* 2005

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. More telling, no new BOT plants have been contracted since 1998.

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. [7]

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 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.[8] A look at the 2000 *Prospectiva* 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 changing fuel mix. Figure 1 below shows current fuel use in generation:

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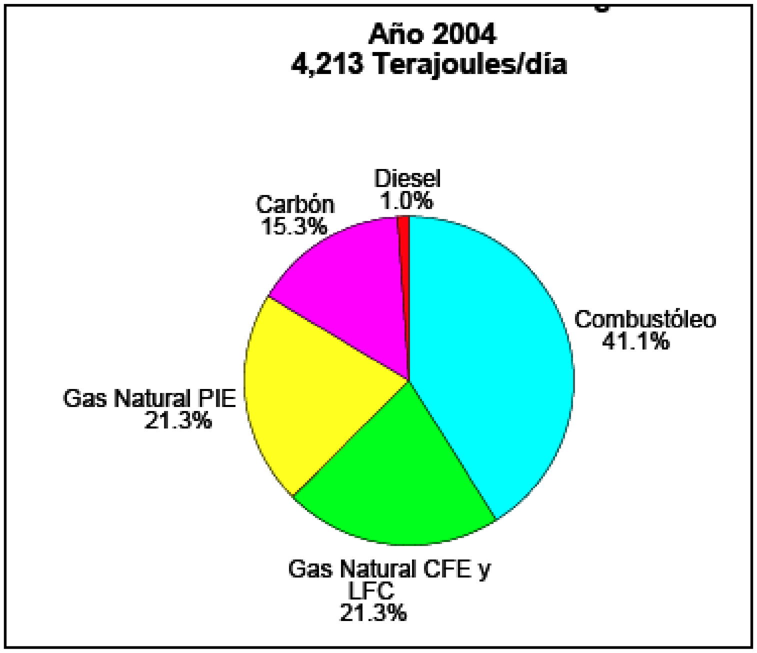
[7] The *Prospectiva* shows more than 5 GW of retirements during the period. However, without a more rapid rate of construction, some of these older plants are likely to be kept in service.

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

**Figure 1: Current Fuel Mix in Generation**




A considerable rearrangement of the fuel mix is expected by 2014, as shown in Figure 2:

**Figure 2: 2014 Fuel Mix in Generation**

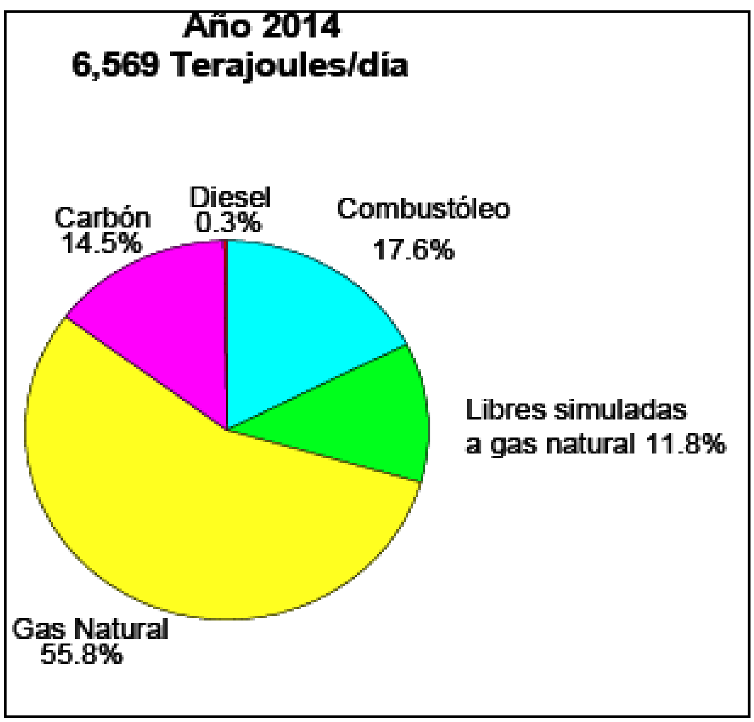


Table 2 below shows the changing fuel mix. The most significant aspect of this evolution is the doubling of natural gas use and the 50 percent increase in coal for generation.

| Table 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** |

At the present time, there are no firm plans to begin construction of new coal-fired capacity. The 33 percent fall in fuel oil use is certainly 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. With a declining reserve margin as a most likely case, the Government continues to encourage the construction of new power plant projects, most of them IPPs based on either new PEMEX gas output or imported natural gas. To meet projected demand for electricity and gas to fuel new generating capacity, the country is currently putting two LNG regasification complexes out for initial design work.[9]

The Mexican Constitution reserves power supply and distribution of over 20 MW as an exclusive right of the state. Since 1992, reformist elements in the government have attempted to chip away at this public monopoly through successive amendments to the Electricity Law to permit private participation through Independent Power Producers (IPPs) and self-supply schemes. Nevertheless, private power in various forms currently accounts for less than 30 percent of Mexican electricity generation.

It is clear that reform plans will have to address the underlying constitutional issues. In September, 2002, the Fox administration tabled before the Mexican Congress an electricity sector reform bill that would amend the Constitution.

The reform would create a wholesale electricity market and unbundle transmission and distribution. Leading private sector representatives have stated that this is the single most important reform in Mexico for growth. However, the reform plan has been stalled since its presentation, and the Fox administration has been unable to push the reforms through a divided Congress. Press stories report that some factions in Congress would agree to a significant reform plan if percentage limits were placed on the volume of foreign ownership allowed in the electricity sector. The issues remain controversial in the context of the current presidential election campaign.

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[9] Mexico has announced plans for five LNG terminals, three on the Pacific coast and two on the Gulf. Two of the terminals will be built very close to the U.S. border in order to facilitate the sale of natural gas to the U.S. (California). Large electric power complexes will be constructed near the re-gasification facilities.

Oil and Gas Sector

Oil and gas exploration, production and refining activities are in the hands of the state-owned PEMEX. The Government relies heavily on PEMEX for income, netting about $50 billion from the sector in 2004, about 40 percent of government revenues. Only modest progress has been made in liberalizing the country's hydrocarbons sector, and investment decisions for new exploration and production are largely in the hands of the Mexican Congress. Congress has not yet decided whether and to what extent to allow new participants in the country's hydrocarbons sector.

The reliance on the hydrocarbons sector to supply cash to the Government at the expense of reinvestment in new oil and gas reserves and production activity has resulted in a 30–40 percent reduction in the country's proven oil reserves over the past decade, to less than 30 billion barrels.[10] Natural gas reserves have also stagnated over the past decade, and stand at 26 trillion cubic feet (Tcf), about 22 years of production at current rates. Current gas production has proved inadequate for the needs of Mexico's industry and electricity generation sectors, and gas and imports from the U.S. now represent almost 10 percent of current demand and are expected to rise to 25 percent in the next decade. The Government of Mexico projects growing gas imports in the future, primarily through LNG regasification terminals on the Gulf and Pacific coasts of the country.

In the 1990s there was an effort to open up some segments of Mexico's gas industry. Private firms are permitted to supply services to PEMEX, the sole producer, and also may invest in transmission and distribution. The Fox administration's chief vehicle for liberalizing the non-associated gas sector is through "Multiple Service Contracts" (MSCs). Under the MSCs, PEMEX would hire companies under 10-20 year contracts to conduct exploration, field development and extraction of non-associated natural gas. Gas obtained in the process would remain the exclusive property of PEMEX. The first batch of some $8 billion worth of MSCs was put out to bid. Although a reasonable approach given Mexico's present legal and political constraints, some wings in Congress and some legal scholars have questioned the constitutionality of these arrangements. As domestic supply is inadequate, these incentives have proven insufficient to dramatically restructure the gas sector.

Oil and gas policy is emerging as a controversial element in the current election campaign. The expected peak production of Mexican oil, declining net exports of hydrocarbons, and relative inexperience of PEMEX crews in deepwater gas production have moved oil and gas issues to the top of the policy agenda.

Indeed, one of the current drivers of policy is the impact of the country's linkage with the US market and the consequent price impacts from hurricanes and other events. Until the past few years Mexico's abundant energy reserves were sufficient to provide self-sufficiency in all forms of energy, significant export earnings and relative isolation from world market events. The

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10 There is some controversy over the actual levels of oil reserves, with *The Oil and Gas Journa*l putting the January 2005 figure at just under 15 billion bbl., a significant drop from 2000. The U.S. Department of Energy places Mexico's December, 2002 reserves at 30.8 billion bbl., indicating that net reserve additions have been slight during the past five years. Mexico does not publish official reserve totals.

country is still a major exporter of oil, but those exports represented less than 20 percent (~$32 billion) of the country's total exports of $165 billion in 2004. Moreover, insufficient investment in gas production and refining/petrochemicals has meant that the country imports almost as much energy (by value) as it exports.[11]

Energy policy decisions in Mexico are the responsibility of the *Secretaria de Energia* (SENER), with executing authority in the hands of the *Comisión Federal de Electricidad* and *Compañía Fuerza y Luz del Centro* for electricity, and PEMEX for oil and gas. Regulatory authority in the energy sector is in the hands of CRE.

Energy Sector Production and Exploration Activities

Oil. Mexico produces about 3.8 million barrels/day, mostly from fields in and around the Campeche Bay in the Gulf of Mexico.[12] Reserves, which once stood above 40 billion barrels, are now rated at 15-18 billion bbl (end 2004). In the twelve months between January 2004 and January 2005, reserves fell by 2.3 billion bbl.[13] PEMEX, the national oil company, must produce virtually all of its output from existing reserves. Of the current production total, about 2.1 million bbl/day, or 55 percent of total output, is consumed domestically.

Exploration and production development activities must be authorized by the Mexican Congress. In recent years the Government has looked to PEMEX as a source of funds, not as a vessel for investment. Without substantial investments annually, the country cannot replace reserves lost due to production, pressure drops and field maintenance problems. A recent burst of upstream activity, resulting in an additional 150,000–250,000 bbl/day of output since 2000, has run its course and additional investment will be needed just to continue production at current levels. Current production is maintained increasingly by resort to enhanced recovery techniques, a useful stopgap until more reserves can be proven. However, the country is still far from a consensus on retaining PEMEX as the sole entity for oil production versus greater reliance on private and foreign companies in the oil sector.

The lack of investment extends to the refining segment of the industry as well. The government-owned refineries have capacity to meet about 75 percent of refined oil product demand, and about one third of gasoline demand, with the remainder met through imports. A major refining technology program is planned, pending Government funding. One of the country's major refineries, at Cadereyta, has already been fully upgraded to properly handle the country's heavy crude oil slate. The Government plans to increase refining capacity in coming years, but the funding for such projects is not yet assured.

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[11] According to the Oil and Gas Journal (Nov. 14, 2005, pp.21-24), Mexico's imports of energy and chemicals were just $1.7 billion less than exports of crude oil. About 55 percent of imports by value are comprised of petrochemicals.

[12] Total liquids production of 3.8 million barrels/day includes about 0.4 million barrels/day of condensates and gas liquids.

[13] The amount by which reserves fell is almost exactly the annual output volume of PEMEX, indicating no net reserve increases in 2001. In 2002 reserves fell further.

Gas. Mexico's current gas production of about 1.5 Tcf (43 Bcm)[14] in 2004 is an increase of more than 40 percent in the decade since 1991. However, production plateaued in 1998 and actually declined a bit between 1999 production of 1.29 Tcf (36.5 Bcm) and 2001 production of 1.25 Tcf (35.2 Bcm). This level of activity puts Mexico in the same output tier as Venezuela, Australia, and Argentina, among others. As with crude oil, PEMEX has the sole right to prospect for and produce gas.

Gas reserves currently stand at 15.0 Tcf, down from 17.27 Tcf in December 2000.[15] PEMEX's budget problems in gas exploration are virtually identical to the oil market situation. Simply put, gas reserves are being used up annually without significant replacement efforts. Unlike the oil sector, Mexico appears to making some real effort to bring additional resources into the upstream gas industry, particularly for non-associated gas reserves. In addition, the Government has permitted private firms to enter the transmission and distribution segments of the gas industry. These modest initiatives in the gas industry are not expected to yield dramatic short-term results and the country has seen a rapid rise in gas imports from the U.S., now running at more than 820 million $ft^3$/day, about 20 percent of total use in the country. Both the industry and power sectors are increasingly dependent on natural gas. By 2020 the IEA expects Mexico to increase gas use in the power sector five-fold, to 44 percent of all generation.[16] This level of gas demand for electricity would be equivalent to the entire current gas production of the country.

To meet this burgeoning demand for gas in the face of stagnant reserves and production, the country is planning to turn to liquefied natural gas (LNG) to provide additional supplies. CFE, the electricity company, has two LNG regasification plant under construction, with plans for four more, each of which will increase domestic supplies by 10 percent over current levels. Eventually, at least four of these plants will be built supplying at least 2 billion $ft^3$/day.

Coal. Coal currently provides almost 7 percent of electric power system capacity and about 15 percent of total generation. The plant capacity is located in the northeast portion of the country, which has some coal reserves. Current output of 11 million tons annually falls short of annual consumption, which now stands at 20 million tons. No new coal-fired power plants are currently shown as under development by CFE or private developers. However, the *Prospectiva* does show coal maintaining a 12–14 percent share of total generation through 2014. Generation from coal is shown to increase by just under 50 percent over the period 2004–2014, indicating that as much as 25 percent of the power plants shown as "other" in the CFE plan (>10 GW by 2014) are actually intended as coal units.

Other Energy Sources. The main source of renewable energy in Mexico today is hydroelectricity. Large hydro plants represent more than 25 percent of installed capacity and 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. CFE plans to halve its oil use by the end of this decade, using large hydro in the short term and natural gas in the medium term. New hydro and

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14 Equivalent to 4.51 billion $ft^3$/day.

15 As with oil, there is significant uncertainly about the true level of reserves. The *Oil and Gas Journal* puts the reserve level at 29 Tcf, while different divisions of the U.S. Department of Energy put gas reserves at 30.1 (*Energy Overview of Mexico*) and 15.0 Tcf (*Mexico Country Analysis Brief*).

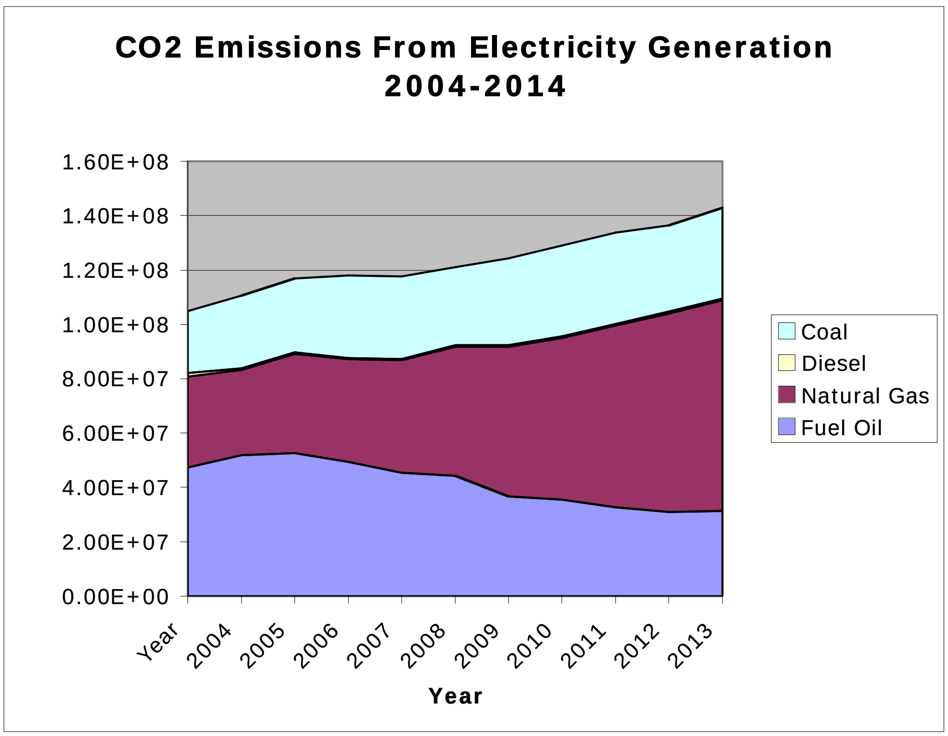
16 The *Prospectiva* shows gas-fired generation already at 55 percent of total output by 2014.

geothermal plants are under construction and these sources could contribute as much as 30 percent of electricity supplies in 2005–2007. After that time, CFE projects that 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.

GHG Emissions in Mexico's Power System

Current emissions of $CO_2$ in Mexico's electric power system amount to about 105 million tons/year (equivalent to 29 MT/yr of carbon). With the *Prospectiva* projections of 143 MT in 2014, the $CO_2$ intensity of Mexico's power system will decline by more than 30 percent by 2014, from 53 g/kWh in 2004 to 43 g/kWh in 2014. Figure 3 shows projected GHG emissions from the power sector for the SENER planning period.

**Figure 3: Total $CO_2$ Emissions by Source**




With the least efficient fuel oil and middle distillate plants retiring in the 2005-2010 period, replaced by gas-fired CCGT and hydro, the overall $CO_2$ emissions of Mexico's power sector actually falls in the first three years by about 7 percent. After that $CO_2$ emissions continue their increase. In 2001, about 60 percent of total $CO_2$ emissions were due to fuel oil use. By 2014, fuel oil responsibility for emissions will fall sharply, though natural gas will take up all of the differential and more, with gas accounting for more than 50 percent of total electricity sector GHG emissions in 2014. As the figures below show, the increase in GHG is well below the increase in generation. The increasing efficiency of the power generation system is due largely to two factors, the replacement of intermediate oil-steam facilities with gas-fired CCGTs and the increasing use of hydro to meet peak demand instead of combustion turbines. Figure 4 shows the changes in generation efficiency over an earlier SENER planning period. Figure 5 shows how $CO_2$ emissions have changed by fuel over the period of SENER and CFE planning.

**Figure 4: Efficiency Changes in Mexico's Power Sector**

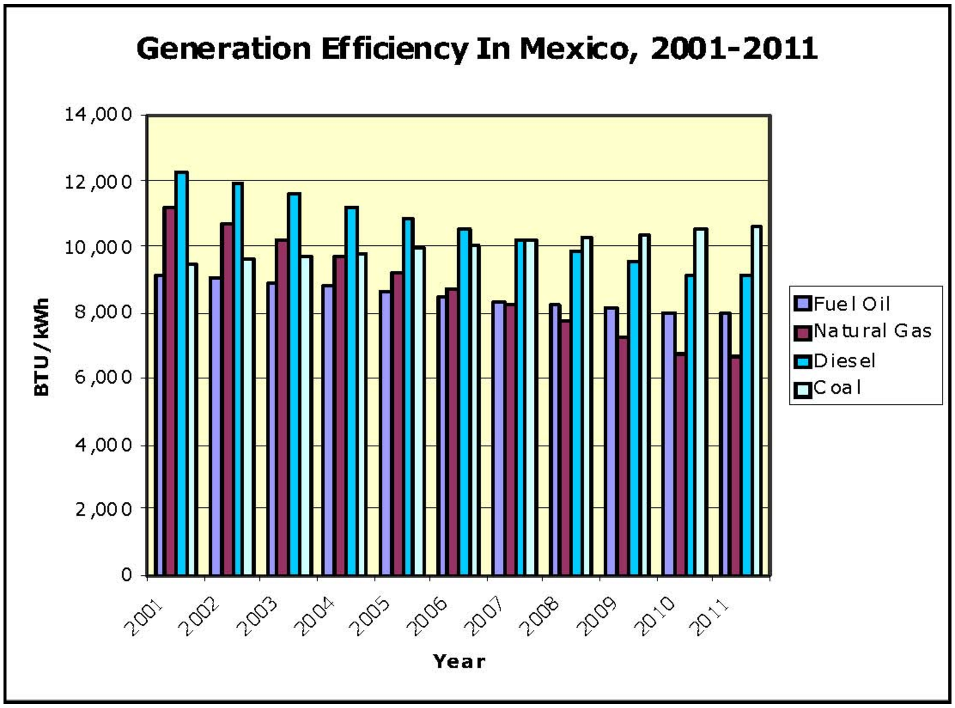
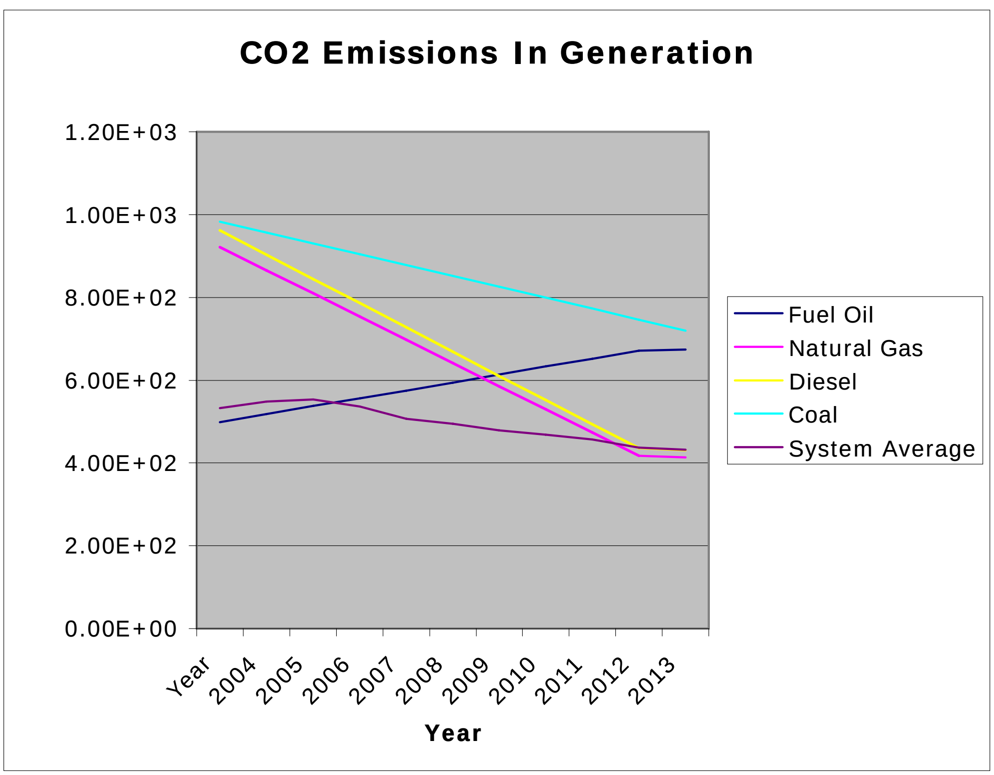



**Figure 5: $CO_2$ From Mexico's Power Sector: g per kWh**



**Impact of 100 MW of Wind Capacity on Power Generation in Mexico**

Basic cost and output data on the proposed investments in wind were analyzed using a simulation model of Mexico's power system. This model calculates the cost of meeting electricity energy and capacity demand under a wide variety of assumptions regarding Mexico's economy, oil sector, gas supply and power technology.

For the purposes of this project, the base case was taken as the SENER/CFE expansion plan, including demand forecasts, economic growth forecasts and technology expectations. The only change vis-à-vis the SENER *Prospectiva* is that this analysis covers a period of 20 years subsequent to the commissioning of the proposed wind investments, unlike the 10-year horizon of the SENER *Prospectiva*.

A wind investment resulting in an additional 100 MW of power generation capacity represents about 0.33 percent of proposed CFE additions over the period of the *Prospectiva*. Moreover, with the 40 percent plant factor, one that is lower than normal intermediate service plants, the proportion of system energy generated by the wind facility will be in the range of 0.3 percent of *additional* output, and less than 0.01 percent of *total* output during the period in question.

CFE Baseline

The Ministry of Energy in Mexico, through SENER and CFE, has plans to construct 50 MW of wind energy plants over the period of the current SENER plan (through 2014). The proposed CFE plant will be commissioned in 2006.[17] No other wind plants are envisioned through the end of the current SENER planning horizon. The output from that investment, about 175 GWh annually, will provide approximately 0.15 percent of additional output in the SEN through 2014. CFE, through its Renewable Energy Directorate, is conducting studies to assess the effects of wind energy on the CFE system and to find ways to enhance the value of that energy once it enters the national transmission system. These studies, now ongoing, are intended to provide a better understanding of the system and power plant management efforts that are required to give wind energy the ability to contribute some degree of firm capacity to the Mexican power system.

At the current state of understanding of these issues it is difficult to attribute firm power capacity to wind energy, given its predictable, though intermittent, nature. Thus the output from the planned CFE wind plant will be given an energy-only value, with a present value of $52.4 million for the period 2006 through 2026. Since the present value of project costs is approximately $66 million, the project is not expected to return net benefits to the owners of the plant, CFE, in the short run. Table 3 shows the economic analysis of the CFE wind energy baseline over a 20 year *economic* lifetime.

[17] This wind baseline describes the original plan for what is now La Venta II, currently under construction at 85 MW.

| Table 3: CFE Baseline Wind Energy Activities, 2005–2026 | | |
|---|---|---|
| **Item** | **Unit** | **Baseline Value** |
| Annual Generation | GWh | 149.8 |
| Levelized Economic Generation Cost | $/MWh | 61.38 |
| Value of Energy Displaced | $/MWh | 44.55 |
| Value of Capacity Displaced | $/MWh | 0.00 |
| Present Value of Project Costs | $M | 66.37 |
| Present Value of Project Benefits | $M | 52.39 |
| Internal Rate of Return | percent | 6.96 |
| $CO_2$ Displacement (MMT 2008-2014) | Tons | 1.2-1.5 |
| **Source**: SENER *Prospectiva* and CogenPro Simulation Model | | |

Impacts of the Model Wind Energy Plant

As a general rule, a single 101 MW power plant will not have a significant impact on a system the size of the CFE SEN. In planning terms, a plant can be considered a part of the least-cost plan if that plant can contribute capacity to the SEN. On its own, the proposed wind facility cannot contribute capacity to the SEN. Almost by definition, the plant generates electricity on a generally predictable, but not firm or dispatchable, basis. Without a firm power rating, CFE cannot delay the construction and commissioning of some other firm power facility due to the commissioning of this wind plant. Therefore, most of the economic impacts of the wind facility discussed below will come in terms of displaced energy.

The issue of the precise value to the SEN of wind energy is still open. However, there are three distinct types of values that can be placed on wind energy output. These are:

1. Wind energy is worth the system marginal energy cost (MEC) at any given time less the cost of providing spinning reserve for that capacity;
2. Wind energy is valued at exactly its energy replacement figure on the assumptions that (i) wind capacity is too small to affect the overall system output, and (ii) wind energy can be replaced almost immediately by some other generator if the wind speed falls; and
3. Wind energy is valued at its energy replacement value plus a capacity value that represents the ability to back up wind output to some, or possibly full, extent.

The current primary locale for wind energy development in Mexico is the Oaxaca province, one that is blessed with abundant and relatively predictable wind resources. Given the relatively high plant factor and good predictability of power generation, the first valuation option seems overly restrictive. Perhaps if wind were a significant proportion of total output in the Mexican system, if the Mexican wind resources were of a lower quality, and if there were little ability to quickly replace the wind output by some other generator, then this approach might have some validity.[18]

[18] If this approach were to be accepted, then the value of wind energy would be approximately 85 percent of the periodic Marginal Energy Cost. All measures of merit, NPV, and ERR would fall into the unacceptable range.

For the purposes of analyzing the value of output for incremental cost analysis, the base cases for wind energy value were the following:

- Wind energy valued at its periodic MEC for the times that the unit generates energy;
- Wind energy valued at the MEC plus 25 percent of capacity value for the times the unit generates energy;
- Wind energy valued at the MEC plus 50 percent of capacity value for the times that the unit generates energy.

The second and third cases, valuing wind at energy plus partial capacity value, will indicate the potential returns to the country if CFE and CENACE understanding and management of wind energy's interface with the SEN are improved over the next several years. A more pessimistic case, with the wind machines generating just 35 percent of the time instead of 41 percent is also presented to assess the robustness of the economic results for the proposed project.

<u>Methodology</u>

A simulation model ("CogenPro") was used to calculate the impacts of the proposed wind energy investments. This model is able to reproduce most of the simulation results of the WASP III or WASP IV models as they pertain to Mexico's system expansion. Although the model works at a lower level of resolution than does WASP III, it contains several additional features that are useful for the analysis of projects. The user inputs a variety of economic and technical parameters regarding the power system and the host country's economy, as well as important technical parameters on fuel prices, operational efficiency, GHG emissions, system operation and fuel supply. In addition, the model embeds a proposed power plant investment in the system simulation and then produces key economic and financial measures of merit for that plant under a variety of assumptions.

The table in the appendix to this annex describes briefly the operation of the key elements of the simulation model used in this analysis.

At the present time other analytical efforts were under way and the results of these activities will be used to further refine and validate the current analysis. In addition, there are current simulation efforts at CFE that seek to provide additional light on questions of the capacity value of wind energy and the economic/GHG reduction value of wind energy when operated in a large system with a variety of resources.

<u>Results to Be Reported</u>

The key outputs of interest concern the incremental costs and benefits of the proposed wind investments. Using the three general cases for establishing the value of the output, the following results will be reported below for each case:

- Generation cost of wind project
- System avoided generation cost, with specified levels of capacity value
- Economic rate of return
- Present value of benefits (as noted above)
- Net present value of project

- $CO_2$ displacement

In each case, the outputs will be provided for a base case and for three other cases — slow economic growth and power system investment, high economic growth and power system investment, and enhanced investments in LNG and coal-fired power plants on the base economic forecast — and two crude oil price forecasts will be used: SENER's current "*alto*" forecast based on Mexico crude at $46/bbl with controlled domestic prices as per the *Prospectiva* and a market forecast based on West Texas Intermediate (WTI) price of $60/bbl, with international pricing of gas and refined oil products.[19]

Discussion of Results

Generation Cost of Wind Project. The model wind project will entail a present value of investment and operation of approximately $133 million, the overwhelming proportion of which is the initial investment cost.[20] The generation cost from the proposed wind facility varies from $50.23–58.94/MWh, depending on assumptions regarding dispatch hours, and operational costs.

System Avoided Cost and Present Value of Benefits. An avoided cost is calculated for the prospective power generation system independently of any proposed investment contained in this analysis. That avoided cost represents the value of additional system investments and the marginal energy cost by season (dry or wet) and time of day (base, intermediate, or peak) for each combination of oil price, economic scenario and investment scenario. For the base case, that is, the SENER/CFE expansion plan and economic growth forecasts, the system avoided cost of new generation falls into the range of $50–54/MWh, for the SENER base and *alto* crude oil forecasts. This discussion will focus on the *alto* forecast and on the market pricing forecast cases. The benefits that are calculated for *each case* represent the value of the energy displaced during the proposed plant's hours of operation plus the value, if any, of capacity displacement attributed to the plant.[21] The energy figure depends largely on three elements: (i) hours of operation, including time of day, (ii) plants displaced, and (iii) fuel prices for displaced plants. This figure will differ from an average of CFE's avoided cost, since it weights the intermediate period, when most of the wind generation occurs more highly than the base-load periods, which figure significantly in CFE's avoided cost. For example, if the wind plant were to operate during a period in which the marginal plant on the system was a gas-fired CCGT (dry season), and a combination of CCGT and hydro (wet season), and assuming that the oil price was based on SENER's *alto* forecast, then the value of the energy displaced by the wind plant would be that marginal energy cost, or $45.61/MWh[22] during dry season, and $39.67/MWh during the wet season. The value of capacity during this intermediate period is about $14.24/MWh.[23] If the plant gets full attribution of capacity displacement value, then the value of benefits attributable to the wind plant is $59.86/MWh in the dry season and $53.91/MWh in the wet season.

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19 Cases using the market pricing of refined products with WTI at prices of $32.50, $45 and 65 per bbl. were also examined.

20 The PVC is calculated based on a project start date in 2006, with commissioning in 2008. If the project were to get under way immediately, then the PVC would rise to about $135 million.

21 Three cases were examined: (i) no capacity payment; (ii) 25 percent capacity payment; and (iii) 50 percent capacity payment. The economic benefits show a higher value for each MWh displaced by the wind than the average avoided energy cost for the system due in large measure to time of day considerations.

22 This figure includes both PEMEX gas and LNG imported at the Gulf of Mexico re-gasification stations.

23 This figure averages $16.25/MWh for the operational hours of the proposed wind plant.

The present value of benefits (PVB) is simply the value of displaced energy and capacity that can be attributed to the plant's output over the simulation period expressed in present value terms. For energy displacement only, the PVB is the value of fuel not burned and ranges from $104-144 million. A 50 percent attribution of capacity displacement value to the plant is worth about $30 million in present value terms, bringing the PVB to $135–174 million.

The base case for this analysis uses a partial capacity payment, representing 50 percent of the value of capacity in the system while the plant is operating. This figure is used with the idea that better management of overall CFE generation and system resources can permit a *predictable* energy source, such as the Oaxaca wind, to displace at least *some* firm capacity in the system some of the time. Throughout the economic life of the plant, this partial capacity payment would be worth approximately $30 million.[24]

<u>Economic Internal Rate of Return</u>. 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 attributable to the project. If no capacity benefit is attributable to the project. The EIRR results for this proposed project are generally negative unless both world and domestic oil prices rise to a level that represents a crude oil price of $55/bbl. If the project can displace some capacity (50 percent of its rated output in this case), then the EIRR results indicate that oil prices in the range of the *Prospectiva alto* forecast ($46/bbl) may allow the plant to just break even and generate some small returns for the society and investors.[25] If the wind facility can be operated in such a manner that the CFE can attribute partial capacity credit to the wind output, perhaps by some combination of wind and hydro twinning, then it is possible for the plant to show positive returns unless oil prices fall below $39.65/bbl. Break-even oil prices for two of the wind/hydro cases are shown below. For a plausible range of oil prices, $46-55/bbl, a twinned wind/hydro facility can generate economic returns ranging from 12.39-16.53 percent.[26] As Table 4 indicates, each 25 percentage points of capacity credit reduces the breakeven oil price by $5-6/bbl. Each percentage point of wind availability is worth about $1.05-1.12/bbl. in the oil price required to break even or 0.33-0.36 percentage points of EIRR.

**Table 4: Breakeven Oil Prices for Different Wind Capacity Credit Scenarios (USD/barrel)**

| Capacity Credit for Wind Project | 0 | 25 | 50 |
|---|---|---|---|
| 41 percent Wind Availability | $50.55 | $45.06 | $39.60 |
| 35 percent Wind Availability | $58.32 | $52.82 | $47.31 |

**Note**: All of these scenarios assume that world oil prices are reflected fully in the Mexican domestic oil products and natural gas markets.

24 It is expected that the outcome of the technical assistance component of the project will provide system management and valuation methods that can enable CFE to continue to provide a capacity payment to the wind plant.

25 A capacity attribution at or above 80 percent is required for the project to break even at oil prices of $32.50/bbl, assuming domestic refined product prices in Mexico consistent with that crude oil price.

26 The 16.53 percent EIRR is based on crude oil at $55/bbl in 2006 and world prices for refined products within Mexico. Internal price controls will reduce the EIRR for that case to 12.73 percent.

Net Present Value of Project. Based on the project's present value of costs of $131.4 million and the PVBs, which range from $120-174 million when some capacity is attributed to the wind plant and $104-144 million when no capacity credit is given, the NPV will be positive or negative as appropriate. In general, project returns are only positive when capacity displacement value attributable to the project is equal to or greater than 25 percent, or when oil prices are above $50/bbl. and domestic prices are not controlled.[27]

The Base Case results shown in Table 5 below correspond to the SENER/CFE reported expansion plan as contained in the *Prospectiva*. Decreasing the wind availability factor so that the plants operational factor falls to 35 percent will worsen results considerably. Those results are shown for the $46 and $55/bbl. + 50 percent capacity credit case in Table 5. The reduced hours cost the project $14-18 million in NPV and 2-2.5 percentage points in EIRR value.

**Table 5: Summary of Model Wind Project Key Economic Results**

| **Oil Prices: (1) Base (SENER/CFE) Case; (2) $55/bbl WTI & world prices inside Mexico** | **Project NPV (millions)** | **Project EIRR** | **Value of Output (per MWh)** | **Present Value of Benefits (millions)** |
|---|---|---|---|---|
| | **Energy Value Only** | | | |
| 46 | ($26.89) | 8.83 percent | $42.93 | $104.49 |
| 55 | $12.35 | 13.36 percent | $58.32 | $143.73 |
| **Partial (25 percent) Capacity + Energy Value** | | | | |
| 46 | ($11.71) | 10.66 percent | $48.85 | $119.67 |
| 55 | $27.53 | 14.97 percent | $64.47 | $158.91 |
| **Partial (50 percent) Capacity + Energy Value** | | | | |
| 46 | $3.47 | 12.39 percent | $54.71 | $134.85 |
| 55 | $42.71 | 16.53 percent | $70.63 | $174.09 |
| **Effects of Reduced Wind Availability** For the two rows below, the annual hours of operation correspond to a plant factor of 35 percent, along with the 50 percent capacity payment proportion rather than 41 percent as in the other results reported in this table. | | | | |
| *46* | *($14.43)* | *10.34 percent* | *$55.69* | *$116.40* |
| *55* | *$18.25* | *13.99 percent* | *$71.33* | *$149.08* |
| **NB**: the present value of costs is $131.38 million for the base wind plant dispatch case and $130.83 million for the reduced wind case. The $55/bbl scenario includes world prices for refined oil products within Mexico. | | | | |

[27] For the 35 percent wind availability case, the breakeven capacity payment is above 50 percent for the Mexican domestic pricing forecast case.

CO$_2$ Displacement. The project can displace as much as 247,000 tons of $CO_2$ annually under the current system configuration or 1.4 million tons over the SENER planning period. Table 6 shows the $CO_2$ reduction attributable to the wind project. If all of the output of the wind project can be attributed to fossil plants only, then the pattern of output of the wind project can reduce $CO_2$ emissions from Mexico's power system by 247,041 tons in the first year of full operation, 2008. That value drops over the SENER planning period as new power plants replace older, less efficient units (see Figures 3 and 4). If management of system resources does not permit CENACE and CFE to distinguish among fossil and other system resources, then the effective $CO_2$ displacement would be lower, starting at 184,368 tons in 2008, falling to 157,210 tons in 2014. The displaced $CO_2$ represents 0.16–0.19 percent of year 2008 expected $CO_2$ emissions from power generation. The figure falls to 0.11–0.13 percent by 2014. The actual displacement figure will probably depend on the ability of CENACE and CFE to upgrade their analysis and system management tools so that the maximum value is obtained from the output of the wind unit.

**Table 6: Emission Reductions due to Oaxaca Wind Plants: 2008-2014**

| Year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|
| **Average of All Plants** | | | | | | | |
| Oaxaca (CO2) | 184,368 | 179,839 | 174,313 | 170,440 | 166,058 | 159,258 | 157,210 |
| Oaxaca (Carbon) | 50,218 | 48,985 | 47,480 | 46,425 | 45,231 | 43,379 | 42,821 |
| **Fossil Plants Only** | | | | | | | |
| Oaxaca ($CO_2$) | 247,041 | 240,940 | 234,102 | 222,416 | 206,532 | 187,464 | 184,411 |
| Oaxaca (Carbon) | 67,653 | 67,653 | 67,267 | 65,607 | 63,744 | 60,561 | 56,237 |
| Source: Calculated from *Prospectiva*, Section 4.3.5. | | | | | | | |

Summary

The tables above indicate the nature of the incremental cost results for the model project:

- Project costs range from \$130–131 million for a 100 MW project and the incremental benefits represent at a minimum the value of displaced energy;
- The value that can be assigned to displaced energy will vary with the price of oil, and ranges from \$104-144 million over the life of the project;
- The other major measurable incremental benefit is capacity displacement, whose value is entirely dependent on whether other firm capacity can be attributed to a project of this nature;
- Improved CENACE system management and dispatch will permit CFE to pay a partial capacity credit to the project, approaching 50 percent of the capacity value in effect when the plant is generating; this fractional capacity is worth about \$6-12.50 per MWh, with a present value ranging from \$15-30 million over the life of the project;[28]

[28] The actual value of the plant's capacity displacement, if any, will depend critically on management of the power system, and coordination of the wind facility with its backup plant. In general, it is only feasible for an intermittent energy resource to claim capacity displacement if it can be operated in tandem with another, firm, power source, or with management of overall system resources acting as the "firming" power source for the wind energy plant.

- Technical assistance is required to improve the tools available to CFE and CENACE to undertake the types of activities necessary to better manage both intermittent and firm system resources, thereby adding value to both.

The net result of this scenario would be positive returns for a 50 percent capacity credit at oil prices above $39.60/bbl.

On the downside, an inability on the part of the project developers or CFE to effectively twin the project with a firm capacity supplier would make it difficult or impossible for the project to contribute net value (net, i.e., not including the economic benefit of the GEF grant) to Mexico unless domestic oil prices are permitted to move to world levels.

Both the positive and negative possibilities should be further investigated to assess the operational, institutional and financial implications of effective capacity provision by an intermittent energy resource. In some countries projects of this sort can provide effective capacity by operating within the same firm as a firm capacity supplier so that the obligation to provide firm capacity is with the generation company. In other systems an independent generator can purchase reserves on the market, making possible the "conversion" of intermittent energy to firm capacity for the customers of that intermittent supplier.

**Technical Assistance**

The technical assistance component of this project is intended to improve the ability of the Mexican electricity institutions CFE and CENACE to manage the value of their system resources. Of particular interest is the issue of how much a predictable energy resource, such as wind, can displace firm system resources such as hydro or combustion turbines. Right now, many people in the energy community believe that the predictability of good wind resources, such as those in Oaxaca, should permit an overall reduction in capacity needed to meet peak and shoulder demands. However, the fact is that we do not now know whether and to what extent this supposition is true.

To obtain the answers to these questions, and to satisfy the entirely proper concerns of a utility with a service reliability obligation, it is necessary to use techniques and tools that can combine the least cost planning and system expansion work now done by CFE, with some of the dispatch simulations performed by CENACE. The proposed technical assistance for this project will bring enhanced such simulation tools to CENACE and CFE.

If there are good data on wind, and if the generation of wind can be projected with some reasonable probability, then a multi-year dispatch model should be able to come up with the expected backup requirements for wind generation units over the course of a year. If the need for backup to wind can be known with some degree of certainty (or probability), then CFE can compute the fractional capacity contribution of the wind resource. In more concrete terms, this means that if wind can replace hydro during shoulder and peak periods with, say, 80 percent certainty, as verified in multi-year resource studies, then the water thus saved can be used as (i) backup for the wind when that resource fails, or (ii) as a replacement for combustion turbines at peak with the water saved from intermediate periods. In general, such energy resources will not need to be employed to meet less critical demands.

Other technical assistance activities are intended to reduce the costs of future wind energy development by providing a larger internal market in Mexico. This market development activity will consist of both market expansion and business advisory services.

## Incremental Costs

Table 5 below, the Incremental Cost Matrix, shows the comparison of the CFE Baseline with the GEF proposed project.

**Table 5: Incremental Cost Matrix**

| | **Baseline** | **GEF Alternative** | **Increment** |
|---|---|---|---|
| **Domestic Benefits** | Produces 360 GWh of annual electricity output through in-place and planned fossil-hydro electricity system. CFE continues to work on assessments of value of wind energy & system management with existing tools and methods. | Produces 360 GWh of annual output, 0.5 percent of additional CFE output over *Prospectiva* period (2004-2014). GEF pays equivalent of about 25 percent of the value of capacity during the period of GEF project Phase I. GEF supports technical assistance for CFE, CENACE, IIE and others to introduce new system management software. Implementation of this software should permit better management of wind and other system resources, adding value to the wind output. | Improvements in system management techniques and valuation of intermittent energy resources. Improvements in energy valuation and dispatch management of all new energy sources for electricity system. Provision of a larger domestic market for wind machines, inducing greater domestic supply and installation and reducing future investment costs for wind. |
| **Global Environmental Benefits** | 1.2-1.5 M tons of $CO_2$ for 2008-2014. | | 1.2–1.5 M tons of $CO_2$ for 2008-2014. |
| **Costs by Component (US$M)**<br>Present Value of Costs: | | | |
| (Investment + O&M) | 111.0 | 131.4 | 20.4 |
| (Technical Assistance) | 0.8 | 4.7 | 3.9 |
| (Project Management) | 0.0 | 0.7 | 0.7 |
| **Total Costs (US$M)** | 111.8 | 136.8 | 25.0 |
| **GEF Incremental Costs (US$M)** | | | **25.00** |

**Process of Agreement**

The CFE Generation Planning Division (*Programación*) in collaboration with CENACE has performed a "with/without wind" analysis of the impact of wind for the determination of incremental costs using CFE's current system planning and dispatch models. Estimations were also made based on modeling performed in the "CogenPro" model described herein which was originally developed for the analysis of grid-connected cogeneration projects, but is adaptable to other generation forms. The CogenPro results were reviewed and discussed with SENER and CFE Senior Management, leading to the agreement on the incremental cost adopted for project appraisal.

# APPENDIX 1: DESCRIPTION OF THE COGENPRO SIMULATION MODELING SYSTEM

| Module | Description | Analytical Output |
|---|---|---|
| **System Expansion** | Future expansion of the power system can be simulated in two ways: (i) a least cost expansion plan is generated consisted with a given (or generated) demand forecast, fuel prices, operational parameters, or (ii) a least cost expansion plan is adapted from the host country and used as a basis for further analysis and discussion. | Plant capacity by type and year of commissioning, investment costs, plant output, variable and fuel costs, average and marginal costs of output, plant retirements |
| **Dispatch** | The existing, new and retiring plants in the system are dispatched on the basis of economic merit for each daily time period and season. Changes in the least cost plan will be reflected in dispatch results as will changes in fuel prices. This module also contains a subroutine for specifying economic and system operation conditions to produce different scenarios for comparison with a base case. | Plant dispatch merit order, MEC by time period, season and year, MEC by plant type, various weighted average MECs and energy generation values. In addition, this module produces a summary by scenario of different operating and economic conditions. |
| **Investment** | A proposed power plant investment can be included in the LCP and dispatch models. The user can specify very detailed assumptions regarding the operational, financial and economic characteristics of the proposed plant. This power plant will than be subject to economic dispatch as appropriate and a variety of economic and financial measures of merit will be produced. Comparisons of PPAs and pool payment schemes can be made. | All of the usual economic and financial measure of merit are produced, including 7 different rate of return calculations, present values of all cost and revenue streams, fuel values (netbacks), returns for different payment schemes (PPA, pool, partial capacity, etc.) |
| **Fuel Prices** | A simulation of oil and refined product markets, including interaction with LNG, pipeline gas, and alternative hydrocarbon fuels, provides the fuel prices for the various power plants in the system. The model works from a specified forecast of a marker crude oil price, or a forecast can be produced by the model, with full stochastic variation of key price factors. This module is liked to a gas production module for pipeline gas supply and to a gas processing module for LNG and LPG supply or export comparison. | Annual prices of crude oil and major refined products (naphtha, mogas, diesel, jet, kerosene, IFO, HFO, LNG, pipeline gas, methanol, LPG), prices in all common units (T, bbl, mmbtu) |
| **Gas Production and Supply** | This module calculates the cost of gas supply (if appropriate) by pipeline, provides comparisons of export v. domestic supply options and pricing options for different pipeline and supply modes. | Gas supply investments, pipeline investment and tariffs, returns to upstream investors, alternative investment and legal regimes. |
| **Gas Processing** | This module simulates the construction and operation of a gas processing complex, with options to produce LNG, LPGs, methanol and ammonia. It is used if LNG is a significant consideration for fuel supply for the power system and can be used on its own to evaluate investments in gas processing for export. | All of the normal economic and financial results are produced, along with alternative fiscal regimes for the government's take from proposed gas system investments. Upstream and gas transportation are internal, or the user can specify an interface with the external gas supply model. |

Operation of the model uses a combination of spreadsheet (Excel), Visual Basic program routines, and optimization programs to calculate results. User-definable parameters exceed 1,000 and data needs are consistent with a simulation model of this scope.

## Annex 16: Policies to Stimulate the Market for Renewable Electricity: International Experience and Lessons Learned

## MEXICO: Large-Scale Renewable Energy Development Project

Internationally, two main strategic approaches have been developed to stimulate renewable energy:

- incentives, mainly financial, that stimulate investment in renewables; and, more recently;
- mandated market policies to create a market demand for renewable electricity.

Supporting activities such as research and development, demonstration, standards, 'commercialization' and outreach are also commonly used to help encourage investment. Increasingly, incentive mechanisms and elements of mandated markets are being used as mutually reinforcing tools, and tailored to suit specific country circumstances, abilities, and objectives.

### Financial incentives

Initial efforts to stimulate renewable energy development often included capital cost subsidies to support research and development and technology demonstrations, followed by more targeted incentives as the scale of installations has increased and the technologies have come down in prices. The range of tools has included capital cost subsidies, tax incentives (accelerated depreciation, investment tax credits, reduced VAT or sales taxes); subsidized interest rates for investment financing, and cost-shared demonstration programs and technology research and development. Tariff-based incentives have been used to directly incentivize renewables and/or as part of competitive tenders for tariff support. More recently, Green Pricing mechanisms have emerged in response to consumer desires and increasingly to Kyoto-based opportunities to utilize the carbon avoidance of RE technologies; some of these include tradable certificate mechanisms to facilitate allocation in the marketplace.

Where financial incentives have been used, they have usually been funded from government revenues (or revenues forgone). Such incentives must be carefully designed if they are to be well-targeted, cost-effective and not distort investment decisions. Predicting the total costs of a financial incentive and how much renewable energy capacity will result is difficult. In order to stimulate and maintain a stable renewable energy industry, financial incentives need to be provided in a stable manner, or the industry may collapse or the stop-start impacts may prevent learning and price reductions. Perhaps most importantly, financial incentives need to be accompanied by a clear set of policies, available tariffs, and capacity development to facilitate sustainable mainstreaming of renewable technologies into the state's/region's portfolio.

Up-front capital cost subsidies are generally not considered to be effective: while perhaps necessary in early stages of technology development, and get over the initial high up-front costs of renewable energy, it is not based on power production, so the incentive can be distorting (i.e. projects are built for the 'wrong' reasons; reduced incentive for cost reduction and long-term maintenance and operation.

Accelerated depreciation, while a potentially useful tool to signal government policy intentions and stimulate investment, can have a similar effect if used on an extreme basis (such as the installation credits used earlier in California). Like feed-in laws, this approach can make it difficult to estimate how much capacity will result, and the costs are similarly hard to predict. On a more restrained basis it can be effective tool, and can be tied to other incentive programs to reduce the impact on treasury revenues.

**Mandated Markets**

Mandated markets may be adopted to address several barriers: first, the lack of any incentive to take electricity from renewable generators (particularly in a reformed and therefore competitive market); second, a natural preference for utilities to develop their own resources; and third (especially for large utilities) the buyers' negotiating power being much greater than that of the renewable energy project sponsor.

Two broad categories of mandated markets attempt to reconcile these barriers, and include:

- **Price-defined Targets** to set a defined price at which renewable electricity must be purchased. In the U.S., an early example of this was the 1978 US Public Utility Policies Regulatory Act (PURPA) under which utilities had an obligation to connect and to pay the avoided cost. In Germany, Spain and France, 'Feed-In Laws' have been used to set a specific price for favored technologies. If the price offered is attractive, such approaches can stimulate investment, but utilities may prove resistant and mainstreaming renewable energy into utility operations may remain incomplete. The actual amount of renewable power procured cannot be predicted accurately; too low an offer price will result in a low level of installation, and too high a level will result in over subscription and higher than anticipated costs. More importantly, this approach provides limited incentives to reduce costs, making continuation of the program an ongoing political and financial commitment.

**Electricity Feed-In Laws**

Focused on increasing installed capacity of renewable energy, feed laws (such as in Germany and Spain) provide a premium price for electricity from renewable sources (usually stated as a percentage of average prices). There is generally no cap on the amount of electricity qualifying, and there may or may not be a specification of the technology eligible to receive payment. One benefit of feed law approaches are that they are relatively easy to initiate and are continuous (if funding is available). Sponsors know the price they'll receive and thus have less market risk. This approach can also foster decentralized markets if that is an objective, but unless specified to include only large projects, may not achieve desired economies of scale.

The main drawback of feed laws is that there is an indeterminate effect on total supply, and consequently on total cost; if costs are higher than expected, the scheme may also be difficult to sustain politically. Further, feed laws do little to exert downward competitive pressure on prices over time. While cost caps may be imposed to manage overall program costs, this works against the higher level of installed capacity that is sought. As found in Germany, feed laws were found to create disproportionate impacts on utilities with different renewable energy resources in their geographical region. A high producer surplus resulting from high feed law prices in German, Denmark, and Spain also resulted in high land-lease prices as land owners saw an opportunity; effectively reducing the share of the tariff support available to the project sponsors.

While feed-laws do tend to achieve rapid market development (which may offer learning curve benefits in terms of cumulative capacity) too rapid development may mean that learning effects (technological as well as procedural and institutional) aren't captured as part of a continuum of projects, and higher percentage of capacity is installed before cost reductions impact the market. A very rapid rate of growth in renewable energy development may mean that the capacity value available in wind may be under-recognized if the rate of installation goes above the required rate of capacity requirements recognized in expansion planning. Thus, as an instrument of industrial policy to pursue technology expertise and market share, feed laws may suit country objectives, but are not the most cost-effective approach.

- **Quantity-defined.** These approaches set the quantity of renewable electricity to be purchased by the entity – either by placing an obligation on a set of utilities, or through a tender for capacity. Two broad categories include:
- **Renewable Portfolio Standard (RPS)**. In an RPS, electricity suppliers are required to show that a certain amount of their electricity (kWh or kW) was generated from renewable energy sources. Least cost acquisition to meet required targets is typically left to market mechanisms, with utilities either producing their own power, procuring it directly, or by engaging in purchase 'Green Certificates' representing qualifying renewable energy power produced by another supplier. Such a certificate approach can facilitate cost-effective transactions across utilities or regions with differing abilities and renewable energy resource
- **Systems benefit charge (SBC).** In an SBC, utilities, the regulator or government call for competitive bids from private developers to build capacity up to a pre-defined level, normally stated in terms of installed capacity. Developers providing the least-cost bid or bids receive funds to make up the difference between their bid cost and the market price of electricity. Costs are generally paid from a pool of funds generated from a surcharge on consumer tariffs.

An early example of SBC approaches is the UK's Non-Fossil Fuel Obligation (NFFO). The California Energy Commission has been using a version of this approach, and is now attempting to expand it to include a Renewable Portfolio Standard.

**Renewable Energy Portfolio Standards**

Patterned after the SO2 credit trading program from the 1990 U.S. Clean Air Act, and RPS uses sales of Renewable Energy Credits as a mechanism by which revenues are transferred from traditional generators to the least cost renewable energy generators to assure their entry into the system and maintain their viability. By closing the gap between renewable energy generation costs and market prices – technologies become more competitive.

Typically has a set rate or target date by which targets must be met, and is underscored with penalties for non-compliance. Various program offer buy-out options for utilities unable to procure qualifying capacity, set higher than the expected marginal cost yet somewhat lower than the penalty – in this way funds are still generated for the supervising entity to procure the renewable energy/clean power.

An advantage is that it doesn't require centralized distribution of funds and is compatible with transition to retail electricity markets and lends itself to green markets expected to develop. A potential downside of this is that the impact on consumers – and potential backlash – may not be known until later on.

**Mandated Markets:** In employing a mandated market share approach, policy can specify either the price that must be paid for renewable electricity or the quantity of renewable electricity that must be bought; it cannot do both. In general, particularly when contrasting price-defined approaches (such as feed laws) and RPS approaches, this is true. Both feed laws (with a set price but an indeterminate subscription rate and costs) and RPS approaches (with set targets but indeterminate costs) can encounter higher than expected costs that could threaten their long-term political sustainability.

This either-or situation may be ameliorated to some degree by the NFFO/CEC type of approach. Unlike an RPS based on a percentage of renewable energy targeted within the overall portfolio, the NFFO approach was quantity-specific only in individual tenders. The CEC mechanism is not quantity based except in the amount of funding available in the incentive pool for each auction. In both cases the programmatic intent was to reallocate funds from a pool of consumer surcharge funds. Neither approach specifies price, but both introduce competitive pressure to minimize price. The quantity requested in a tender can be specified incrementally and revised upwards if necessary and if funds are available. The amount paid per kWh can be capped to protect the program and fit the program within available resources. Both the penetration level attained and the price paid per unit may remain indeterminate, but can be estimated with reasonable accuracy and tested in the market. Total program expenditures can be defined - given a known level of resources, a known level of willingness by the utility to provide a tariff representing at least some of the value to the system (in terms of not only energy but also capacity, diversification value, and environmental benefits), and an expected level of price points offered by project sponsors in response to a tender, a competitive tariff support scheme can maximize the quantity available at any given set of financial resources. Thus, while the risk remains that the cost per unit and total renewable energy generation purchased remains undefined until tenders are evaluated, the overall program approach can be open-ended. In terms of addressing the Mexican context (where a de facto single utility approach makes an RPS less suitable), the NFFO/CEC approach appears most practical.

**Example #1 – the U.K. Non-Fossil Fuel Obligation:**
The NFFO was a guaranteed market enablement mechanism that introduced an obligation on the regional power companies in England and Wales to purchase a certain percentage of their electricity from non-fossil fuels. The policy arose as a consequence of utility privatization and the need to subsidize nuclear resources that couldn't be sold; renewable energy was not the initial target. The program provided for a premium payment for non-fossil power derived from a surcharge on utility bills across the consumer base, and its objective was to use a series of competitive tenders within defined technology categories (or 'bands') to get a steady convergence between price paid for renewable energy under successive NFFO orders and the market price that was needed.

Projects awarded contracts to generate at its contracted capacity for up to 15 years (8 years in the first two tenders). In NFFO-2 – a 'strike-price' rather than bid price was used – i.e. all suppliers were paid the bid prices for the most expensive contracted project in each band. Thus, some suppliers got more than they bid; some suppliers intentionally underbid knowing they would get the strike price. Any generation in excess of agreed capacity was sold outside the NFFO agreement.

**NFFO Benefits:** The largest benefit from NFFO was a dramatics decrease in supply prices, especially for wind, where the average bid price fell by 31 percent between 3rd and 4th tenders, making it close to conventional costs. The decline was for a variety of reasons, including longer contracts allowing investment to be written off over longer period, technology improvements (in part due to rapid experience gains in Europe under feed laws), and a decline in the cost of finance. However, various sources attribute much of this cost reduction to development activity in Europe in response to feed law support, and critics say that the NFFO merely squeezed profitability in the U.K. The Irish AER (Alternative Energy Requirement) is outwardly similar to the British NFFO, with five tenders launched since 1994. One result of the AER is prices among the lowest in Europe, with projects over 3 MW get up to 4.812 eurocents per kWh and local/community projects (below 3 MW - 10 percent of contracts) get up to 5.97 eurocents.

**NFFO Problems:** Rapid development pace resulted in some poorly conceived projects; as a result, procedures for 3$^{rd}$ tranche changed to give contracts for 15 years rather than 8. The period tender approach created project clusters with relatively heavy activity interspersed with inactivity, creating a stop-start situation that was difficult for sponsors to manage effectively. Administrative costs were high, in part due to peaks of activity. Even with awards and purchase contracts, delays due to planning restrictions or local opposition hindered many projects.

A significant criticism of the NFFO approach is a high number of bid winners unable to come to closure - out of 3,271 MW of awarded contracts in the NFFO, only 821 MW have been installed

– success rate of 25 percent. The lack of penalties for non-performance and lengthy development periods remitted resulted in speculative pressures as bidders anticipated future technology cost reductions that they would benefit from if they delayed.

**NFFO Lessons:**

- A large pool of developers can be unlocked if institutional and financial barriers are relieved.
- Flexibility of legislation to permit procedural changes to account for unforeseen consequences can be very useful.
- Gas prices were an ongoing obstacle, both in that by remaining low over a long period, they made it difficult to justify higher cost renewables in the long run, and by continuing to inhibit cost reduction that would follow from increased penetration of renewable energy.

**Example #2 - The California Approach:**

The California Energy Commission (CEC) is currently operating a renewable energy incentive program based on competitive tenders for electricity production-based tariff support. As a function of deregulation of the California utilities in 1996, the California Legislature created enabling legislation that underlies the current program. Assembly Bill 1890 provided the initial guidance for de-regulation, while establishing policy over 4 years to maintain and protect existing in-state renewable energy capacity through the restructuring process [1/]; it provided support for new renewable energy capacity development, and created incentives to stimulate further penetration of emerging renewable energy technologies. The bill required the CEC to submit a report to the Legislature outlining allocation and distribution recommendations. This report resulted in Senate Bill 90, which gave the State authority to administer funds totaling approximately $540 million collected from a small consumer surcharge collected through investor owned utilities. Other sources of funds included voluntary contributions from customers and municipalities.

**Key features of the CEC program:**

The CEC program includes distinct accounts for 4 categories - New Generation, Existing Generation, Emerging Technologies, and Consumer Applications.

| | |
|---|---|
| New Renewables | 50 percent |
| Existing Renewables | 20 percent |
| Emerging Renewables | 15 percent capital cost buy down, small scale |
| Customer Credit Fund | 10 percent |
| Consumer Education | 5 percent |

Information here is based primarily on the New Generation support activities, which has spent a total of $241 million over three auctions ($161 million in Auction #1, $40 million for both the second and third auctions). The New Technologies Account has tendered $162 million in

1/ California has nearly 6,600 MW of utility and independently owned RE resources across solid-fuel biomass, geothermal, wind, small hydro (size 30 MW or less), solar, landfill gas, digester gas, and municipal solid waste. Producing 26,000 GWh in 1994, or 12 percent of California consumption, continued operation of these resources was considered critical.

support in 3 auctions over 4 years and 3 auctions, based on following approach: Reverse auction - per kilowatt-hour incentive for power production incentive.

- Bids based on cents per-kilowatt hour request, cents bid (no finer than 1/100th of a cent in constant, nominal cents per kWh, paid monthly, over at most 5 year period).
- Bids ranked in order of lowest incentive required to highest until available funds are depleted or all bids have been accepted.
- Cap of 1.5 cents per kWh as an upper limit on bids.
- No project can receive more than 25 percent of total funds available.
- Minimum on-line date - projects on line before target date eligible for 10 percent bonus on top of original commitment (in no case can total incentive with bonus be more than 1.5 cents).
- 10 percent reduction basis for a range of incremental delays. By one year after target, award is reduced 50 percent; beyond that, to zero.
- New projects only; at least 80 percent of fair market value of project is from new equipment and output not sunder under previous contracts.
- Projects with fossil-fuel component not considered to be on-line as a renewable energy generator until they meet requirement of no more than 25 percent of fossil in operations.
- Project must be located in California.

The CEC elected to let technologies compete within a common pool, and unlike the NFFO program, did not 'band' technologies to differentiate among different costs and operating characteristics.

Note that producers are generally also eligible for an approximately 1.7 cent Federal Production Credit for renewable energy, bringing the potential for incentive to over 3 cents.

Estimated generation in bids is a key data input; it is hard to hard to define precisely, but important to determine level and allocation of incentive funding. Overestimation would tie up funds unnecessarily; underestimation would lead to insufficient funds in the program. Thus:

- Under-estimation of generation is discouraged by limiting incentive payments to no more than the generation proposed - i.e., extra generation will not receive incentive payment.
- Over-estimates are discouraged through reasonableness checks – if actual generation averages less than 85 percent of estimated generation over the first 3 years, cents/kWh reduced by 25 percent for remaining 2 years of payments.
- To avoid front-loading of payments, incentive payments in each of first three years limited to 25 percent of project's total award fund.

**Well Defined Timeline:**

#1 - Preparation and adoption of a project award package

While winners are notified, they are not assured of payment until a Project Award Package is completed. This document designates bid status as a winner, documents understanding of permitting and regulatory requirements, and listing and schedule of applicable milestones for construction and operation, and expected schedule for payments. CEC must be notified in advance of any post-bid changes relevant to the project, the bid, or amount of incentives, paid. (i.e., the ownership of the project could change, the size could increase, but additional generation would not be paid for).

| | |
|---|---|
| #2 - Project Applications Filed For | 6 months |
| #3 - Project Approvals Obtained | 15 months |
| #4 - Project Construction Started | 18 months |
| #5 - Project Construction Progress Check | 24 months |
| #6 - Project Completed and On Line | 36 months |

**Forfeitable bid bonds** are required (to ensure that bids are serious) as 10 percent of expected total incentive payments. These are not used to ensure construction or operation and are returned to sponsors after passing milestones 1 and 2 above.

**Project late in coming on line** forfeit payments beyond 5 years of expected on-line date - i.e. if it is a year late coming on line (but the CEC has permitted it to continue) it will be eligible then for only 4 years of payments. This protects the program against undue 'mortgages' of available funds, and incentivizes performance.

**Cancellation of previous funding awards** done only through irrevocable surrender of previous award, and cannot be conditional upon winning new award (in other words, if slow to perform on initial reward, can't reprogram with new funds and thus stall/keep commitment alive. Circumstances for canceling/reducing and award include:

- Material change in project
- Sponsor fails to satisfy terms, timing
- Commission loses contact
- False/leading info
- Project not making progress
- Funding not available

Observers have noted the need for flexibility to respond to changing landscape, which in California included both the need to support existing facilities that were 'orphaned' by industry restructuring, and by the overall power crisis in California – which also threatened existing projects while making it very difficult for CEC auction winners unable to reach closure on IPP contracts. Some stakeholders have suggested that there should be a limit on the amount of funding any single company (as opposed to project) can receive in auction. The drawback is that complexity of corporate structures makes this hard to determine; in addition, the CEC's view is that their aim of attracting the most cost-effective projects means that if a single company with multiple project is a successful bidder, then that is itself a measure of cost-effectiveness

**Current Status:** The CEC program is currently in flux with RPS legislation and the CEC program extension being passed at the same time. As SB 1078 (the RPS bill) is written, the CEC has authority only to set up a tracking and verification process, certify eligible renewables, and help the CPUC set the market price for energy to be used as a benchmark in utility solicitations for renewables. It currently appears that the utilities will actually conduct their own solicitations in response to their RPS targets under the aegis of the CPUC. The utility will not pay the bid price, but a 'market price' set by the Public Utilities Commission. Funding from the CEC program (i.e. the surcharge-supported fund) will then be used as "supplemental energy payments" to cover the difference between what new renewable projects bid into the utility solicitations and the benchmark set by the CPUC and CEC.

The challenge in this emerging system will be in determining the benchmark or market price that the utility must pay; the higher this is the more resistance there will be by the utilities; a lower benchmark will increase the costs incurred by the public use fund and at the extreme could exhaust this fund without reaching the RPS target. The provision in the RPS legislation that it should be evaluated on their 'least-cost best fit' remains ambiguous, as the real-world characteristics include level of production, firmness, impact on the transmission system, diversification and environmental values, etc.

### Strategic Choices for Mexico:

**Program Choices:** While perhaps a viable option for development of early technologies, direct subsidies are generally not an effective way of garnering cost reductions and learning already developed and internalized in the market and would be considered outmoded for today's renewable energy markets. Similarly, given the modest level of renewable energy experience in Mexico, and the de facto single utility that significantly limits options for trading and cost minimization across multiple utilities, a quantity-defined approach also has limited prospects in the current Mexican environment.

### CEC approach and Mexico circumstances

In terms of developing and operating a renewable energy incentive program, the key differences between California and Mexico are the level of renewable energy experience, the political environment, and the funding source for the proposed Mexico program. A key similarity that should be considered is the need for an incentive program to be linked to a clearly available IPP contract at specified conditions of price, capacity payment, and other supply requirements - the CEC reverse auction system has been successful, but nevertheless hindered by lack of contracts due to the poor financial condition of the sector. This experience with CEC incentive program has, in large part, stimulated political closure on an RPS. While an RPS is not currently a recommended approach for Mexico, this larger set of issues should be kept in mind for the long term and for the long-term sustainability of renewable energy project and markets in Mexico.

## Annex 17: Information about Some Key Issues Related to Wind Energy Project Development in Mexico: Land Leasing, and the Potential for Job Creation

## MEXICO: Large-Scale Renewable Energy Development Project

Summary of a Draft Report (Full report available in the project files)

January 29, 2003
*Prepared by:*
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Global Energy Concepts
American Wind Energy Association

*Prepared for*
USAID/Mexico
and
Government of the State of Oaxaca
Secretariat of Industrial and Commercial Development (SEDIC)

**Summary:**

Modern electricity-generating wind turbines are becoming a familiar site in windy regions of many countries, due to dramatic increases in wind energy development. Wind electric turbines vary widely in size and applications, from small machines with rotor diameters less than one meter wide that produce only enough electricity to light a few bulbs and charge batteries, to structures with a span bigger than that of a Boeing 747 passenger airplane that generate enough electricity for hundreds of homes. "Wind farms," or arrays of multiple large wind turbines installed in one location, can generate electricity that can be distributed by a utility to homes, businesses, municipalities, and other users on the grid. Wind farms can range in size from a few megawatts to hundreds of megawatts in capacity. Wind farms are "modular," which means they consist of small individual modules (the turbines). Projects can be expanded and turbines can be added as electricity demand or the ability to develop new facilities grows. Many countries have areas with strong winds and have excellent potential for wind farm development.

With conventional fossil fuel plants, owners or developers of projects are rarely involved in prospecting, developing, securing, or transporting the fuel supplies for their power plants, as the fuel is generally purchased and delivered by a third party. In the case of a wind farm, however, the project developer effectively secures "fuel supply" by securing the wind rights to a particular piece of land with favorable wind resources. Often land suitable for wind farms is owned by rural landowners or held by a communal entity. This requires negotiation between the wind developer and landowner(s) on various issues having to do with wind development, not the least of which are what and how the developer will pay the landowner(s) for the use of the land.

There are many reasons why rural landowners may be interested in leasing their land to wind farm developers:

- ***Income Diversification*** – Wind energy is a new kind of “crop” that is “harvested” under different weather conditions than agricultural crops. Year in and year out, on windy days the wind turbines generate electricity, whether the fields below them are fallow or in production.
- ***Increased Income*** – Leasing the wind rights on windy land to a wind farm developer can provide valuable additional income. At the same time, most of the leased land remains available for farming or ranching around the turbines.
- ***Economic Development for the Local Community*** – Wind energy development can bring a boost to the local economy, including through the creation of skilled jobs either manufacturing turbines or building and operating wind farms.
- ***Cleaner Air and Water*** – Wind energy is one of the cleanest energy options available today. It does not pollute the air and water, nor produce waste that must be stored or disposed of. Wind power can be used on a large scale for years to come, without damaging the health of local residents or affecting future generations.

The Isthmus of Tehuantepec in Oaxaca, Mexico, has been identified as having a high potential for wind farm development. As in other parts of Mexico, much of the land in the Isthmus is either owned by poor rural communities and held by communal entities known as *ejidos*, or owned by communities under other traditional communal ownership structures. Developing wind farms in the Isthmus thus faces a major challenge: project developers will often need to negotiate with entire communities or large groups of landowners to approve wind farm development, rather than negotiate directly with a single landowner.

One notable impediment to wind power development is that many of the local community leaders and members lack important information to negotiate effectively with project developers. Specifically, community leaders and members often do not know how landowners elsewhere are compensated and what are prevailing rates. In other cases landowners may not have a clear understanding about how much of their land would be used for wind turbine installation, or how compatible certain types of ranching or farming operations such as sugar cane cultivation are with wind farm development on the same lands.. In addition, the local communities are interested in a realistic assessment of the prospects for some community members to work on wind farms. Given the above, community leaders and members feel they are at a distinct disadvantage when negotiating with wind project developers.

In response to community leaders’ and members’ concerns about the lack of information, the State Government of Oaxaca, through the Secretariat of Industrial and Commercial Development (SEDIC), requested USAID/Mexico support to conduct a study that would provide *ejidos* and other communities in the Isthmus of Tehuantepec region with objective information on the types of agreements and contracts typically used in the U.S. and elsewhere between wind power project developers and landowners. Information requested included the typical magnitude of payments, structure of agreements, and means of verifying actual generation or power sales revenues. While several *ejido* representatives have explained their need for information and advice, several wind farm developers have also expressed strong support for this activity because they think that an objective approach to this issue will be much more effective than information a wind project developer could provide (given perceptions of bias).

The report addresses frequently asked questions from owners of windy land, and the types of agreements and contracts between developers and landowners typically used in the U.S. and two Latin American countries. Specifically, the report presents typical contractual arrangements, payment structures, verification methods, and advantages and disadvantages of different approaches. The report also examines the land lease process for wind energy projects, land uses compatible with wind farms, and potential job creation from the introduction of wind farms.

**Wind Resource Requirements for Wind Farms**

Wind resources are extremely site specific and, because there is a cubic relationship between wind speed and the power in the wind, small differences in wind speed result in significant differences in the power output from a wind project. As a result, securing the rights to the wind on the appropriate land is a crucial part of developing a successful wind project.

Not every site with relatively strong winds is adequate for wind farm development. For example, a site where the wind is strong from time to time may not be suitable for project development, as wind turbines do not operate efficiently in turbulent, swirling gusts of wind. Turbines operate best in steady winds of an average speed of at least six meters per second (m/s) (21 kilometers per hour, km/h).

**Environmental and Noise Concerns**

Although wind power is generally an environmentally benign technology, an environmental impact assessment (EIA) is often required before installing wind turbines, even on private land. This will help determine whether wind turbines at a specific location pose any environmental concerns, whether during the construction phase or during operation. Environmental assessments can help clarify any concerns members of the community may harbor, for example about potential noise or impacts on wildlife (two concerns that are often voiced). An EIA will confirm that today's large wind turbines are very quiet (at a distance of 180 meters or more, a wind turbine is no noisier than a kitchen refrigerator) and can determine whether any local bird species might be at risk from the turbines (this is often not the case). Lighting on the turbines is reportedly a nighttime nuisance for some local residents in the U.S. (lighting is required in the U.S. by the Federal Aviation Administrations for towers above a certain height, typically 60 meters). Some contracts specify the amount and manner of lighting that will be installed to prevent such a problem. Whatever the requirements, many developers place wind turbines at least 150-300 meters from houses and 45-75 meters from non-participating landowner property lines to ensure maximum safety and minimize the chances of a noise problem.

**Developer-Landowner Agreements**

The paper outlines three key issues regarding contractual agreements:

- the principal differences between leasing and purchasing agreements.
- a comparison of the main options for land leasing mechanisms
- an analysis of the prices typically paid, according to the different mechanisms used.

The full paper reviews these issues in detail and provides ranges of lease revenues from other established wind markets.

**Wind Energy Job Creation and Local Employment Opportunities**

As in most business ventures, wind energy projects create jobs. In general, the employment opportunities associated with a wind power project are in manufacturing, construction, and operation and maintenance. Compared to conventional generation options, wind development creates more jobs per dollar invested and per kWh generated. A study conducted by the New York State Energy Office found that 10 million kWh of electricity produced by wind energy generates 27 percent more jobs in the state than the same amount of energy produced by a coal plant and 66 percent more jobs than a natural gas combined-cycle power plant.

**Manufacturing**

Wind power projects employ a number of manufactured components, including towers, wind turbines (including blades, generators, gearboxes, controls), electrical control equipment, cables, and others. Generators for large wind turbines are currently manufactured in Mexico, and certain components such as towers and electrical cabling could be sourced in Mexico. Transmission line and telecommunication towers have long been manufactured in Mexico, and wind turbine tower manufacturing has begun in northern Mexico (Monterrey). There is certainly a possibility of wind turbine tower manufacturing being initiated in Oaxaca if the wind power project development grows sufficiently in the Isthmus. It is estimated that a wind turbine tower manufacturing facility producing one hundred 65 to 75-meter towers annually would create employment for one hundred factory workers, roughly one job per tower per year.[1] Locally produced materials (e.g. cement) would likely be used in construction.

However, it is likely that in the early stages of wind power development in Oaxaca, there would not be significant local manufacturing-related employment, and employment would mainly arise from construction and operations and maintenance (see below). In the longer run, if wind power development in the state expands significantly, and if one or more of the industry members decides to establish a manufacturing base in Oaxaca, local manufacturing and related employment could increase.

**Construction**

Construction-related employment for a wind project usually involves short-term assignments during the construction phase of the development process. Construction time for a large wind project is generally a year or less, depending on the size of the project and other factors. In the U.S., for a 50-MW wind project, the equivalent of 40 full-time jobs may be created during the construction period. In Mexico, more jobs may be created, depending on different labor requirements for construction activities, such as excavation and road grading, and assuming that the general contractor for the work hires local labor. Typical personnel requirements include construction management, electricians, heavy equipment operators, security personnel, and

[1] This estimate of employment in tower manufacturing in Mexico is based on discussions by Winrock staff with tower manufacturing firms. Wind turbine generators have been produced in Mexico by Fuerza Eolica for many years; many of these generators have been exported to the US and installed in projects there.

general laborers for assembly and civil works. The numbers of these positions that are filled by local personnel depend on the skill base of the local population, and the contracting company location and policies.

**Operation and Maintenance (O&M)**

The number of people employed by a wind power project during commercial operation depends on the number of turbines and the administrative structure of the project. For instance, a 10 MW project composed of ten 1 MW turbines will require less maintenance than a 10 MW project composed of 100 kW wind turbines. Although some of the maintenance activities on the larger wind turbines may require more time or different equipment (for example, more sophisticated) to complete the repair, many maintenance activities require the same level of effort regardless of the turbine size.

An analysis of the staffing levels for the projects in the Turbine Verification Program (TVP) project mentioned earlier is shown in Figure 4, indicating the full-time personnel-to-turbine ratio. The data suggests that each turbine requires approximately 11 employees. Considering that the majority of the turbines in this project are between 500 kW and 750 kW, the analysis suggests that in this project, between 5.5 and 8.3 jobs are created for every MW of installed capacity.

Staffing levels were also reviewed for a number of other projects and the data confirm the analysis above. Specifically, for six large projects (between 25 and 100 MW) with turbines of 750 kW or greater, approximately one job was created for every 5-8 MW of installed wind capacity.

For wind projects in developing countries, the staffing levels are generally much higher due to varying labor practices and lower labor rates. In India, for example, 10-15 people may be employed to maintain a project of only a few turbines. For the one developing country project for which data was available, the staffing level was approximately 1 job for 2.5 MW of installed capacity (or 1 job for every 4.5 turbines). In Mexico, staffing levels would likely be slightly higher than those in the U.S.

Although a wind project operates automatically, operators may be employed to monitor the plant and address any system alarms. Operators may also function as maintenance dispatchers and record keepers. Their skills include computer literacy, inventory management, job and equipment scheduling, performance record keeping, statistical trend analysis and data processing. Requirements for these employees depend upon the sophistication and capabilities of the central control and monitoring systems and the size of the project. Some operation centers are located far from the wind project site. Smaller projects may employ only a limited staff that is responsible for both operation and maintenance. Depending upon the ownership structure and proximity of the sites, maintenance crews and operations people can be used for several projects.

The construction and operation of a wind project results in the purchase of local goods and services such as construction materials and equipment, maintenance tools and supplies and maintenance equipment, and manpower essentials such as food, clothing, safety equipment, and other articles. Support services such as accounting, banking, legal assistance also are required.

The Kern County Wind Energy Association estimates that approximately $11 million is paid annually to local businesses for goods and services as a result of wind energy projects in Tehachapi.[2]

## Skills Training

Larger wind projects can optimize the mix of skills in their maintenance crews. It is desirable to have staff personnel trained in mechanical and electrical/electronic areas. Comprehensive training programs are available from most turbine manufacturers. Although the exact specifications will vary, a typical O&M training program consists of several weeks of training at the manufacturer's facility, with emphasis on wind turbine theory and familiarity with the equipment. Classroom work, practical work on the assembly lines with the mechanical equipment and control panels, and experience in the field on installed turbines is generally combined with quality assurance and safety training during this period. After completing a manufacturer's training course, personnel can be present during equipment installation to gain additional familiarity with the wind turbines. It is not necessary for all maintenance personnel to receive such comprehensive training. On-the-job training of additional personnel is common provided the experienced technicians are available to share their knowledge. It is important to have multiple qualified technicians available on a project so that the maintenance expertise is not lost if a single person changes positions.

Wind project maintenance personnel are often referred to as windsmiths. Most windsmiths have basic mechanical or electrical skills or experience. For the majority of the maintenance activities, the work is accomplished by climbing the tower and working within the confines of the nacelle. This type of physical activity requires agility and strength, similar to the skills of a utility lineman, combined with greater familiarity with mechanical systems and rotating machinery. As a result of the physical demands, in the U.S. there is often significant turnover in maintenance technicians.

As wind projects become more widespread, training programs are becoming more institutionalized. Some of the larger developers have instituted in-house training programs for new personnel. Several community colleges in the U.S. have also begun wind project operations and maintenance training courses. In Tehachapi, a local vocational school offers an adult learning class in wind project operations and maintenance. This program takes several months to complete. Annex E contains a sample course outline from this program. In some cases, however, programs have been discontinued due to funding limitations.

## Conclusions:

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[2] Tehachapi, California is one of the three main wind development areas in the State of California. The first wind turbines in the area were installed in the mid-1980s; however, new wind farms and "re-powered" projects continue to be installed today. (Re-powering refers to the replacement of older, smaller wind turbines with newer, larger models). Wind development in Tehachapi includes approximately 500 MW of wind capacity and more than 3000 wind turbines, ranging in size from approximately 100 kW to more than 1 MW. Tehachapi is also the location of the company headquarters and/or the central operations and maintenance facilities for several developers.

The Isthmus of Tehuantepec in the State of Oaxaca has been identified as an area with a high potential for wind power generation. This is one of the sites with greatest wind power potential in the world. However, it is important to consider one of the key factors to be able to build wind farms in the area: the small landowners — mostly *ejido* owners — who should be included as an integral part in the development of wind farms.

Due to the important role of these landowners, it is important to provide information and advice for them to develop mutually beneficial contracts with project developers. These contracts must ensure fair payments and mechanisms that will promote economic benefits for the area. Lack of information is therefore an impediment for the successful negotiation between communities and developers.

This report attempts to integrate key information for landowners to help them learn about how land lease contracts are executed in other countries, in addition to the employment benefits that might derive from wind farm construction. The study looks at information from 23 wind farm contracts, mostly located in the U.S., and other wind power industry documents.

The study found that there are several wind farm land lease **types of contracts**. Particularly:

- The most common type of contract (13 out of 23) is the payment of royalties with a percent of gross revenue, or a percent over billing. This scheme has several important advantages, such as providing an incentive to both developer and landowner to ensure maximum wind farm productivity, as well as to represent an easy to verify mechanism when basing royalties on a percent of gross revenue, or a percent of total billing.

- To prevent the landowner from ending up with payments lower than expected due to aspects out of the landowner's control (e.g., technical failure in the turbines), the royalty scheme is often supplemented with a guaranteed minimum payment.

- Another widely used payment scheme is the payment of a fixed or flat fee (7 out of 23). This figure is determined either by hectare or by installed MW. However, most of the cases using a flat fee were smaller wind power projects (for example, 2-5 turbines), which represent demonstration or trial projects. In other words, flat fee agreements are not common in the market.

- There are several elements for land lease contracts, and landowners must go over them in great detail to ensure that there are no misunderstandings during the project's life. One of these elements, for example, might be the activities that can conducted simultaneously on the land around the turbines, which is often compatible with its previous use (for example, ranching and/or farming).

- In cases where the land has multiple owners, developers typically take one of two approaches. On one hand they base payments on the power generated by specific turbines located on the individual plots of land. On the other hand, they may base payments on the average output of all of the turbines in the project, multiplied by the number of turbines located on each plot of land. The second option is easier to verify and document, and carries the least risk for the landowner.

Regarding specific **payment sizes** for turbine installation, the study determined the following:

- The range of payments found under the royalty scheme for the U.S. is between one and four percent of gross revenue, with the majority between two and three percent. For Latin American contracts, this percent was between two and three percent.

- Considering royalty and flat-fee payments, the analysis suggests an average payment of $2,200 per MW, which represents a range of US $1,200 to US $3,800 per MW. The average rate equals a flat-fee payment of approximately $3,300 per 1.5 MW wind turbine per year.

- With regards to lease payments tied to a specific percentage of gross revenues, projects in the Tehuantepec region may produce higher revenues per hectare—and higher payments to landowners—than is typical because of the potential increased density of the turbines (compared to other projects in different terrain and a different resource make up), as well as due to the superior wind power resource. However, higher array losses may also reduce the energy output from a wind project in this region.

- According to the information reviewed for this report, land requirements for a wind power project can range from 7.7 ha/MW to 76.8 ha/MW. Approximate payments per hectare[3] range between approximately US $320 and $450.

- According to a financial analysis prepared for the study, energy price and capacity factor have a major impact on the profitability of wind power projects. Land lease payments also have an impact on project profitability, but this impact is more modest than that of energy price or capacity factor.

The payments mentioned above, however, have to be taken into account within the **context** in which they are being made. Particularly:

- In the United States there are various incentives to foster wind power energy generation. For example, a national production tax credit is available in the U.S. for wind energy projects. Some U.S. states also mandate “renewable portfolio standards” (RPS) which require that a certain percentage of the electricity generated come from wind or other renewable resources. In other countries where the wind power sector is developing rapidly, similar incentives exist.

- In Mexico these incentives do not exist. However, the Mexican government has created a very favorable opportunity for the development of wind farms through a favorable scheme — the self-generation or self-supply scheme, which allows a large power consumer to buy directly from a third party, other than CFE. It is thought that self-supply projects will be the

[3] Assuming a 2 percent lease payment, 40 percent capacity factor, and energy price of $.035-$.05/kWh.

ones to initially foster the development of wind farms in Mexico, even though CFE projects will also play an important role.

The study also looked at data regarding possible **employment** generation from building, operating and maintaining the wind farms. Particularly:

- In the early stages of wind power development in Oaxaca, employment related to tower and turbine manufacturing will likely be minimal. However, there is certainly a possibility of wind turbine tower manufacturing being initiated in Oaxaca if the wind power project development grows sufficiently in the Isthmus.

- Job generation during wind farm construction might be significant and could reach up to 80 full-time jobs for every 50 MW wind farm. These jobs, however, are temporary in nature and last only throughout the construction stage, which generally lasts a little under a year.

- The longer lasting wind farm-related jobs are operation and maintenance positions, and the analysis indicates that one job is generated for every five to eight MW of installed capacity. Therefore, a 50 MW wind farm would generate between six and ten permanent O&M positions.

The information contained in the report must be considered within its own context, as the development of the projects reviewed depended greatly on the incentives available for power generation with renewable energies and these incentives do not exist in Mexico. It is also important to acknowledge that Mexico has conditions that in turn would foster and hinder the development of wind farms. For instance, wind conditions in the Isthmus of Tehuantepec are among the best in the world. The wind generally blows in a single direction, has a considerable and consistent force, and the land is mostly flat terrain. These factors suggest a great potential for power generation at very competitive prices. On the other hand, there are constraints for the development of wind farms in the Isthmus, such as the unavailability of transmission and distribution lines to evacuate the energy that might be generated in the Isthmus and the industrial capacity derived from a reduction of power generation costs.

In spite of the complexity in the development of wind farms in the Isthmus of Tehuantepec, one thing is clear: landowners are key to the development of this industry. This study has attempted to provide useful information to landowners for them to be aware of the various elements that might come into play when negotiating a contract with wind power project developers.

The integration of landowners and their active participation in the development of wind farms in the Isthmus of Tehuantepec, will make it possible to install the first large-scale projects in Mexico, thus setting a cornerstone to begin using renewable energies for the benefit of future generations.

## Annex 18: STAP Roster Review

## MEXICO: Large-Scale Renewable Energy Development Project

## STAP Review

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*This is generally a technically sound and innovative project with good potential for enhancing the commercial competitiveness and stimulating the renewable electricity sector in Mexico. Its approach, providing assistance with policy and regulatory measures and in designing and funding financial mechanisms, is potentially very effective. The project also has a good potential for replicability in other regions of the world. A numbers of issues that require more detailed consideration and that may be important for the success of the project are discussed in the following detailed review.*

### Scientific and technical soundness of the project

*Has the most effective and appropriate approach been used to remove the barriers?*

The approach is generally sound. The measures suggested appear appropriate and potentially effective. The approach of stimulating renewable energy uptake through the introduction of financial mechanisms while providing assistance in addressing key policy and regulatory issues appears most appropriate and applicable to many countries, Mexico in particular. Although an indication of the measures to be developed is provided, the actual appropriateness and effectiveness of the project will depend on how the financial mechanism is designed and how the policy and regulatory barriers are tackled in parallel. This may require a clearer plan.

Response: Upon GEF Council's approval and during the final project appraisal stage the project components will be finalized in consultation with the Government of Mexico. Basic agreements have been reached describing the specific tasks to be undertaken by different entities during project preparation. Some of these key activities include: development of standard bidding and contractual forms for renewable energy projects, establishment of agreed methodologies for least-cost calculations, detailed operations manual for BANOBRAS, development of a framework for identifying, assessing, and managing potential environmental impacts related to the program and sub-projects, establishment of technical standards for interconnection and assessment of networks to accommodate renewable energy systems.

The 'strategic choices' which are being pursued by the GoM are considered to be valid (IPP project contracted to CFE and integrated with the grid, tariff support mixed with other financial mechanisms, implementation of National Fund for promotion of renewable energies). However, these strategic choices will only be effective if complemented by a number of other actions aimed at removing technical and institutional barriers.

The current policy and regulatory framework in Mexico for the promotion of renewable energy is weak. Technical assistance will be key in resolving electricity pricing and third party access issues. While a lot of emphasis has been placed on the issue of least-cost pricing, a number of other issues require careful consideration, such as technical standards and commercial regulations for grid interconnection, upgrading of transmission and distribution networks for integration of renewable energy projects into the grid, and opportunity awareness of relevant stakeholders.

Response: We agree. In fact, specific technical assistance components and funding --ear-marked for CENACE/CFE and IIE--will be directly addressing these issues (see table of components and financing, section C.1, item: Systems Operations 2.5 million).

There is also a need to design systems that keep transaction costs low while promoting renewable energy project proposals that are financially and environmentally sound and that have a good chance for successful implementation.

Tariff support has the advantage of providing a good degree of comfort to renewable energy investments, but its design is crucial to the success of the scheme. In some cases tariff support schemes may lead to little competitive pressure and lower than expected cost reductions over time. This aspect should be considered in designing the scheme. Since tariffs provide no obligation on the introduction of renewable energy, there may be no strong incentive to remove barriers to renewable energy penetration. Their removal is crucial to the success of the project and strong technical assistance efforts need to be aimed at addressing them. Also, the removal of institutional and regulatory barriers needs to be more strongly addressed and milestones set with regard to the design of suitable policy and regulatory measures, which should be reflected in the trigger points and key indicators.

Response: The project is designed to introduce competitive pressure and cost reductions, by providing the tariff support on a competitive basis, and on subsequent rounds of bidding rounds. While it is probably impossible to avoid some degree of "gaming" of the system, anticompetitive behavior protections --as learned in the UK, Irish and California best practices-- will be built into the auction system design (see annex:" Policies to Stimulate the Market for Renewable Electricity: International Experience and Lessons Learned"). Even though at present tariffs provide no obligation to introduce renewable energy, the combination of: the growing demand for electricity, the availability of local resources, the potential for capital cost reductions, the increased in technical capacity to absorb renewable energy projects and the GEF support, are expected to result in such production costs for renewable energy that within the project's timeframe will allow them to compete directly with alternative generation options. This will result in a sustainable renewable energy industry for the longer term.

Although the five year length of tariff support appears to be suitable for some wind projects, it may not be suitable for the promotion of a mix of renewable sources of electricity. A more detailed discussion of the requirements of a tariff support scheme supportive of a variety of renewable energy sources is desirable. An advantage of a tariff structure is that it offers an opportunity for supporting renewable resource diversity and this should be taken advantage of from the beginning of the program.

Response: Most of the renewable technologies that are to be supported through the financing mechanism (e.g. small hydro, wind energy, biomass, small geothermal) have the common characteristic that their up-front capital costs are high and pose a significant challenge to bring the projects to financial closure. The five-year period proposed for wind projects provides good incentive for project developers to operate their plants at maximum efficiency while providing a cash-flow stream that can accommodate debt service coverage targets for the first years of operation, that can then facilitate additional financing. Moreover this timing is close to the estimated number of years needed for projects to approach the break-even point for the payback of investments. Longer support periods could spread thin the financial support needed in the first years of operation, where perceived risks are higher and raising capital for financing is harder. For particular cases where project developers may need to extend the payments, the Mexican financial sector is sufficiently advanced to use project financing arrangements that may restructure the tariff subsidy payments to longer periods. Shorter support periods might create sustainability issues if plant operations focus disproportionately in the two or three first years where subsidy benefits would be much higher. A similar evaluation of financing needs appropriate to each technology will be made once sufficient capital and experience is acquired to enable organization of auctions along technology banding lines.

The focus of phase 1 of the project uniquely on wind energy appears restrictive and not properly justified. Many opportunities exist for other low cost renewable sources of electricity, biomass in particular. Mexico has a large sugarcane industry with an important potential for cogeneration and power exports to the grid. Other relatively low cost biomass opportunities may be available, including co-firing with fossil fuels. A more detailed discussion on how the project will assist in promoting a diverse renewable energy supply would be helpful. The proposal provides little indication of the opportunities and costs associated with a variety of renewable sources of electricity.

Response: We agree. Mexico does have good potential for renewable energies in general, and the project is designed to support a range of renewable energy technologies. As stated in the project document (Section C.1.): " **Phase I** of the program would target renewable energy technologies on a least-cost basis in terms of minimizing the level of GEF tariff support required, both initially and over time. Initially these projects are expected to be primarily wind, and potentially small hydro. Given the high quality of the wind resource, and high prospects for organizational learning and cost reduction, wind is viewed as particularly responsive to GEF Operational Program guidance (OP#6) which targets long-term technology cost reduction. If additional cost prospects for other technologies are identified, and/or additional co-financing is identified, other renewable energy technologies may be supported in Phase I. **Phase II** is expected to continue tenders under the Financial Mechanism to amplify and replicate renewable energy installations under the program. Incentive support will be 'banded' to expand support to other technologies (including small geothermal, biomass and small hydro) and differentiate support to levels required to stimulate these applications."

GEF funds leverage deserve a more detailed discussion. A 10:1 leverage may be high depending on the level of tariff support provided and the level of financial incentives from the GoM. However, what is important is how the leverage ratio of GEF funds will increase over time and in relation to different renewable technologies. Greater GoM support may be required to gain fuller advantage of the GEF funds, for example in assisting the development of a local renewable energy-based industry. Also, greater GoM support may be required to promote the longer term commercial viability of a broader range of renewable sources.

Response: As the financial analysis section indicates, during the first phase, $17million of the financing mechanism are likely to support capital cost investments of about $120m. This is a ratio of 1:7 for the first stage where higher support is needed and where barriers are higher. Over time, because of cost reductions and organizational learning the ratio improves significantly in terms of leveraging the GEF funds. The case for support of broader range of renewable energy sources and GoM is addressed in comments above.

In order to ensure the appropriateness and effectiveness of the approach it is fundamental to ensure that it is integrated with other policies (e.g. environmental and agricultural) and that it is coherent with sectoral reforms. Greater links with other policies can enhance the effectiveness of the project.

*Has the most appropriate and effective approach been used to reduce the costs of the technologies?*

If suitably designed, the tariff support and other financial mechanisms are an effective and appropriate approach to achieving cost reduction of renewable energy technologies. The program proposed could lead to significant progress in the commercial viability of renewable electricity. In particular, the project could establish the commercial viability of wind electricity under favorable wind regimes. However, a better understanding is required of progress that would be made under the project with regard to the commercial viability of other renewable sources of electricity.

*Was the potential market determined on the basis of RETs data and databases?*

Good information is available and has been used for understanding the cost evolution of wind electricity and calculating the financial viability of wind energy projects. It is also believed that a significant potential for wind electricity at relatively low costs exists in the Oaxaca region. However, little discussion is provided on the resource potential and cost of other renewable electricity sources. More information on these may be required to understand how they should be integrated in the project.

*Has an evaluation of the demand-side mechanisms to support after-sales service been undertaken?*

The nature of the mechanisms proposed should ensure that servicing of the renewable energy projects is in the interest of the project developers. The project could be instrumental in developing a renewable energy service industry in Mexico. It is strongly encouraged that technical assistance activities, such as raising awareness in relevant domestic and international industries and development of relevant skills locally, and other support measures be aimed at its development.

*Adequacy of the financing mechanism?*

The tariff support mechanism appears to be a suitable financing mechanism in the Mexican context. It should be aimed at stimulating a variety of renewable energy sources, and the establishment of different tariff bands for different renewable electricity technologies should be considered. Other financial mechanisms are discussed, such as accelerated depreciation. However, a more comprehensive discussion of other financial mechanisms may be required to understand what measures are needed to promote different renewable electricity sources. For example, capital grants may be useful in some cases and have been a common component of a successful mix of measures promoting renewable electricity in Europe. The financing mechanism proposed should be successful in creating satisfactory leverage of GEF funds and leading renewables along the commercialization path. The GoM and the Bank may wish to make use of other programs to exploit synergies in developing a Mexican renewable energy industry. The potential evolution of power sector reforms in Mexico needs to be carefully considered as it may affect the viability of the project.

Response: Renewable energy technologies quite often face the barrier of perception that they cannot deliver sufficient output. Capital grants were considered during project development but where deemed an inferior approach, because they reduce the incentives to project developers to properly address technical and operational risks during project design and to maintain high operational standards once the projects are commissioned. By conditioning the payments on electricity output, the project tackles the operational sustainability issue of renewable energy projects, as well as the notion that not enough energy is actually delivered.

*Comments on the design the project?*

The project is shaping up well with an understanding of the key issues to be addressed well underway. There appears to be suitable involvement of key Mexican organizations, and their commitment is crucial. The planning of the project phases could benefit from greater clarity and a more detailed project plan would be desirable. The establishment of clearer milestones may also be desirable. The question of program duration, in particular with regard to the promotion of a variety of renewable electricity sources, also requires further attention.

Response: Further details of project design will be developed during the further preparation and appraisal stages as described above (see first comment and response). The project's duration and support for other renewable technologies however, is unavoidably defined by resource constraints. While it is highly desirable to support all renewable energy technologies, there is a still limited funding envelope available at this stage both from the GEF, as well as from complementary renewable energy support sources. Current costs and potential for cost reductions of the technologies will reveal an appropriate supply curve during the project's bidding rounds. The project does not preclude, or favor, in the long-run any technology in particular; it relies on competition to provide the best solutions at different points over time. Nevertheless, the technical assistance components of this project will provide an environment that would benefit future additional initiatives to support specific technologies should the energy policy strategy of the country point to that direction, and additional funding from other sources become available.

*Will a process be put in place to monitor the project?*

A project monitoring process is envisaged, but little details are provided. Success measures should be put in place and applied regularly.

Response: The project has the monitoring function embedded in the design. Firstly, distinct auction rounds, and program phases, will provide interim information on the progress of the mechanism; actual payments are tied to energy outputs, therefore key project indicators will be recorded automatically during project implementation. Secondly, different components related to technical assistance will have to produce required deliverables for the actual mechanism to take place, which will again be monitored essentially during project implementation. Finally, the detailed form of the monitoring plan and assignment of specific institutional responsibilities will be fully developed during the further project preparation and appraisal stages in conformity with World Bank and GEF guidelines and best practices.

*Is the barrier removal supported by an underlying policy framework?*

The GoM has set out a strategy aimed at a greater promotion of renewable energy. The project proposed will be an integral part of the strategy and appears to have the support of the key institutional organizations.

**Identification global environmental benefits**

The project has a very large potential for greenhouse gas benefits through the realization of renewable electricity projects and through the enhancement of their commercial viability and development of a renewable electricity market in Mexico. The $CO_2$ emissions reduction calculations could benefit from greater detail (simple calculations I have performed lead to different results).

Response: Estimates of $CO_2$ emissions may be reconciled once it is noted that USAID/CENACE/ATPAE (association of Mexican energy technical professionals) studies have estimated an avoided $CO_2$ emissions factor of about 0.6-0.7 g/kWh for the Mexican grid. Remaining differences relate to differing assumptions on emissions horizon (e.g. planning horizon vs. physical project life) and capacity factors, etc.

**Fit within the context of the goals of the GEF**

The project has a perfect fit with GEF Operational Policy 6.

**Regional context and replicability of the project**

The project is possibly replicable in countries with a similar electricity market structure to that of Mexico, i.e. electricity markets dominated by vertically integrated utilities, at the early stage of liberalization, and with a weak policy and regulatory framework for renewable energy promotion, and in countries at more advanced levels of liberalization. The potential for replication is large. Technical assistance developed under this project could also be readily transferred to other projects.

**Sustainability of the project**

The project is potentially sustainable. It tackles policy and regulatory issues that are fundamental to the promotion of renewable electricity. It aims at implementing financial mechanisms that will improve the commercial viability of a variety of renewable electricity sources and initiate a renewable electricity market in Mexico. The project will also stimulate some competition among renewable electricity sources. In order to prove sustainable the project will need to prove that that it is generating growth and cost reductions related to renewable electricity in Mexico. In particular, the project needs to demonstrate that the approach is promoting diversity in renewable electricity supply. The project needs to set targets in relation to key policy and regulatory measures needed to be adopted during duration of the project to reduce the technical barriers to renewable electricity penetration. The establishment of alternative funds and the modalities of their funding need to be addressed to complement GEF funds or ensure program continuity. This should be done in the context of potential power sector reforms and development of other market based approaches for the promotion of renewable electricity.

**Linkages to other focal areas**

Given the potential broad range of renewable energy activities that may be covered by the proposed project, it is difficult to assess the exact linkages to other focal areas. It is encouraged that technical assistance be directed to the development and dissemination of guidelines for good practice, environmental in particular, in the development of renewable electricity projects.

Response: The development of environmental guidelines specific to renewable energy projects is a GoM commitment under the Environmental SAL.

**Linkages to other programs and action plans at the regional / sub-regional level**

The project proposal draws well on relevant development agency projects and international policies aimed at the promotion of renewable energy. This approach should be pursued in the project developments stages. A specific link is also made to the Programmatic Environment Structural Adjustment Fund (Mensal II).

**Other beneficial or damaging environmental effects**

Not possible to comment

Response: Specific quantification of local/regional environmental benefits (reductions in SOx, NOx and particulates), and their valuation will be performed during the course of further project preparation and appraisal.

**Degree of involvement of stakeholders in the project**

Key institutional stakeholders are involved in the project. Activities are being pursued to involve local actors that may be affected by renewable electricity projects. Some NGO and renewable energy industry involvement of has been achieved by workshops. A more active involvement of renewable energy industry players is desirable to understand the barriers they are facing. Also, a more active discussion with NGOs, such as WWF, that are launching major campaigns aimed at the promotion of renewable energy with energy companies and the public may be desirable.

**Capacity building aspects**

Strong technical assistance is envisaged during phase 1 of the project, mainly to assist in designing and implementing financial mechanisms and policy and regulatory aspects. The establishment of a 'one-stop shop' for assistance to renewable electricity project developers is an important aspect of capacity building.

**Innovativeness of the project**

The project is innovative in its approach providing assistance with policy and regulatory measures and in designing and funding financial mechanisms.

## Annex 19: Maps

## MEXICO: Large-Scale Renewable Energy Development Project

[Map MEX34480 to be inserted here]