



## Global Environment Facility

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August 13, 2003

Dear Council Member,

UNDP, as the Implementing Agency for the project, ***Mexico: Action Plan for Removing Barriers to the Full-scale Implementation of Wind Power***, has submitted the attached proposed project document for CEO endorsement prior to final approval of the project document in accordance with UNDP procedures.

The Secretariat has reviewed the project document. It is consistent with the proposal approved by the Council in October 2002, and the proposed project remains consistent with the Instrument and GEF policies and procedures. The attached explanation prepared by UNDP 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.gefweb.org](http://www.gefweb.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,

  
for Leonard Good  
Chief Executive Officer and Chairman

cc: Alternate, Implementing Agencies, STAP



11 August 2003

*Len*  
Dear Mr. Good,

**Subject: Climate Change/OP-6: REVISED PROJECT DOCUMENT “Mexico: Action Plan for Removing Barriers to the Full Scale Implementation of Wind Power in Mexico (Phase 1)” – PIMS no. 2222**

Further to our memo of 09 July 2003, I am pleased to attach herewith the revised project document to above-mentioned project, with Response to Council’s comments and co-financing letters. The brief was approved at the GEF Council Meeting in October 2002.

Also attached is the Response to GEF Secretariat comments dated 28 July 2003.

As per paragraph 29 and 30 of the GEF Project Cycle, we are submitting this project document for circulation to the members of the GEF Council and, subsequently, for your final endorsement.

Thank you in advance for expediting the review and approval of this project.

Yours sincerely,

*Warm regards.*

A handwritten signature in black ink, appearing to read 'Frank Pinto', is written over a horizontal line.

Frank Pinto  
Executive Coordinator

Mr. Len Good  
Chief Executive Officer and Chairman  
Global Environment Facility  
Room G6005  
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Washington D.C. 20433

Cc: Catherine Vallee, UNDP-GEF Regional Coordinator  
Richard Hosier, UNDP-GEF Climate Change Principal Technical Advisor

# Mexico: "Action Plan for Removing Barriers to the Full Scale Implementation of Wind Power in Mexico (Phase 1)"

## Response and Clarification of GEF Concerns

### (1) Private Sector Co-financing:

*GEF Sec Comment: The attached letters from the private companies express support for the project, but all basically say some variation of "once the Regional Center for Wind Farm Technology is constructed in Oaxaca, we will analyze/consider/evaluate the possibility of participating." This is not at all \$4.5 million in confirmed co-financing commitment from these companies to install wind turbines at the Center, as stated in the project document: "Wind turbines for the RWTC will be in-kind contributions from project developers or wind turbine manufacturers (\$4.5 million)" (pp. 40-41). And if such commitments await completion of construction of the center, there is no way that these investments will materialize in Phase 1 within the first two years. Thus, my reading leads me to conclude that Phase 1 amounts to \$4.7 m from GEF and \$2.2 m. from the government (which is confirmed by the government's letter), plus possible "associated financing" (i.e., not confirmed) of \$4.5 from private companies sometime in Phase 1 or 2, and that Output 2 (the Regional Center) of Phase 1 will consist of whatever the GEF pays for (more than half of total GEF Phase 1 funds) but possibly nothing else. Either the co-financing commitments need to be strengthened or clarified, or the description and financing amounts for Phase 1 need to change.*

We agree with you that some letters annexed to the project document do not articulate a clear commitment. However, it was our understanding that private co-financing was in no need of commitment letters. Therefore, letters of interest attached to the project are for information only.

The very valid point about timing for private sector turbines installation has been identified during our internal review process and discussed at length with the project team. As a consequence, and to avoid waiting for the construction of the center to attract private co-financing, a number of corrective measures have already been taken, some of which are already reflected in the project document:

1. In the project workplan, getting commitment for private co-financing to install additional turbines is starting in the fourth month of the project. This will have a positive impact on timing. What we have discussed with the team is that, ideally, all turbines could be installed at the same time.

2. The project team has already started to liaise with manufacturers to this end and in particular close ties are being developed with the Dutch and the German industry.

3. For your information also, an additional co-financing of 1 million Euros, reported nowadays as associated co-financing, is in negotiations with GTZ. This will provide additional opportunities to get private commitment on the ground through exchange programmes.

As per Council document on co-financing definitions, private contribution in kind and in cash are an integral part of co-financing. Associated financing is described as being not essential for the project. In our view, this co-financing is essential to the project through provision of technology transfer, center's sustainability, and technology adaptation to local conditions, among others.

(2) Complementarity with other GEF Interventions:

*GEF Sec Comment: Paragraphs 83-84 on "complementarities with other GEF interventions" (the World Bank SPRE) have not changed since the project brief was submitted to Council in October 2002. They need to be updated in light of the Council's approval of SPRE at the May 2003 meeting, the contents of that approved document, and any discussions UNDP has had with the Bank since then. What can you say now about the complementarity and also possible overlap, and operational means to address those issues?*

Reference to the World Bank SP project is reported in various instances in the project document (Paragraphs 42-46, 49, 74, 83-84). In fact, the World Bank initiative has been designed taking into account UNDP's initiative - which was waiting for approval for nearly a full year due to lack of resources. UNDP's comments, mainly related to potential overlaps, have been taken into account in the preparation of the World Bank's Project Brief. Various coordination meetings are taking place in Mexico at the initiative of the GOM. Specific topics for coordination and synergies were discussed and agreed upon such as: output of grid stability studies of the center as input of the World Bank project, exchange of information among teams, etc.

Nevertheless, for clarity, we updated the corresponding paragraphs (83-84) and are pleased to submit a revised version of the project document.

# United Nations Development Programme

## Project of the Government of Mexico

**Project Number:** MEX/02/G31 (PIMS 2222)  
**Title:** Action Plan for Removing Barriers to the Full Scale Implementation of Wind Power in Mexico  
**Short Title:** Wind Energy  
**Duration:** 2 years (this project constitutes the initial phase of a 5-year project)  
**Starting Date:** May 2003  
**Completion Date:** April 2005  
**Implementing Agency:** United Nations Development Program  
**Executing Agency:** Energy Secretariat (SENER)  
**Government Implementing Agency:** Electrical Research Institute (IIE)  
**Project Sites:** National  
**Primary Target Beneficiaries:** Target place (environmental habitat); natural features; atmosphere  
**DCAS Sector/Sub sector:** (8) Energy; (46) Sector policy and planning  
**ACC Sector/Sub sector:** (5) Energy; (40) New and renewable sources of energy  
**Primary Areas of Focus:** (3) Promoting environmental and natural resources sustainability  
 (21) Promotion of sustainable energy and atmospheric quality  
**Primary Type of Intervention:** (3) Program support; (10) Program technical support

<b>Summary of GEF and Cost-Sharing Inputs in US\$ as per attached budget</b>	
<b>INPUTS</b>	
<b>1G-GEF</b>	<b>4,736,000</b>
<b>Co-Financing GoM</b>	<b>2,216,000</b>
<b>Third Parties</b>	<b>4,860,000</b>
<b>TOTAL</b>	<b>11,812,000</b>

**Brief Description:** In its two phases, this project aims to reduce global CO<sub>2</sub> emissions by 4 million tonnes (Mt) per year by promoting the development of a commercial wind energy market in Mexico with a target of 2000 MW of installed wind power capacity in ten years.

Phase 1 of the project will launch a comprehensive and systematic effort to reduce identified barriers to wind energy development, beginning with a co-ordinated initiative aimed at revising the institutional, legal and regulatory frameworks of the electricity sector so that they provide a more level playing field for wind energy. An educational campaign, geared towards raising awareness among government officials of the benefits of wind energy, will be carried out simultaneously. Technical, informational and human resource barriers will be addressed through the creation of a regional centre for wind energy technology. At this centre, local technicians and engineers will obtain hands-on experience in the operation of a diverse range of wind turbines, wind energy equipment will be assessed for operation under local conditions, and international standards and best practices will be applied and adapted for Mexico. A preliminary assessment and mapping of wind energy resources at the most promising sites in the country will also be carried out in Phase 1 in order to obtain the wind resource data essential to the development of public tenders for commercial projects. Finally, a set of comprehensive feasibility studies will be developed in Phase 1, in conjunction with any required preparatory activities, geared toward the formulation of three 15-30 MW business-demonstration wind power plants.

A comprehensive evaluation of the effectiveness of Phase 1 activities will be carried out prior to submitting an additional request for Phase 2 resources. If necessary, Phase 2 of the project will pilot the development of the three commercial wind power plants and will begin by preparing and carrying out a competitive bidding process by CFE for the three wind power plants. GEF resources will be used to provide temporary production incentives to be determined during Phase 1. Lessons learned and best practices will be monitored and documented to assist future developments. Data and experience gained from both phases of the project will be widely disseminated throughout Mexico and Latin America, by means of a best practices manual and a series of training courses and workshops as well as via the Internet. This Project Document relates to activities and financing approved for Project Part I.

**Costs and Financing (Million US\$):**

		<b>Phase 1</b>	<b>Phase 2</b>	<b>Total</b>
<b>GEF</b>	Project	4.736	7.735	12.471
	<b>Sub-Total GEF</b>	<b>4.736</b>	<b>7.735</b>	<b>12.471</b>
<b>Co-Financing</b>	Government	2.216	2.984	5.200
<b>PARALLEL FINANCING</b>	Private sector	4.860	13.400	18.260
	International Financing		53.600	53.600
	<b>Sub-Total Other financing</b>	<b>7.076</b>	<b>69.984</b>	<b>77.060</b>
<b>Total Project Cost</b>		<b>11.812</b>	<b>77.719</b>	<b>89.531</b>

Approved and Signed by:

Signature:

Date:

Name/Title:

Secretariat of Energy

\_\_\_\_\_

Under Secretary

Secretariat for Foreign Relations

\_\_\_\_\_

**Director of the Unit for Scientific and Technical Cooperation**

United Nations Development Program (UNDP)

\_\_\_\_\_

Resident Representative, a.i.

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## List of Acronyms

ANES	National Solar Energy Association
BD-WPP	Business Demonstration Wind Power Plant
BOT	Build-Operate-Transfer
CFE	Federal Electricity Commission
COFER	Advisory Council for the Promotion of Renewable Energy
CONAE	National Commission for Energy Conservation
CRE	Energy Regulatory Commission
GHG	Greenhouse Gas
GIS	Geographical Information System
GOM	Government of Mexico
IEA	International Energy Agency
IIE	Electrical Research Institute
IPP	Independent Power Producer
LFC	Luz y Fuerza del Centro
Mt	Megatonne (1 million metric tonnes)
PND	National Development Plan
SHCP	Secretariat of Finance and Public Debt
SE	Secretariat of the Economy
SENER	Secretariat of Energy
SEMARNAT	Secretariat of Environment and Natural Resources
UNFCCC	United Nations Framework Convention on Climate Change

## A. PROJECT CONTEXT

### Background and Project Context:

#### National Policy:

1. A key objective of Mexico's 1995-2000 National Development Plan (PND) was to strive for a balance between economic, social and environmental objectives. The Plan also encouraged the active involvement of civil society in environmental management. The current PND (2001-2006) states that: *The government is committed to the introduction of policies aimed at protecting the environment and achieving a sustainable and harmonious development. We cannot compromise the sustainability of our ecosystems with unrestricted growth.* The Federal Government is currently carrying out a participatory process for the integration of a proposed 25-year National Development Plan. The sessions on energy sector policy and reform have strongly recommended the incorporation of renewable energy as a core policy element. Mexican authorities are also committed to pushing forward with energy sector reforms that will allow private investment in energy generation, distribution and transmission, without privatisation of state goods. Traditionally, self-sufficiency has been the main priority of the energy sector. However, recently, increased importance is being placed on issues such as energy efficiency, environmental impact, and the removal of price controls on fossil fuels.

#### The Electricity Sector

### 2. Electricity Supply:

The installed capacity and electricity generation in Mexico at the end of 2001 is shown in the chart below.

Producer	Installed Capacity (MW)	Electricity Generation (GWh)
CFE	36,236	190,881
LFC	827	1,636
Independent Producers <sup>1</sup>	1,456	4,589
<b>Sub-total Public Sector</b>	<b>38,519</b>	<b>197,106</b>
Self-suppliers	2,232	NA
Co-generators	1,136	NA
Other private producers	524	NA
<b>Sub-total Private Sector</b>	<b>3,892</b>	<b>12,610</b>
<b>NATIONAL TOTAL</b>	<b>42,410</b>	<b>209,716</b>

<sup>1</sup> Supplementary to the Public Sector because total of electricity from independent producers over 25 years.

The integration of the Public-Sector's installed capacity at the end of 2001 is shown in the chart below.

<b>Plant Type</b>	<b>Installed Capacity (MW)</b>	<b>Total Electricity Generated (GWh)</b>
Oil Fuel / Gas	14,283	90,500
Combined Cycle	5,188	25,378
Turbogas	2,381	5,457
Internal Combustion	143	361
Dual	2,100	14,109
<b>Sub-total Hydrocarbons</b>	<b>24,095</b>	<b>135,805</b>
Coal	2,600	18,567
Nuclear	1,365	8,726
Geothermal	838	5,566
Hydro	9,619	28,435
Wind	2	7
<b>Sub-total Alternative</b>	<b>14,424</b>	<b>61,310</b>
<b>TOTAL</b>	<b>38,519</b>	<b>197,106</b>

**3. Projected Electricity Demand:** National consumption of electricity is expected to increase at an average annual rate of 5.6 % over the years 2002 to 2011<sup>2</sup>. This growth translates into a projected demand of 291.5 TWh (313.1 High, 266.7 Low) in 2011, as this relates to electricity generation needed to cover demand, representing an increase of 122.2 TWh and estimated required new capacity of 30,300 MW. Of this, 14,228 MW is already under construction or planned, the majority using combined-cycle gas-turbine technology, in addition to several new hydro and geothermal plants. The remaining 14,634 MW will be supplied through new projects, with an expected 1,438 MW to be built for self-supply. An opportunity niche therefore exists for supplying a reasonable portion of the non-committed 14,634 MW of new capacity using renewable energy. The fact that new supply will be provided primarily by low-CO<sub>2</sub> emitting energy forms indicates some willingness on the part of the Government of Mexico to mitigate CO<sub>2</sub> emissions. In addition to on-grid demand, there are still 5 million Mexicans that do not have access to electricity, all of them living in remote rural areas, where renewable energy is often a competitive option.

**4. Regulatory Roles in Mexico's Electricity Market:** Mexico's Energy Secretariat (SENER) is the governing body responsible for setting policy in the energy sector. The

<sup>2</sup> SENER, Documento de Prospectiva del Sector Eléctrico Mexicano (2000-2009)

Energy Regulatory Commission (CRE) is a decentralized unit of SENER that oversees the operation of the sector and is responsible for granting permits for electricity generation. The generation, transmission, distribution and sale of electricity are—with some important exceptions—exclusively public sector activities in Mexico. Within most regions of the country, these activities are the responsibility of the Federal Electricity Commission (CFE), a state owned decentralised company of the energy sector. Mexico City and portions of the surrounding states of Mexico, Morelos, Hidalgo and Puebla, are the jurisdiction of a second public sector utility, known as “Luz y Fuerza del Centro” (LFC). Private sector participation has been permitted under certain conditions for independent power production, small power generation (<30MW), self-supply and co-generation, since 1992 when the *Law for Public Electrical Service* was modified by Congress. Nevertheless, private sector participation has been moderate and is currently responsible for generating only 8.2% of the total national electricity production. However, of the 30 new plants currently planned or under construction, 26 are privately financed, 19 of these to operate under the IPP modality, and the remaining 1 will be constructed as BOT plants by private sector companies, and only three will be built with public funds.

**5. Electricity Reform:** In 1999, Mexico’s previous government launched a reform proposal for bringing about structural change in the electricity industry. The proposal suggested that the government should operate and regulate the transmission of electricity, while the private sector could be involved—via regional concessions—in generation, distribution and sale of electricity. The participation of the private sector would be supervised by the state, especially with regards to the distribution. The state would also operate as a broker or intermediary between electricity producers and end-users, facilitating the operation of an electricity market. Congress did not approve this proposal before the current government took office. At present (early 2003) the current federal administration is promoting a non-privatising reform to the electricity sector. There are numerous differences of opinions about the reform, as well as different time horizons regarding Congress decision. Nevertheless, it has been recognized by energy authorities that the current regulatory framework in Mexico is not appropriate for the development of renewable energy.

**6. Electricity Rates:** The Secretariat of Finance and Public Debt (SHCP) approves energy tariffs based on rates proposed by CFE, together with input from an advisory committee with representation from CRE, SHCP, CFE, LFC, and SENER. Prices vary between and within sectors, depending on the region, time-of-day, and voltage levels, and are adjusted every month using a prescribed methodology, based on the rate of inflation as well as international fuel prices. In addition to these adjustments, they are also subjected to occasional increases as required to keep prices in harmony with Mexico’s economy. Average electricity tariffs paid in 2002 for each sector are shown in table below. During 2002, the overall average tariff was 6.33 US¢/kWh. The lowest tariffs were found in the agricultural sector (3.13 US¢/kWh) where electricity prices are subsidised by the state, as part of its internal policy to promote agricultural development. The commercial sector paid an average of 13.03 US¢/kWh and the average price for domestic customers was 6.07 US¢/kWh.

Sector	Average Tariff US cents (kWh)
Residential	6.07
Commercial	13.03
Services	11.33
Agricultural	3.13
Industrial	5.5
<b>Average National</b>	<b>6.33</b>

**Average tariffs by sector (year 2002)**

**7. Buy-Back Prices for Independent Power Production:** Prices paid to independent power producers (using conventional technologies) are determined by CFE on a case-by-case basis, taking into account factors such as investment and operating costs, payback periods, *etcetera*. There are three categories of independent power production: IPP (>30MW), Small Power Production (<30 MW), and Self-Supply, each of which is governed by a different set of rules for defining contracts and determining buy-back prices.

- In the case of IPP, when new capacity is required in a certain region, CFE sends out a request-for-proposals, and selects the producer(s) offering the lowest long-term cost/kWh, as long as the electricity source has been included in SENER's official planning document.<sup>3</sup>
- For Small Power Production, the producer first signs a power purchase agreement (PPA) with CFE (once it has been granted a permit from the CRE) and then attempts to sell its electricity to CFE through a regional electricity auction. Once again, CFE buys from the lowest bidder, in accordance with dispatching regulations. The PPA does not guarantee that CFE will buy any electricity from the small power producer; however, it does obligate the power producer to only sell to CFE. There are currently no small power producers in Mexico.
- Self-Supply Producers using conventional energy sources can sell surplus electricity to the grid, under the terms of a previously signed PPA, but CFE can only buy electricity, as it is required, following dispatch rules. Prices paid are based on CFE's marginal costs which are currently between 4 and 9 US¢/kWh depending on the region and time-of-day. These prices are discounted by 15% if electricity is purchased outside of the agreed-upon hours<sup>4</sup>.

**8.** Recently (September 7, 2001), the Mexican Energy Regulatory Commission issued the rules for the interconnection of *intermittent* energy sources to the national electricity grid, with the idea of fostering the penetration of non-dispatchable sources of energy such as wind and solar. The new interconnection contract is favorable in the sense that surplus electricity produced at certain times of the day can be accountably accumulated for accreditation of electricity consumed during another time of the day. The interchange is

<sup>3</sup> The 2000-2009 planning document does not include any wind power capacity, but it is reviewed every year. Up to now, only weightless suggestions to change this situation have been made. This project's strategy includes analysis and actions in order a moderate but meaningful quantity of wind power can be directed to IPP projects.

<sup>4</sup> More details on how buy-back prices are determined can be found in Annex E.

allowed on the basis of a ratio given by the local electricity marginal costs ratio. Besides, wheeling costs are reduced to the plant's capacity factor percentage. Nevertheless, according to present numbers regarding electricity tariffs and marginal costs (January 2003), only a few categories of wind energy projects could meet profitability under these "favorable conditions". Profitable projects could be self-supply wind power projects for municipal lighting, and, with a bit of luck, self-supply projects for the industrial sectors also could be profitable, as long as they are located where there are excellent wind energy resources. At present (January 2003) there are no other incentives for stimulating renewable energy generation by the private sector, and, since the current law mandates CFE to purchase power from the least cost option, wind power development in the IPP modality has been practically null.

**9. Mexico's Greenhouse Gas Emissions:** According to Mexico's First National Communication to the COP of the UNFCCC (1997), Mexico's total CO<sub>2</sub> emissions in 1990 came mainly from the combustion of fuels for generating energy, change in land use, agriculture, and emissions due to leaks associated with the production of oils and gas. Mexico's total CO<sub>2</sub> emissions in 1990 were 444.5 Mt. The energy sector constituted the most important source of this gas, with 297 Mt (67%) from which 68.3 Mt (23%) came from electricity generation (a level of 0.590 kg CO<sub>2</sub>/kWh was estimated for 1990<sup>5</sup>). From 1987 to 1993, CO<sub>2</sub> emissions associated with energy use increased by 14.06 %, but on the other hand, per capita CO<sub>2</sub> emissions fell by 7.1% (from 3.75 to 3.48 tonnes). Although Mexico's per capita emissions in 1994 ranked 17<sup>th</sup> in the world, Mexico's emissions were much lower than those of the developed countries. Intensity relative to Mexico's GNP decreased by 6.1% from 1987 to 1993, indicating that the decoupling of energy consumption and output has already begun, due to the results of specific actions to this end. It is clear that the more developed countries are the ones that emit the greatest quantities of greenhouse gases, which supports the principle of a common, but differentiated, responsibility in the face of Global Climate Change (GCC). As seen in most of the world over the last decade, natural gas for electricity generation has been used as an immediate way to mitigate GCC. At present, combined cycle gas turbines offer the highest commercially available plant efficiencies, and emit less carbon dioxide than oil and coal, as well as low investment and electricity production cost. This last characteristic is very attractive for developing countries. A level of 0.561 kg CO<sub>2</sub>/kWh has been estimated for the year 1999, which means that this level fell by 5% compared with 1990, indicating that some efforts have been made in this direction. Mexico's national electrical demand is projected to rise at 5.6 % annually from 2002 to 2011. At present, most of this new capacity requirement is projected to be met using natural gas<sup>6</sup>. However, a meaningful part of the new electricity requirements could be met by wind energy, and other renewables, in order to avoid additional CO<sub>2</sub> emissions.

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<sup>5</sup> Sheinbaum Pardo, Claudia. "Inventario de gases Invernadero en México: Importancia del sector Eléctrico". Taller Latinoamericano de Control y técnicas de Previsión de las Centrales termoeléctricas. IIE/ Comisión Europea. Cuernavaca, México, Junio 1996

<sup>6</sup> SENER, Documento de Prospectiva del Sector Eléctrico Mexicano (2000-2009)

## Status of Renewable Energy in Mexico

**10. Government Commitment:** The Government of Mexico has shown its interest in expanding the role of renewable energy in the national energy mix by introducing several new institutional mechanisms that focus on the promotion of renewable energy:

- CFE's *New Sources of Energy* unit is mandated with identifying potential renewable energy applications and promoting and carrying out renewable energy projects within CFE.
- Under the auspices of SENER, an *Advisory Council for the Promotion of Renewable Energy (COFER)* was created in 1997 by the National Commission for Energy Conservation (CONAE), in coordination with the National Solar Energy Association (ANES), with the responsibility of assisting the government in the identification of strategies for removing barriers to the implementation of renewable energy in Mexico.
- In 1999, CONAE was officially mandated by SENER with the task of fostering and promoting the application of renewable energy in Mexico, as a form of energy diversification, in addition to providing support for applied research in the field.
- The Secretariat of the Environment and Natural Resources (SEMARNAT) has restructured its operation so as to facilitate the implementation of renewable energy in Mexico on environmental grounds. SENER and SEMARNAT are currently co-ordinating policy and programs dealing with energy and the environment.
- In the year 2000, the Energy Secretariat (SENER) instructed its R&D arm, the Electrical Research Institute, to carry out work on an initiative known as the Pilot Plan to Foster the Development of Renewable Energy, that looks at market issues for eight distinct renewable energy technologies. The main objectives of this plan are to contribute to the establishment of a national policy on sustainable energy, to identify barriers to the implementation of renewable energy options in Mexico, and to create the central elements that will facilitate the elimination of these barriers, foster the development of a local renewable energy industry, and facilitate the implementation of renewable energy technologies on a commercial scale in Mexico.<sup>7</sup>
- A task force led by CRE and CFE developed a modified version of Mexico's grid interconnection contract that would allow self-suppliers of intermittent sources of energy, such as wind, the opportunity to do business under the current legal framework (see section 8).

**11. Installed Renewable Energy Capacity:** Following hydroelectricity, which has a national installed capacity of 9,619 MW, geothermal energy is the renewable energy source that has been most developed in Mexico. The country's total installed capacity of geothermal energy is currently 838 MW which is the third largest in the world after the US and Italy. Most of the geothermal development in Mexico was country-driven and technically supported by IIE. Other renewable energy resources have not followed the same

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<sup>7</sup> This program proposal originated from the work on wind energy technologies carried out for this plan. Further details on the Pilot Plan can be found in Huacuz J: RE in Mexico: Barriers and Strategies. REFOCUS, The International Renewable Energy Magazine, Jan/Feb 2001.

path - Mexico's abundant solar resources have been exploited only in a very small way, primarily for water-heating, rural electrification and telecommunications applications, the latter two totaling about 11 MW. Wind energy development to-date has been primarily limited to small-scale research applications, with the exception of two CFE-operated plants: 1.6 MW in the south of the Isthmus of Tehuantepec (Oaxaca) and 600 kW in Guerrero Negro on the Baja California Peninsula. A 550 kW turbine had also been installed for self-supply by the company Cementos Apasco, but this wind turbine went up in flames by middle 2002. The Mexican government has carried out an extensive rural-electrification program, through which over 2500 rural communities have been supplied with photovoltaics, small hydroelectric units, wind generators and wind-PV hybrid systems. Over 60,000 solar home systems have been installed, as well as close to 13,000 PV-powered rural telephones.<sup>8</sup>

**12. Renewable Energy Potential:** The renewable energy resources in Mexico have not been satisfactorily quantified, nor systematically analysed as to their real potential for electricity generation. However, from available estimates one can infer that they are abundant<sup>9</sup>.

- **Wind:** Based on available information, the most viable potential for wind-electric generation has been conservatively estimated at 3000 - 5000 MW for the entire country. The strongest wind resources are found in the Isthmus of Tehuantepec, the coasts of Quintana Roo, Veracruz, Tamaulipas, and Baja California, and the high plateaus of the states of Zacatecas, San Luis Potosí and Hidalgo.
- **Small Hydro (>10 MW):** According to CONAE's estimates, the small hydro potential in Mexico could be around 3,000 MW. In the states of Veracruz and Puebla, one hundred sites have been identified where it could be feasible to generate around 3,570 GWh (equivalent to 400 MW). According to IIE's estimates, an additional potential capacity of around 300 MW could be installed along existing irrigation channels.
- **Solar:** Solar energy is abundant throughout the country, and Mexico's solar potential is considered to be among the highest in the world. Opportunities exist for the extensive use of both solar-thermal systems and photovoltaics, especially in the northeastern region of Mexico.
- **Biomass:** Estimates for the potential for electricity generation from biomass are as follows: 7000 MW from agricultures residues (from the 10 principal agricultural products), 70 MW from wood waste from sawmills and 150 MW from municipal waste.

**13. Estimated Benefits of Renewable Energy:** The benefits of launching a countrywide renewable energy program in Mexico have not yet been fully quantified. However, an IIE study<sup>10</sup> has estimated the benefits of a national wind energy program. The study estimates that a program that develops an installed capacity of 5000 MW would generate 30,000 direct and 30,000 indirect jobs (both permanent and temporary), bring in around US\$ 5,000 million in private capital investment for plant construction, and avoid the emissions of around 9 Mt of greenhouse gases.

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<sup>8</sup> Huacuz J, Agredano J: Beyond the Grid: Photovoltaic Electrification in Rural Mexico, Prog. Photovolt. Res. Appl. 6, 1998)

<sup>9</sup> Boletín IIE septiembre / octubre 1999, "Energías renovables en la oferta energética nacional", Dr. Jorge Huacuz, IIE

<sup>10</sup> Borja, M. et. al., *Energía Eólica: centrales eololéctricas*, IIE, ISBN 968-6114-14-9, Feb. 1999.

## **Wind Energy Potential**

**14. Mexico's Wind Energy Resources:** Estimates<sup>11</sup> have indicated that Mexico's most viable wind resources would be sufficient for the installation of 3000 - 5000 MW of wind power. These figures are based on rough regional estimates, as detailed evaluations of wind resources have yet to be carried out. Other sources<sup>12</sup> indicate that there are many areas in the country with moderate wind resources that could eventually be efficiently tapped using improved wind turbine technologies. Based on the experiences of other countries, it is reasonable to expect that extensive exploration and improved wind speed measurements throughout the country will result in higher estimates of Mexico's wind energy potential.

**15. Strongest Potential:** Mexico's strongest wind energy resource is found in a 3000 km<sup>2</sup> region known as "La Ventosa" located on the Isthmus of Tehuantepec in the State of Oaxaca. Average annual wind speeds in this region range from 7 to 10 m/s, measured at 30 metres above the ground. It is estimated that up to 2000 MW of wind power could be commercially tapped in La Ventosa given the favourable characteristics of the region, for example, its topography, existing infrastructure, and the local government interest, in addition to its excellent wind resource. Initial data from CFE's 1.6 MW pilot plant indicate that the average capacity factor for future wind power plants over the whole region could exceed 30%, a rate that exceeds the average capacity factors of the majority of identified wind resource areas around the world. In fact, CFE's 1.6 MW pilot plant, located in one of the best windy sites in the region (La Venta), has operated at a 5.5 years average capacity factor of 38%, which compares favourably to wind power plants located in best windy inland sites in the world.

**16. Key Regions for Wind Energy Development:** Additional regions with potential for significant wind power development are located in the states of Zacatecas, in the high central plateau, Tamaulipas and Veracruz, on the coast of the Gulf of Mexico, the Pacific shore of Baja California, the coastline of Quintana Roo on the Caribbean Sea, and the state of Hidalgo, immediately north of Mexico City. Currently, the State Governments of Tamaulipas, Nuevo Leon, Baja California, Hidalgo and South Baja California, are very interested in exploring the feasibility and potential benefits (i.e., economic, environmental, and social) that wind power development could bring to their respective regions, and are negotiating technical assistance agreements with the IIE to this effect. It is expected that successful business-demonstration wind power projects, located in strategic locations in some of these states, would attract the attention of other local governments, and consequently, synergies would be created, as has been the case in leading wind power countries. Selected locations in additional states, Michoacán, Querétaro, Guerrero and Puebla, for example, could also prove to be suitable for wind power development.

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<sup>11</sup> National Commission for Energy Conservation (CONAE), the New Energy Sources Unit of the Federal Electricity Commission, and the Unit of Non Conventional Energy Sources of the Electrical Research Institute.

<sup>12</sup> National Association for Solar Energy, ANES.

**17. Institutional Expertise in Wind Energy Development:** Mexican institutions currently involved in wind energy promotion, research, and development include SENER, CONAE, IIE, and CFE.

- SENER has been advancing in formulating strategies for the promotion and support of renewable energy, as well as in directing and co-ordinating specific projects or actions carried out by CONAE, IIE and CFE.
- CONAE has been involved in the promotion of wind energy applications at international seminars and workshops, and has provided institutional support to private companies and investors who wish to carry out wind power projects in Mexico.
- The IIE has been conducting research in wind energy for almost 20 years, and represents Mexico at meetings of the IEA Implementing Agreement on Wind Energy as well as in the Iberoamerican Network on Wind Power (RIGE). The IIE has expertise in wind resource assessment and in the design and construction of small wind turbines (up to 10 kW). IIE also has in-house technical capacity for project identification, site evaluation, feasibility studies, and engineering, as well as in the economic analysis and development of wind power projects, and the development and use of GIS for renewable energy applications.
- CFE was responsible for preparing and carrying out the bidding process that led to the construction and operation of wind energy plants at its installations in La Ventosa and Baja California.

**18. Educational Programs:** Several engineering colleges and universities, such as the National Autonomous University in Mexico City, the Autonomous University of the State of Mexico, La Paz Institute of Technology in South Baja California and the Oaxaca Institute of Technology, are involved in short diploma and undergraduate courses on wind energy technology and applications. Important but limited efforts are being made to develop an engineering program that specializes in wind power through a consortium of engineering colleges in the State of Oaxaca. This initiative is supported by the state government with technical coordination provided by the IIE. It would ideally be expanded and replicated in other parts of the country as the need grows and financial resources become available.<sup>13</sup>

**19. Capacity in the Manufacturing Sector:** A 5 kW turbine of Mexican design is currently manufactured in Mexico, primarily for export markets. Since 1999, a Mexican company, Fuerza Eólica, has been manufacturing 750 kW electric generators for an international wind turbine manufacturer. According to a recent study carried out by the IIE, a number of wind turbine components, including towers, generators, gears, conductors, and transformers, could all be manufactured in Mexico using existing infrastructure. Over 200 Mexican companies have been identified as having the capacity for manufacturing parts required for wind turbines and for wind power plants. The country also has excellent technical expertise in civil, mechanical and electrical engineering, which could be tapped for plant design and construction.

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<sup>13</sup> This educational initiative is consistent with STAP recommendations on capacity-building in the renewable energy market.

## **Ongoing Activities:**

**20.** IIE is currently developing a Geographical-Information System (GIS) that will provide Internet access to regional data on renewable energy resources as well as information on renewable energy technologies. Because of the extreme regional variations in wind energy resources, this would be a particularly useful tool for wind energy developers, if detailed data were available.

**21.** IIE is also currently carrying out limited field measurements and data analysis of wind resources in a small number of sites, as a preparatory step leading up to the installation of a large number of reference stations throughout the country. One anemometer is installed in La Venta, Juchitan, Oaxaca; and has been working since middle 2000. Information gathered from La Venta, is published in IIE's Web site. A number of private and public users have been using this data for formulating wind power projects. As a matter of fact, this was the only data publicly available when private investors began to formulate their projects. Preliminary formulation of a number of private formulated wind energy projects was carried out using IIE's data. Project developers have since installed their own anemometers in specific terrains in order to carry out detailed bankable studies. Today, in La Ventosa there are more than 20 anemometers installed by project developers. This shows that the proposed scheme of installing reference stations in promising areas and publishing the information, really works for calling the attention of project developers. A benchmark indicator of the quality of measurements carried out by the IIE in La Venta, is that RISO National Laboratories (Denmark) has already included La Venta IIE's data on the international World Wind Energy Database, which is being integrated with high quality. Another anemometer was installed on a ridge called "Cerro Pelón", located near Pachuca in the State of Hidalgo. Ten months of data have been recorded. This installation was carried out by the IIE in cooperation with the Energy Commission of the State of Hidalgo. Monthly reports are sent to the Executive Secretary of the Energy Commission who distributes the information to interested parties. By the end of 2002, five anemometers were installed in the North region of the State of Nuevo Leon. These anemometers were installed and are operated by the IIE, in the framework of an agreement between the Trust for the Development of the North of the State of Nuevo Leon. The project was supported with 50,000 USD by the North American Development Bank. The studies in Hidalgo and in Nuevo Leon, as well as the considerable quantity of anemometers already installed in La Ventosa, are just a few samples of the additional actions that will merge with the Action Plan for Removing Barriers to the Full-scale Implementation of Wind Power in Mexico.

**22.** Since mid-2000, the Secretariat for Economic Development of the State of Oaxaca has been actively involved in the promotion of wind energy as a source of new investment and job creation in the region of La Ventosa. The state government has been establishing contacts with wind energy companies from abroad, inviting them not only to build wind farms in the region, but also to establish manufacturing operations to serve local and export markets. By early 2003, a number of project developers have been negotiating wind rights with landowners, some of them have signed contracts, and have obtained federal permits to build wind power stations (issued by CRE). Nevertheless, the reality is that up to now, most of the project developers do not have sound projects. Indeed, most of them are just preparing the ground (and securing land). This has brought about some degree of

speculation regarding wind energy development in La Ventosa, to the point that last year a prestigious international magazine published exaggerations about it. The truth is that in present circumstances, only a few self-supply wind energy projects will have the chance to progress under the regulatory framework in force. Under present circumstances there is no room for IPP wind energy projects.

**23.** In June 2001, a two-day international meeting was held in Cocoyoc, Morelos, to discuss “Best Practices for Renewable Energy”. The event was organised by SENER, through CONAE, IIE and CFE, with support from the IEA Secretariat and the Renewable Energy Working Party. The meeting included the participation of the GEF, UNDP, and UNEP as well as renewable energy specialists from Mexico, Spain, the Netherlands, and the United States. Bilateral and donor agencies from several countries were also present, as well as officials from a number of Mexican government agencies. The objective of the workshop was to share experiences with regards to the development of renewable energy markets and to encourage further dialogue among national and international stakeholders on the potential prospects and opportunities for renewable energy in Mexico. In particular, the meeting concluded that based on international experience, the following elements are key to the development of renewable energy markets:

- That developers have guaranteed access to soft loans, and that terms and conditions for the repayment of loans need to be clearly specified in financing contracts;
- Access to these loans need to be backed up by a legal framework designed especially for the specific type of project;
- Some form of incentive is essential for promoting the first investments;
- To actually be effective, these incentives should be based on kWh produced rather than on installed capacity;
- Incentives should not be homogeneous, but should be specific to each technology;
- Solid institutions are essential;
- Technical standards need to be developed or adopted in order to assure the quality of systems and equipment.

Conclusions of the meeting were submitted to SENER for consideration and follow-up.

**24.** In November 1999, the IIE, jointly with the IEA Executive Committee of the Implementing Agreement for Co-operation in the Research and Development of Wind Turbine Systems (IEA Wind R&D), organised an “International Seminar on the Implementation of Wind Power”. The seminar, held in Mexico City, attracted over 80 people including key officials from the energy and environmental public sectors, as well as delegates from private companies. Delegates from most member countries of the IEA Wind R&D attended this meeting, where experiences on the implementation of wind power in Spain, Denmark, Germany, United States, and Greece were addressed by international experts. One of the results from the seminar the Executive Committee was a unanimous statement that “We conclude from experience gained in participant IEA countries that the existence of national R&D programmes has played a crucial role in the successful implementation of wind energy. The examples of Denmark, Germany, the USA and Spain also demonstrate how R&D programmes can help establish successful national wind energy industries. For the first phase of a Mexican R&D programme, we recommend that priority be given to wind resource assessment, demonstration projects (monitored wind power plants) in targeted deployment areas, and wind turbine test centres to provide training and

indigenous technical development. We consider that a national R&D programme which includes these activities, will form the framework to stimulate the successful implementation of wind energy when a market enablement mechanism is introduced". At present, the IEA Wind R&D is formulating an action for "Wind Power Market Acceleration" in developing countries. Some countries in each of the four regions would be selected for initial evaluation and outreach efforts. As a longstanding member of the IEA Wind R&D, Mexico could potentially be selected as one of the case studies for Latin America.

Three "Colloquiums on Opportunities for Wind-Power Development in La Ventosa" have been held in the State of Oaxaca" (October 2000, November 2001, and November 2002). The first Colloquium, held in 2000, served as a kick-off meeting to promote the development of wind energy in the state, and included representation from Germany, Spain, Japan, and the United States, as well as policy-makers from SENER and CFE, and representatives from international financial institutions and Mexican industry associations. Private sector agents are actively pursuing opportunities in Mexico for wind power development, especially under the self-supply modality. Although it is likely that little commercial development under this modality will take place by mid-2003, as private demand for feasible, local solutions with renewables grows, risk assessment (including client related) and pricing issues will quickly limit wind potential development under this modality. There are only two very small private-sector wind projects operating in Mexico<sup>14</sup>. Several permits have nevertheless been negotiated by the private sector for future development, mostly for the municipal lighting market (Island of Cozumel, Baja California, Isthmus of Tehuantepec). These projects, which have been approved but not initiated, will not allow the direct sale of power from the private sector to the municipality, rather they will require the establishment of an auto-supply partnership. The barriers to the development of these projects are telling in the context of the current GEF proposal; especially in the sense that when all things are put together, profitability and bankability of the wind power projects are not easily achievable, nor are the conditions confident enough.

**25.** Tapping full wind potential comprises both totally private and public led processes in Mexico. These private companies principally include Gamesa, Endesa, GE Wind, Vestas, Dewind, Deproe, Frlander, and ABB. The November 2001 and 2002 Oaxaca Colloquiums, jointly organised by IIE and the Government of Oaxaca, covered opportunities for the application of wind power throughout Mexico, and the colloquium series is quickly becoming the country's most important wind energy event. These colloquiums also provided opportunities for private sector developers to meet with financial institutions and government representatives. The Colloquiums have been used for presenting some interesting initiatives coming out from public sector delegates. One of them is a proposal generated by CONAE for creating a green-fund and a voluntary green energy market. The

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<sup>14</sup> One consists of a 250kW tower in Baja California Sur state (*Compaa Exportadora de Sal, S.A. de C.V.*) installed more than 10 years ago to provide power to salt producing company. Maintenance has been spotty at best, and the technology is now obsolete. The second is a 550 kW tower (the model is no longer on the market), set up by a cement company (*Cementos Apasco S.A. de C.V.*) in Coahuila on a trial basis to evaluate the technical and economic feasibility of meeting their energy demand through wind power. Needless to say, a single 550 kW generator falls far short of meeting the cement company's needs, and the Cementos Apasco has decided not to expand the operation given the lack of a favorable regulatory framework and the medium to low-level quality of on-site wind resources.

first idea is based on establishing a tax applicable to all electricity consumers in Mexico, in order to create a green fund that would be used to finance renewable energy. The voluntary green energy market proposal is based on the international idea of green-electricity overpricing to voluntary green-electricity consumers. Although the proposals presented by CONAE were welcomed by most people attending the Colloquiums, no additional formal pursuit has been carried out, or at least, there is no news about the progress of these initiatives.

**26.** In August 2001, the Secretaries of SENER and SEMARNAT and their respective staff met to discuss issues to jointly develop a policy on sustainable development for the Mexican Energy Sector. The purpose was to co-ordinate common objectives and to establish a shared vision concerning common goals and challenges, with global climate change among the main concerns. The meeting concluded that energy supply must be guaranteed in accordance with the sustainable energy policy, which in turn must take into account social, economic, and environmental sustainability. National programs on energy and environment must also be aligned and co-ordinated to ensure fulfilment of environmental goals on the basis of a shared vision and strategy. Conclusions from the meeting also emphasised the need to foster the use of alternative energy sources by means of voluntary programs on renewable energy, long-term contracts, and incentives for the development of this energy source by private investment. Therefore, a more favourable policy environment for renewable energy is expected for the coming future.

**27. Proposed National Wind Energy Program:** In its efforts to establish a national program for wind energy in Mexico, the IIE has estimated that, if a considerable barrier removal effort were carried out, 490 MW of wind energy capacity could be installed over the next five years and 2000 MW over the next ten years. Assuming that wind-generated electricity will displace energy generated from a mix of technologies, the first 490 MW of wind power plants in Mexico would reduce annual greenhouse gas emissions by close to 1 Mt of CO<sub>2</sub> equivalent<sup>15</sup>, while 2000 MW of wind power would reduce annual emissions of CO<sub>2</sub> by approximately 4 Mt. The development of 5000 MW of wind power, thought to be the lowest estimate of the full wind potential in Mexico, would therefore reduce annual CO<sub>2</sub> emissions by a total of 10 Mt. These estimates are reasonable when compared to the developments in other countries. Germany, for example, installed its first 4000 MW of wind power plants over 10 years and Spain has installed its first 2300 MW over eight years.

**28. Cost Competitiveness of Wind Power:** As has been stated by the Danish Wind Turbine Manufacturer Association<sup>16</sup>, “there is no such thing as a single price for wind energy.” In addition, there is no single levelised production cost (LPC) for wind energy. Reasons for this cost variability for wind power are numerous - investment costs are highly site-dependent, maintenance costs vary according to the type of wind turbine selected, electricity production is strongly dependent on the wind resources at the installation site, etcetera. However, in order to compare wind power projects with other technologies,

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<sup>15</sup> Calculated using a conservative average indicator of 0.766 kg CO<sub>2</sub>/kWh, obtained from the national electricity balance for 1999 (see response 2) to STAP review in Annex D, page D-1).

<sup>16</sup> Danish Wind Turbine Manufacturers Association. [www.windpower.org](http://www.windpower.org)

estimates of average cost/kWh are necessary. As an example, one international study<sup>17</sup> concluded that: “Wind energy is presently cost competitive in locations with good wind resources (as compared to oil, coal, diesel, hydro, and nuclear). The present cost level is around 4.7 US¢/kWh. The projected cost of wind energy in 2020 is 2.5 US¢/kWh, based on an installed capacity of 80 GW by 2010 and 1200 GW by 2020.” Table 1 gives a cost comparison of diverse generating options.

**29.** It is clear from Table 1 that when no externalities are included, wind power, small hydro, and landfill gas are the renewable sources that are currently most competitive for electricity generation. Investment costs for wind power range from 800-1200 US\$/kW, and its levelised production costs range from 3.2 - 9.2 US¢/kWh, levels that are not out of line with the current range of electricity tariffs in Mexico.

**30.** Combined-cycle gas turbine technology currently offers the lowest investment cost per kW at US\$ 480, as well as the lowest levelised production cost (2.85 US¢/kWh), again, when no externalities are included. Since CFE is mandated to buy the cheapest electricity available, renewable generation must compete with combined cycle turbines on an economic basis alone. However, the price of natural gas has been rising considerably as a result of increasing demand. Price volatility of natural gas became significant by the end of the year 2000 and uncertainty with respect to short and medium term costs is now a major concern. In December 2000, contingency measures were adopted in some countries in order to guarantee the economic viability of new combined-cycle gas turbine projects. Mexico was not the exception in this upheaval in the natural gas market, and the Mexican Government encouraged consumers of natural gas to enter into future delivery contracts and provided assistance to access spot markets. However, the government has stated that it is not willing to intervene via subsidies to stabilize/reduce market prices for natural gas. Consequently, several energy officials are now questioning the market reliance of gas-fired technology. As of January 2003, this situation was becoming more critical due to increased volatility of the price of natural gas.

**31.** It is expected that an economic viability crossover point between wind and combined-cycle technology will occur sometime over the next 20 years. The exact point in time is essentially a function of two factors: natural gas prices and improvements in wind power technology through applied R&D.

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<sup>17</sup> Long Term R&D Needs 2000-2020. 35th IEA Topical Expert Meeting. Implementing Agreement for Co-operation in the Research and Development of Wind Turbine Systems. International Energy Agency. The Netherlands. March 2001.

**Table 1.** Comparison of costs of different electric-generating technologies<sup>18</sup>

<b>Technology</b>	<b>Plant Capacity (MW)</b>	<b>Investment cost for the plant capacity in previous column (US\$/kW)</b>	<b>Levelised production costs – LPC (US¢/kWh)</b>
Residual oil-fired steam turbine	37.5	1,316	6.6
Gas fired turbine	42.5	586	9.0
Combined cycle gas turbine	272	480	2.85
Diesel (internal combustion)	40.5	1,323	5.46
Coal fired steam turbine	700	1,204	4.0
Geothermal	26.95	1,165	3.6
Hydroelectric	100	1,431	4.82
Wind	50	800 – 1,200	3.2 – 9.2
Solar photovoltaic	NA	3,500-7000	25-150
Solar thermal	NA	2,000-4,000	25
Landfill Gas	NA	630-1,170	4-6
Small Hydro	NA	800-6,000	3-45

**32.** An indicator known as the average Business-Feasibility Buy-Back price (BFBB) corresponds to the fixed reimbursement per kWh that an investor needs to receive in order for a project to be profitable. A preliminary exercise was carried out at IIE where the BFBB was estimated for wind power projects for a range of capacity factors. In this exercise, it was found that the BFBB is from 6.3 to 5.6 US¢/kWh for capacity factor from 35 to 40 % respectively. In the case of “La Ventosa”, the average marginal costs for electricity production within CFE are about 4.9 US¢/kWh. This suggests that an incentive from 0.7 to 1.4 US¢/kWh could be required to achieve independent power production wind-power business feasibility. However, the average BFBB was computed using a conservative average investment cost of 1,100 USD/kW, but at present, some project developers are talking about investment costs as low as 800 USD/kW for big wind power projects. Furthermore, recent studies generated from IIE’s wind data have shown that within an important area within La Ventosa, capacity factors could exceed 50 %. This shows some of the difficulties in trying to carry out generic studies on the matter; nevertheless, annex H gives a broad idea as well as rough indicators of the potential for a wind power market in Mexico.

**33.** Wind energy is also a reasonably cost-effective way of reducing CO<sub>2</sub> emissions. For example, the weighted average of the levelised cost of the electricity that could be replaced

<sup>18</sup> Estimated costs for the first eight technologies were found in “Costos y Parámetros de Referencia para la Formulación de Proyectos del Sector Eléctrico (COPAR).” Comisión Federal de Electricidad. México 1999. Cost estimates for the last four technologies were found in “Documento de prospectiva preparado en la Unidad de Energías No Convencionales del IIE.”

by wind energy in Mexico<sup>19</sup> is 5.5 US¢/kWh, while the range of the levelised cost for electricity generated from wind power is 3.2<sup>20</sup>- 9.2<sup>21</sup> US¢/kWh. If the mitigation cost is computed utilising the following formula:

Mitigation cost (US\$/ton of CO<sub>2</sub>) = Incremental Cost (US\$/GWh / 766 (Tons CO<sub>2</sub>/GWh), then the cost ranges related to mitigation of CO<sub>2</sub> emissions in Mexico are a function of the wind energy levelised production costs.

### **Barriers to Wind Energy Development**

**34.** A number of significant barriers to the development of a wind power market in Mexico have been identified and are described below:

- **Institutional, legal, and policy frameworks** – The current legal framework does not favour the commercial development of renewable energy (hydropower notwithstanding), in spite of the country’s important resources. CFE is legislated to buy the cheapest electricity available, without considering external costs, and to give preference to firm capacity for new power installations in order to ensure the reliability and stability of the national grid. Buy-back prices for electricity do not allow for any increment for renewable energy and buy-back prices for non-programmed electricity production are discounted. No capacity credits<sup>22</sup> are granted for intermittent power production, and CFE is under no obligation to purchase renewable energy production. Renewable power access to the electrical system is allowed by law, but not necessarily encouraged, in part because the effects of intermittent sources on the national grid have not been adequately explored. Since buy-back prices are based on consumer rates, as determined by SHCP, CFE currently has no authority to grant exceptions or provide incentives for renewable energy. A critical need therefore exists for the creation of *tailor-made* regulations for renewable energy, in particular for wind, as well as complementary modifications to the legal framework. Proposals made in the past by private sector wind energy promoters have lacked the necessary institutional support to be carried forward and have not included a comprehensive approach to barrier removal. Thus their effect has been minor.
- **Economics of wind power** – In Mexico, as is the case in most countries, the majority of wind power plants cannot compete with conventional power on the basis of costs/kWh alone. Wind resource availability does not generally coincide, in terms of location or time of day, with the most favourable buy-back prices. However, the average price of electricity in Mexico in the year 2002 was estimated at 6.33 US¢/kWh. It is therefore expected that with moderate incentives wind can become a competitive form of electricity generation in Mexico. This support could, for example, come from some type of innovative mechanism, such as the *transitional*

<sup>19</sup> See table 1 and response 2) to STAP review in Annex D, page D-1

<sup>20</sup> Assumes an investment cost of 800 US\$/kWh, a capacity factor of 40% and a discount rate of 7%

<sup>21</sup> Assumes an investment cost of 1200 US\$/kWh, a capacity factor of 20% and a discount rate of 10%

<sup>22</sup> Power producers normally receive a payment for their installed capacity available to the grid, in addition to what they are paid per kWh delivered. This payment is known as the capacity credit.

*price guarantee* that has been implemented in Spain. A range of mechanisms would have to be analysed in order to select the one (or more) that will be most appropriate for and successful in Mexico. As numerous studies comparing financial mechanisms have been carried out by other countries, such an analysis should begin by reviewing existing studies<sup>23</sup> as to their relevance for Mexico.

- **Financial limitations** - In order for commercial wind projects to be implemented, potential project developers, both national and international, need to have confidence in the financial viability of the wind power market in the country. Given the lack of experience in commercial wind power development in Mexico, a potential financial network needs to be identified and strengthened so that it is able to identify and understand the business opportunities and risks associated with wind power development. The regulatory barriers outlined above can become financial constraints by perpetuating the perceived high investment risks associated with projects with elevated preparation costs and no guarantee that they can be implemented within a reasonable time frame. There is a critical need to cultivate a confident and stable business environment that can provide appropriate guarantees to international and national financial institutions on the viability and profitability of wind power projects.
- **Market structure and human resources** - Although several manufacturers of wind turbine components are already operating in Mexico, more needs to be done to ensure the existence of a healthy domestic industry that can supply wind turbine components on a competitive basis. Broader exchange and closer cooperation must be established between the manufacturing industry and the research institutions involved in wind power technology in order to consolidate national expertise. There is a significant lack of personnel trained in both the development and implementation of wind power projects, and in the operation and maintenance of wind energy technologies. Several training initiatives aimed at developing specialized wind energy capacity in Mexico are under way, but these are still very limited.
- **Technical and information barriers** – Except for a few sites, the wind resource data currently available for Mexico is very general, and inadequate for pre-investment studies. Although initiatives to expand Mexico’s wind energy database are in progress, these activities are insufficient to develop a database that can facilitate the formulation, evaluation and negotiation of wind power projects. There are currently no national standards, specifications nor recommended practices for the development of wind power projects in Mexico, to assist developers who wish to begin projects in this country. Potential developers will therefore be wary of bringing in technology that has not yet been tested and utilized in Mexico. There is also a significant lack of knowledge among the main actors in the potential wind energy market regarding the state of development of wind technology, and the potential benefits that it could bring

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<sup>23</sup> See for example : J. Armstrong. The Littlechild Model. Independent Energy, September 1996. C. Larsen, et al. National Summary Report on State Programs and Regulatory Policies for Renewable Energy. North Carolina Solar Center, January 1998.

to society. In spite of CONAE's efforts in this regard, outreach activities are still limited by a lack of funds.

Global trends<sup>24</sup> indicate an annual growth rate of approximately 30% in grid-connected wind installed capacities; nevertheless, due to the reasons discussed in the preceding paragraphs, the growth of grid-connected wind power facilities in Mexico has been negligible.

### **International Experience in Barrier Removal: Lessons Learned**

**35.** Proponents of this project recognise that similar barriers<sup>25</sup> have had to be removed in all of the countries currently leading in wind power development. It is clear that some of these countries have overcome important barriers on their own, but most have had to be encouraged and supported by international programs and policies in spite of their degree of prosperity. In fact, in spite of the significant efforts made through international policies and the copious financial support of the European Union, expected progress on the implementation of wind energy in Europe has not yet been achieved, and wind energy resources in Europe are still unevenly and insufficiently exploited. It is important to note that the IEA recently stated that national R&D programs in countries such as Germany, Denmark, the USA and Spain, played a crucial role in the successful implementation of wind energy. They also recommended that priority for the first phase of a national R&D program be placed on: wind resource assessment, demonstration projects in target deployment areas and wind turbine test centres to provide training and indigenous technical development.

- **Europe:** As an example, “Spain introduced a special regime for renewable energy with the specific target that *the contribution of the renewable energy to the Spanish energetic demand will be at least 12% for the year 2000*. The regime gives two choices to producers: one is a fixed price for the kWh generated, the second option is a variable price, calculated from the average price of the market pool, plus a bonus per kWh produced. The fixed price and the bonus are updated every year by the Spanish government and the Industry according to the annual variation of the market price. Wind energy buy-back price in 2000 was 5.8 US¢/kWh (3.1 base price + 2.7 bonus)”<sup>26</sup>. As a result Spain has installed 2577 MW in less than eight years, and current target for 2010 is 8974 MW. Since 1991, the German Electricity Feed Law obligated utilities to pay-back to wind power producers 90% of the average tariffs per kWh that private consumers had to pay. In 1999 this amounted to 7.8 US¢/kWh. In 1999, a completely new renewable energy law was issued by the German Government. The general contents of this law is: obligation on electricity grid operators to give priority access to all renewable electricity, fixed tariff for each renewable, rules on grid connection and grid reinforcement, mechanisms to spread the tariff costs equally across all grid operators (renewable quota arrangement). Operators of wind turbines should receive at least 8.4 US¢/kWh for the first five years of operation. From the sixth year, the tariff for turbines that have generated 150% more power than a defined “standard turbine”

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<sup>24</sup> World Energy Assessment, op. cit.

<sup>25</sup> Annual reports of the IEA Wind R&D.

<sup>26</sup> Avia, Félix. IEA Wind Energy Annual Report 2000, pg. 155.

will drop to at least 5.7 US¢/kWh. For wind turbines that produce less than the theoretical 150% reference turbine limit, the period of maximum payment is extended by two months for every 0.75 percentage point by which production fails to reach 150% of the standard turbine output<sup>27</sup>. Germany now has more than 6000 MW of installed wind power capacity. One study<sup>28</sup> suggests that it is no coincidence that those countries that have offered fixed buy-back prices for wind power generation (e.g. Spain, Germany and Denmark) have had more success in developing wind energy markets than countries that have set quotas for wind capacity, such as the UK, Ireland and France, where results have been relatively disappointing. The European Commission, in its White Paper for Renewable Energies, similarly points out that “A major factor in the recent market success of wind energy in...Denmark, Spain, and particularly Germany which now has the world’s largest electricity generating capacity from wind, has been the price paid by the utilities to wind generators for sale onto the grid.”

- **India:** India is the most advanced developing country in wind energy development, with a total of 1340 MW of installed wind energy capacity as of March 2001. The Wind Energy Division of India’s Ministry for Non-Conventional Energy Sources (MNES) together with thirteen State Nodal Agencies encourage wind energy development through financial incentives, demonstration projects, and policy support, as well as a through the creation of a Centre for Wind Energy Technology (C-WET). C-WET, which is an autonomous institution of MNES, has set up a total of 463 wind monitoring stations throughout India (data is available on the internet) and is responsible for developing standards, and testing and certifying wind turbines. India also has a significant local wind turbine manufacturing industry. It is important to note that India received substantial financial support from Denmark for developing its wind energy market<sup>29</sup>.

- **China:** China began developing its wind resources over a decade ago, but as of the end of 2000, only had 345 MW of installed capacity. China is the world’s largest manufacturer of small wind turbines, which currently provide relatively inexpensive power for rural areas. However, China does not produce any large turbines, and therefore these must be imported at considerable cost. Most wind power plants in China have had to rely on concessionary loans for financing since wind energy is still relatively expensive when compared to coal and hydro, which have been heavily subsidised for years. In 1999, China initiated a new policy that would allow renewable energy projects to receive loans at reduced rates as well as guaranteed access to the grid and premium buy-back prices. It appears, however, that a lack of clarity in this policy is slowing project development – in fact, as of March 2001, no project taking advantage of this policy had yet been approved. China is also considering new market-based instruments as part of its next 5-year plan, including a mandated market share for renewable energy, and the trading of green certificates.<sup>30</sup>

- **State of Texas (USA):** In 1999, the State of Texas enacted the Renewables Portfolio Standard as part of the state’s restructuring of the electricity legislation. This

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<sup>27</sup> N.Stump; R.Windheim, IEA Wind Energy Annual Report 2000, pg. 99.

<sup>28</sup> A. Wagner, *The Growth of Wind Energy in Europe*, American Wind Energy Conference, Burlington, VT, June 1999.

<sup>29</sup> Information on India was obtained from India’s Wind Power website : [www.windpowerindia.com](http://www.windpowerindia.com)

<sup>30</sup> “Energizing China’s Wind Power Sector”, Lew, Debra and Logan, Jeffrey, [www.pnl.gov/china/ChinaWnd.htm](http://www.pnl.gov/china/ChinaWnd.htm).

standard requires an additional 450 MW of renewable energy to be installed by 2003, and increasing increments over the next six years, for a total of 2000 MW by 2009. All retail sellers of electricity must obtain their share of renewable energy either directly or through a credit-trading program, and can choose to buy green power through the Texas Pilot Choice Program that began June 1, 2001. As a result, some 600 MW of new wind energy projects and 100 MW of other renewable energy projects are currently proposed or under development. According to a survey conducted by the American Wind Energy Association, the Texas legislation is the most effective policy any state has recently adopted to promote renewable energy. It not only sets the requirement high enough to trigger market growth, but it makes the requirement apply across the board to electricity providers, bases proof of compliance on tradable credits and sets penalties for non-compliance.<sup>31</sup>

## **B. BASELINE PATH OF DEVELOPMENT**

**36.** The business-as-usual scenario for meeting Mexico's increasing electricity demand favours increased investment in combined cycle natural gas plants, with natural gas possibly supplying 90% of new capacity by 2009. However, shortages and volatility prices of natural gas could represent a constraint in this direction, which in turn could reverse to oil or coal use. This would result in an important increase of GHG emissions in the electricity sector. On the other hand, given the relative wealth of fossil fuels found in Mexico and the pressure on the Government to focus on basic needs, it cannot be reasonably expected that Mexico would implement wind power on the basis of its global environmental benefits alone. The country is interested in wind as long as its exploitation can generate substantial national economic and social benefits as well. The number of private wind power projects that have been negotiated, but have not moved forward due to the lack of initiatives and constraints the energy sector is currently facing, attests to this situation. Many developers have publicly indicated their interest and possible strategies for meeting private agents' (including municipalities) needs under the self-supply modality. However, the development of these individual markets will not resolve the issues related to internalisation of environmental variables and private consumers related risk, a propitious regulatory framework for renewables and the technical considerations that grid-connected wind farms pose for CFE. This project concentrates on the second set of barriers related to public tenders for grid expansion.

**37.** Thus, the baseline scenario involves little successful commercial development of wind resources over the coming decade. The search for economic support for launching a national wind energy program would continue, together with the operation and maintenance of the two existing wind power stations (1.5 and 0.6 MW).

**38.** The institutions that are already working to promote wind energy development (discussed in 7.3) will continue their ongoing activities. Specifically, in the baseline scenario, the following activities will proceed:

- IIE will carry out limited wind energy measurements in the most promising areas, provide support for pre-investment studies, further the development of its GIS,

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<sup>31</sup> "Texas round up on wind power", Environmental News Network, March 30, 2001: [www.enn.com/news](http://www.enn.com/news).

although with limited wind energy data, and continue its ongoing activities in capacity-building.

- SENER and CONAE will continue promoting wind energy as a viable energy source, regardless of market barriers, as a means to displace fossil fuels.
- COFER will continue to provide advice and input to policy makers and other interested parties on the benefits of wind energy.
- SENER and CRE will continue its limited efforts to modify the legal framework, which may pave the way for private investment in self-supply projects.
- Mexican companies will continue to manufacture electric generators and 5 kW turbines for export markets.

## **C. GEF ALTERNATIVE COURSE OF ACTION**

### **Project Objectives and Strategy**

**39.** The development objective of the project is to reduce annual GHG emissions in Mexico by 4 Mt CO<sub>2</sub> equivalent<sup>32</sup> through the installation and operation of commercial wind power plants in Mexico on a large scale, delivering electricity to specific market niches or directly to the central grid through revised national wind energy contracts. The immediate objective is to reduce the identified barriers to wind energy commercialisation in order to 1) facilitate the installation and operation of the first three commercial wind energy plants in Mexico with grid connection, 2) create the critical elements needed for a sustainable wind energy market in Mexico.

**40.** The project adopts a comprehensive and systematic approach for removing barriers to the full commercial development of wind power in Mexico. It has been designed to utilize a phased strategy, wherein the first 2 years focus on establishing national and regional capacities; removing institutional, legal, regulatory barriers (barriers 1 and 2); and improving the resource information base through wind resource assessment—barrier 5). This first phase of the project will promote the initial move toward market commercialization of wind power in the promising regions within Mexico.

**41.** As it has been conceived and designed, Phase 2 of the project (with an estimated duration of 3 years) will focus on securing the construction of 3 commercial wind power plants rated at between 15 and 30 MW each, within the context of energy markets where renewable energy generation can fill strategic supply niches. This second phase is expected to comprise an initial commercial phase, with the promotion of possible business models and contract modalities. It should introduce selected financial mechanisms in a sustainable manner accompanied with an extensive information dissemination campaign.

**42.** However, in the time intervening between when this project was designed and approved, the potential need for and role of a Phase 2 of this project have changed, largely by the approval by the GEF of the World Bank's project entitled "Large-Scale Renewable Energy Development Project" (GE-PO77717). As neither the GEF nor UNDP can support

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<sup>32</sup> Based on an installed capacity of 2000 MW with an average capacity factor of 30%. It is assumed that the wind energy will displace combined cycle gas turbines.

a Phase 2 project that does not fully respect the achievements of the World Bank project, the original architecture and specific contents of the Phase 2 project will be carefully reconsidered prior to its submission to the GEF Secretariat and Council for approval.

**43.** Phase 1 of this project has been carefully prepared with broad stakeholder consultations within the GoM administration, and the project is considered to be an important component of Mexico's efforts to fully incorporate wind energy in national planning. GoM's integrated strategy for renewable energy responds to specific issues such as energy diversification, new investment opportunities, national research and development capacity, emissions reductions, and regional development. During the implementation of Phase 1 of this project, early lessons learned from this effort and from those of the World Bank project will be used to adjust the additional barrier-removal activities proposed for inclusion in Phase 2. If both this UNDP-GEF project and that of the World Bank are considered successful, there may be no further need at all for Phase 2 of this UNDP-sponsored effort. Careful evaluation of the progress achieved under both projects will be necessary prior to preparing and finally submitting for approval Phase 2 of this initiative.

**44.** Built into the design of this Phase 1 project are qualitative and quantitative benchmarks to be compared with the actual status of wind energy development at the end of Phase 1 of this project. In addition, an external, independent evaluation of the project, its achievements, the achievements of the World Bank project, and the current status of the wind energy market in Mexico will be undertaken to determine whether or not the investment support for the 3 business demonstrations originally expected to take place in Phase 2 of this project is still feasible and necessary to the open functioning of the wind-market in Mexico. That evaluation will be published prior to the revision of the Phase 2 proposal, and the resulting Phase 2 proposal will be revised, reworked, or abandoned accordingly, to be consistent with the conclusions of that evaluation.

**45.** If Phase 1 barrier removal activities are fully successful, the World Bank project has reasonable success, and the wind market appears to be functioning as envisioned, the GEF resources for Phase 2 will not be needed. GOM and UNDP are therefore requesting funds for Phase 1 only. The eventual transition to Phase 2 will take place if and only if the Phase 1 project is successful, and the additional support envisioned in Phase 2 is still considered necessary because of the failure of the renewable energy market to develop as desired.

#### **Project Outputs, Activities and Indicators**

**46.** The project is divided in two phases in order to allow for maximum flexibility in the process. For more details on project activities and indicators, refer also to Annex B: Project Planning Matrix and F: Work Plan/Time Table.

Phase I is designed to remove barriers of institutional, legal, regulatory, information, human capacity, and technical nature and will be comprised of:

- Renewable energy institutional, legal and regulatory framework, output 1;
- The construction and operation of a wind energy centre, output 2;
- Wind resources mapping, feasibility studies, project proposals and project promotion, output 3; and

- Promotion and support for wind energy development, output 6.

It is expected that, at the end of Phase 1, the necessary conditions for a bid-driven wind development will be highly advanced in accordance with the GOM policy. If they are not, then Phase 2 of the project will not go ahead. Phase 2 will also not go ahead if support to such bid-driven developments is deemed unnecessary due to the successful and timely implementation of the World Bank project. In any event, the Phase 2 project will be tailored to fit the new conditions prior to its submission to the GEF Secretariat and Council.

As currently conceived, Phase 2 is oriented to temporary incentives during market take-off. In the event that Phase 2 is judged necessary to contribute to the successful implementation of the market's development, it is anticipated that Phase 2 might draw from a menu of activities designed to:

- Expand data collection;
- Construct three 15-30 MW wind facilities;
- Introduce Appropriate Financial Mechanisms; and
- Promote and support wind energy development.

### **Inception and Implementation Activities of Phase 1:**

Activity (i): Project formalization; One or more stakeholder meetings will be performed in order to present and prepare the project. There will also be sub-activities to prepare, negotiate and obtain signatures of required agreements.

Activity (ii): Institutional harmonization; Integration of the Steering and Working Committees, the PCU as well as of Specialized Teams and Expert Groups. Specific benchmarks will be elaborated and the general Work Plan reviewed. Furthermore, detailed work plans and time tables will be prepared for each outcome.

Activity (iii): Personnel selection and hiring; Development of statements of work, followed by call for candidates, selection and hiring of personnel.

Activity (iv): Project monitoring and evaluation; The sub-activities of this concept are constituted by an inception workshop and its subsequent report, day to day project monitoring, quarterly and annual progress reports, annual audits, phase-one final external evaluation and potential preparation of Phase 2. This includes objective specific measures as specified in following sections of this chapter.

**Output 1.** Enhanced institutional, legal and regulatory framework for wind energy (GEF: US\$ 1.287M; COFIN: US\$ 0.310M - Phase 1: US\$ 1.187M)

**47.** In order to reduce the institutional, legal, regulatory and economic barriers (1 and 2) to wind power commercialization, Phase 1 of the project will begin with a thorough review of the current institutional, legal and regulatory frameworks affecting the electricity market in Mexico, so that a clearer and more comprehensive understanding of these barriers is developed before any changes are proposed. This process will build extensively upon already existing analyses in Mexico and in other countries regarding such issues, and it will increase in a significant manner the intensity and scope of processes already under the mandate specifically given by SENER to CONAE. Thus, SENER will lead the review process, heading a group with representation from the Ministries of the Environment (SEMARNAT), the Economy (SE) and Financial (SHCP) as well as CRE, CFE, and IIE. This group will then proceed to work together with distinct stakeholders on the local, regional, national and international level, to identify and propose a set of potential amendments that together would stimulate the development of wind energy in Mexico, based in part, on the experiences of other countries. The overall review will include an analysis of crucial technical, financial and economic mechanisms that could help level the playing field for wind energy in Mexico and specify how the new regulatory framework should address them. This includes issues such as grid-access for wind power, PPA models for IPP, incentives to wind power development and fitting financial modalities.

**48.** Proposed regulatory, institutional and legal amendments are then submitted to the appropriate government institutions, and monitored and reviewed until an appropriate framework has been developed that provides equitable conditions to wind energy generation. To facilitate the effective political acceptance and implementation of these amendments, an educational campaign will be launched to secure sufficient awareness and knowledge among major decision-makers - such as the Congress, state and government officials - of the economic, environmental and social benefits of wind power.

**49.** This will be achieved through a two-pronged approach of targeted task forces working towards drafting reform proposals with the regulatory, legal and institutional ambits in Mexico, combined with the utilization of participatory processes involving workshops, specialist seminars and targeted courses for practitioners and non-practitioners involved in the field as distinct decision makers. The project takes advantage of GOM's efforts to "piggyback" convincing elements for regulatory framework modifications in the overall sector reform in a similar manner, as the World Bank will eventually do. These elements include the elaboration of model contracts during Phase 1, increasing the analytical capacity of CRE and others to evaluate instruments such as capacity credits, and in general to expand the criteria used in the decision-making process on renewable energies. These are targeted support efforts, not broad sector reforms. If appropriately addressed, the removal of the barriers as discussed above would allow the government to consider renewable energy on levelised terms to meet identified generation targets through public tenders. IIE has a clear role and mandate to provide reliable technical information on renewable energies to CFE, the agency that would carry out any public tenders. UNDP/GEF will provide funding and technical assistance to complement and guarantee the broad level of participation of all relevant stakeholders in this above mentioned process involving

strategic planning, negotiation and monitoring, and local, regional and national resource people available during critical points of progress in the process of promoting the reform proposals. A specific activity will be carried out in phase 2 corresponds to inclusion within the regulatory framework of financial mechanisms (i.e. guaranteed or bonus) if needed.

**50.** Monitoring and evaluation of project outputs and activities will be performed on a continuous basis, in order to ensure consistency with established work plans. A final evaluation of phase 1 will contain a thorough analysis of the results of the project (see section G. Monitoring, evaluation and dissemination).

### **Activities Output 1:**

Activity 1: Thorough review of the current institutional, legal and regulatory frameworks affecting wind energy development; specifically, a group led by SENER will carry out a full review of frameworks and propose amendments. This effort includes environmental, energy, electricity, economy, financial and social frameworks, as well as a detailed review of the resulting document.

Activity 2: Preparation of proposals on potential amendments of existing institutional and legal frameworks; Proposals include regulations on grid-access for wind power, PPA models for IPP, incentives to Wind Power development and fitting financing modalities. The resulting proposals are then reviewed, cleared, and included into a formal decision-making pipeline.

Activity 3: Promotional campaign aimed at sensitizing related parties on wind energy development issues; A promotional campaign will be carried out, reaching most of the major decision-makers within the public sector, including ministers, congressmen, key actors, and general public. Explicitly, this comprises the development of the terms of reference for the promotional campaign material, call for tenders, preparation and publication, supplier selection process and procurement process. The actual campaign will be launched as soon as the associated strategy is defined.

**Output 2.** National and regional capacities established to support the development of wind as a viable energy supply source within the energy market (GEF: US\$ 2.625M; COFIN: US\$ 5.750M - Phase 1: US\$ 7.425M and Phase 2: US\$ 0.950M).

**51.** A Regional Center for Wind Energy Technology will be constructed in Oaxaca where personnel will be able to gain understanding and hands-on experience in the operation and maintenance of a variety of wind turbine technologies installed on the platform. This facility will offer the following to different stakeholders: a) support to interested wind technology manufacturing companies for the characterization of their products under local conditions of La Ventosa; b) means to train local technicians for operation and maintenance

of a diversified range of wind turbines; c) an easily accessible national technology display<sup>33</sup>, facilitating the encounter between wind manufacturers and Mexican industries, thus promoting the identification of potential shared business ventures; d) a modern and flexible installation to obtain hard operational data for a special study on grid safety related to the interaction of specific types of wind turbines with the local grid; e) a means to understanding international standards and certification (issued abroad), in order to detect additional requirements to fit local conditions; f) a means to increase the playing level of national research and technology development, including joint projects or specific collaboration activities with prestigious overseas R&D institutions; g) studies regarding the effect of intermittent wind power on the grid operated by the CFE to ensure efficient actions on behalf of the government.

**52.** After the permits and agreements have been obtained, and the platform is in place, the project will hold targeted workshops at the RWTC in the two principal fields of, 1) technically oriented workshops aimed at strengthening national capacities of wind power technology by initial training of interested technicians, and, 2) a broadly oriented course-workshop on the implementation of wind power with an integrated approach, spanning from technical, environmental, economic and social issues. This latter activity is aimed at participants from related governmental institutions - such as SENER, CFE, CONAE and CRE - as well as the private and academic sectors. Furthermore, training activities will be performed at technical institutions in order to internalize a wind energy approach in institutional programs.

**53.** The importance of such a wind facility to promote the development of national wind initiatives on a sustainable basis has been increasingly emphasized through recent experiences, in which the lack of adaption contributed to technology failures, notwithstanding the fact that the wind turbines were certified (e.g., Costa Rica, Greece). This has led to recent initiatives to construct similar facilities in Greece, Spain, and The Netherlands as well as for expanding the testing capability of existing facilities (e.g., RISO) in order to evaluate the performance of wind turbines under extreme conditions (high or turbulent winds). In Mexico, the 1.6 MW wind power plant, operated by CFE, also experienced some technological adaptation problems. Furthermore, the operation of the wind facility will be very valuable to provide training and indigenous technical development, as it was recommended by the wind energy committee of the IEA.

**54.** In recognising the key role played by government-led research and development initiatives detailed above, the proposed centre in the project is not to be used to “screen” potential investors in commercial enterprises, rather the focus is on human resource development, generation of data to refine existing modelling methodologies useful to

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<sup>33</sup> When in operation, the facility will include a number of commercially available wind turbines interconnected with CFE’s transmission lines for a pre-arranged but limited period of time. The facility will be operated under the responsibility of IIE, overseen by a small ad-hoc committee integrated by institutional bodies of the wind energy industry, the national regulatory bodies, the GEF-UNDP, and the CFE. This ad-hoc committee will have the responsibility of approving the rules for the operation of the facility, and to guarantee equal opportunity, fair access, transparent operation, and intellectual property rights safeguards to all those interested in the use of the facility. Wind turbine characterization and other related activities will be carried out by IIE research staff in collaboration with the turbine owner, under the provisions and terms of reference of individual agreements established under the umbrella of the operational rules for the facility approved by the ad-hoc committee.

identifying other promising regions, generation of reliable information on the effects of intermittent power sources on the grid, and proving the stated technical specifications of different types of equipment under real-life conditions. The inclusion of the proposed financing for the centre responds to an overall strategy designed by the Mexican Ministry of Energy to promote the inclusion of renewable energies in the national energy mix in a significant manner. UNDP considers that the inclusion of the centre is part of country-driven strategy that is coherent within the GEF operational strategy and also with UNDP's mandate to promote sustainable human development. The GEF funding sought for the construction of the facility will be applied to the construction of the civil works and electrical installations for the interconnection with CFE's lines, and the installation and commissioning of a first 500 to 700 kW wind turbine. It will also facilitate capacity building and dissemination efforts linked to the results generated by the regional wind technology centre, so to secure wide spread impact upon regional development of sustainable energy markets. The facility will be connected to the national grid operated by the CFE through an interconnection agreement, targeted to facilitate the operation of the centre. Proceeds from the sale of electricity to CFE will go into a trust fund to help finance the day-to-day operation of the facility and to support complementary research activities.

**55.** The experiences from the project will be formulated in a widely disseminated best practice manual. Among specific topics to be included are project formulation and evaluation, interconnection standards, land-tenure issues, environmental practices, and a standardised procedure for obtaining necessary permits. Specific monitoring and evaluation of project outputs and activities will be performed on a continuous basis, in order to ensure consistency with established work plans. A final evaluation of phase 1 will contain a thorough analysis of the results of the project (see section G. Monitoring, evaluation and dissemination).

#### **Activities Output 2:**

Activity 4: Preparatory activities for the RWTC; The project will be reviewed by the Working Committee, and negotiations be concluded regarding land issues in order to secure wind-rights. Moreover, sub-activities are oriented towards design of the interconnection line. Additional efforts will be concentrated to the permits and agreements required to build the RWTC (with CFE and CRE, among others, and including issues such as environment, construction and land use); procurement of the interconnection agreement, construction and operation permit at the federal level, environmental permit at the federal level, and construction permit at the local level. Finally, a detailed design review will be performed.

Activity 5: Bidding processes for the RWTC; after initial preparation and realization of a detailed bidding processes plan, preparation of bidding bases and calls for tenders, sub-contracts will be endorsed for starting construction of the RWTC.

Activity 6: Basic infrastructure construction for the RWTC; Preparation and construction of interconnection line, control room and wind-turbine-site

access road, ducts for power and signal cabling, foundations for a wind turbine and transformer, associated cabling.

Activity 7: Installation of additional wind turbines; Manufacturers and project developers are invited in order to agree upon specific modalities necessary for installation and testing of equipment. There will be sub-activities for the construction of foundations for wind turbines and transformers, associated cabling as well as the necessary measures taken for the transportation and installation of wind turbines and towers, and commissioning of wind turbines.

Activity 8: Commissioning of the RWTC; Definition of operational protocols. Usage by stakeholders of the services offered by the RWTC. Wind technology manufacturers are offered the necessary conditions for characterization of their products under local conditions, a fitting space for technology display, data collection and generation of technological studies on equipment and interconnection issues.

Activity 9: Courses on wind energy included in the programming of technical institutions; Training activities will be performed at technical institutions in order to internalize a wind energy approach in institutional programs.

Activity 10: Workshops in the RWTC; The first two workshops on wind power technology will be held in the RWTC in order to train interested technicians in the operation of wind power plants with the purpose of strengthening national capacities.

Activity 11: Course-workshop in the RWTC; A course-workshop on the implementation of wind power is held in the RWTC in order to improve the understanding of wind power technology among key actors. The course-workshop will enhance the associated knowledge among key participants from SENER, CFE, CONAE, and CRE, as well as from the private and academic sectors. The agenda will cover all major topics on the implementation of wind power, including technical, environmental, economic, and social issues.

Activity 12: Best practices manual; A first edition of the best practices manual will be completed, including topics such as project formulation and evaluation, interconnection standards, land-tenure issues, and environmental practices. The manual will be disseminated via internet, and 100 CD copies are distributed in meetings, seminars, and workshops.

**Output 3.** Wind energy resources assessed at the sites with the highest commercial development potential in Mexico, and complete feasibility studies for 3 wind power plants (GEF: US\$ 1.260M; COFIN: US\$ 2.710M - Phase 1: US\$ 2.857M and Phase 2: US\$ 1.113M).

**56.** The third focus area of phase 1 will be aimed at improving the quality, quantity and regional coverage of wind resource data in the country in an attempt to reduce the information barriers (barrier 5) to wind energy development. To produce this output the project will specifically promote four main lines of initiatives. At the 15 most promising sites for commercial wind power development in Mexico within 5 selected states, reference stations will be set up to evaluate the wind energy resources in a precise manner using the latest internationally approved techniques. The information obtained will then be classified and mapped into an advanced GIS database managed by the IIE, together with a wider national wind resource database available to potential developers and other interested parties, incorporating information about protected and environmentally sensitive zones. Feasibility studies will be commissioned for 3 promising wind power projects at distinct sites. The studies will cover all issues relevant to the commercial development of 15 – 20 MW wind power plants, including environmental impact, land tenure, financing, detailed resource assessment, transitional rate guarantees, etc. General bidding bases for the model projects will be prepared and approved by the Steering Committee. Simultaneously, the project will receive expression of cooperation from related stakeholders and project developers.

**57.** Finally, a set of background studies that will provide generic information required by developers for the implementation of future wind projects will be undertaken for the region of La Ventosa. These studies will provide an environmental impact assessment for the region that includes environmental impact levels, wind energy potential, land ownership, infrastructure availability (roads, electrical lines), grid-safety and potential electricity uses. Other regions of Mexico might also be assessed, depending on the availability of time and funding. All information gathered within this activity would be made available to state and federal authorities as well as to potential national and international investors for use in the promotion and development of specific projects. It is anticipated that this information will save time, effort and money for project promoters and developers, and therefore will help facilitate the creation of a wind energy market. UNDP/GEF funding will be utilized to cover strategic mapping of wind resources in selected states preparing the ground for commercial development. Additionally, it will support the establishment of sufficient information and solutions, representative of the national level, to handle critical issues of land ownership, environment and infrastructure availability and potential in important development regions in Mexico.

**58.** Monitoring and evaluation of project outputs and activities will be performed on a continuous basis, in order to ensure consistency with established work plans. A final evaluation of phase 1 will contain a thorough analysis of the results of the project (see section G. Monitoring, evaluation and dissemination).

### **Activities Output 3:**

Activity 13: Preparatory activities for wind resource assessment; The Working Committee will perform a specific review and prospecting of the most promising areas. Sites for wind measurement will be identified and negotiation of permits to install measurement towers as well as equipment acquisition will be concluded.

Activity 14: Wind resource assessment; Fifteen anemometric reference stations will be installed and operated by the project personnel. Wind data will be collected and wind energy resources evaluated every two months at 15 sites in 5 states. Actualizations are subsequently carried out every two months. Wind resource characteristics will be continuously disseminated worldwide through internet. Additionally, a one-year wind energy resource evaluation area one-year wind energy resource evaluation is to be completed for fifteen promising sites.

Activity 15: Model wind-power-projects feasibility studies & formulation; Three feasibility studies will be completed for the development of three 15-20 MW plants to be operated under regulatory improved conditions or innovative modalities. The activity includes the identification of opportunities for new and innovative projects, compilation of detailed information, analysis of information, and formulation of projects. General bidding bases for model projects will be prepared and approved by the Steering Committee. Preliminary negotiation with interested stakeholders and project developers will take place, as well as preliminary evaluation of promising projects. In this way, the project will receive the necessary inputs to produce detailed documentation of promising projects, financing proposals, detailed evaluation of financial feasibility, and, preparation of bidding bases.

Activity 16: Generic studies for La Ventosa; Publication of a first document for the wind energy project at La Ventosa. Elaboration of generic studies on land tenure issues and on wind mapping, environmental zoning, infrastructure development, grid-safety and interconnection planning as well as on wind-power dissemination.

Activity 17: Generic studies aimed at facilitating the processing of wind projects; a draft chapter on social issues will be issued for the best practice manual. Additionally, a generally applicable methodology will be elaborated for packaging permits to speed the licensing of wind turbines.

**Output 4:** Development and construction of three 15-20MW wind energy business models in distinct regional energy markets in Mexico (GEF: US\$ 6.667M; COFIN: US\$ 67.650M - Activities carried out in Phase 2).

**59.** As a first step, a competitive bidding process, co-coordinated by CONAE and IIE, will be arranged for selecting the private sector companies to develop three 15 – 20 MW commercial wind projects. This activity will involve close cooperation with the state governments of the regions in which the projects will be implemented, so that these governments can assist in bringing in potential private sector players and additional in-kind contributions. The implementation of the plants will be monitored and documented by IIE and CONAE with supervision of SENER in cooperation with the project developers, so that lessons learned can assist in the development of future projects. Experience acquired through these projects will also serve as input to the formulation and implementation of

future market-oriented renewable energy policies within the revised national wind energy policy framework. GEF funds directed to this activity will not be used to subsidise investment or construction of the wind power plants, but rather to remove financial barriers during the operation of the plants, for example by reducing wheeling charges or providing temporary premium buyback prices. It is expected that allocating funds in this manner could set an example for potential government regulatory actions that could trigger the implementation of additional projects without the need for financial support.

**60.** Preparatory work for this activity is already underway in several states where private project developers have begun discussing possible projects with potential electricity users. Under the current legal framework, these early projects will most likely be of the self-supply type that are permitted under existing electricity laws, in which sales of electricity to CFE are only optional. Joint ventures between private sector companies, or between private sector companies and the government, can be anticipated. Thus the project modality opted for under the support to the above mentioned 3 commercial plants will be evaluated during the initial 2 years of this project to secure the promotion in a manner that gives maximum impulse towards broad regional and national commercial wind markets in Mexico.

**Output 5:** Introduction of appropriate financial mechanisms in the Mexican energy market to encourage commercial wind power development. (GEF: US\$ 0.315M; COFIN: US\$ 0.510M - Activities carried out in Phase 2).

**61.** As suggested by the European Union<sup>34</sup>, wind ventures generally profit from national subsidy programs that may include loan guarantees, fiscal stimuli for capital investments, the establishment of risk-sharing investment funds for renewable energy, as well as premium renewable tariffs, clean production incentives and green markets, among others. What works in one country is not necessarily going to work elsewhere; therefore it is essential that the various financial mechanisms be studied within a Mexican context. With the assistance of expert advisors, financed by this project, CONAE will study a diverse range of financial instruments as to how they might work in Mexico to stimulate commercial wind power development. It is clear that GEF funds are insufficient for implementing a large-scale subsidy program, consequently alleviation of the 3 business-demonstration wind power plants will not be considered as a large-scale replicable option. Of the options analysed, one or two will be identified as having the best potential for success in Mexico and will be developed in greater detail and proposed for introduction at the national level.

**62.** In order to facilitate access to international financing for potential investors in wind power projects, guidelines will be prepared describing the various international financial options available, the requirements of each, and the steps required for accessing these funds. These guidelines will be disseminated to potential wind energy project developers. Information exchange meetings, such as the Wind Energy Colloquium in Oaxaca—now under preparation for its second annual meeting—will serve as one means to disseminate relevant information. UNDP/GEF will facilitate the interchange with other international

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<sup>34</sup> Working paper of the European Commission “Electricity from renewable energy sources internal market”. <http://www.wind-energie.de/english/workingpaper.html>

experiences both through targeted study missions, workshops and seminars to increase both national and international definition and operation of appropriate financial mechanisms adapted to local and national circumstances found in Mexico.

**Output 6:** Promotion of relevant wind power development information based on tested institutional and financial mechanisms (GEF: US\$ 0.315M; COFIN: US\$ 0.540M - Phase 1 US\$ 0.342M and Phase 2 US\$ 0.513M).

**63.** The experience and information acquired at the RWTC will be invaluable to future project developers. To facilitate access to this information, a promotional campaign will be designed and implemented to ensure widespread dissemination of information about wind energy to all of Mexico's regions. Information gained from the pilot projects will include lessons learned from the permitting process, financing arrangements, plant construction and system performance. In addition to the promotional campaign to be carried out under Output 1, during phase-one a number of promotional actions will be supported under Output 6 (e.g., colloquiums, seminars, meetings, brochures), in order to increase awareness of GEF's presence.

**64.** Monitoring and evaluation of project outputs and activities will be performed on a continuous basis, in order to ensure consistency with established work plans. A final evaluation of phase 1 will contain a thorough analysis of the results of the project (see section G. Monitoring, evaluation and dissemination).

#### **Activity Output 6:**

Activity 18: Promotional campaign; Nation wide support for linked promotional activities. Information and lessons learned from the project will be made available to future project developers in order to leverage their success potential. Four wind energy meetings will take place, together with seminars, colloquiums, or conferences complementary to the activities performed in the other outputs. Activity 18 includes elaboration and dissemination of brochures, posters, folders or specialists participation in the described project related events.

## **D. RISKS AND SUSTAINABILITY**

### **Sustainability**

**65.** The multi-faceted approach adopted by this project was designed with the long-term sustainability of a wind energy market in mind. By systematically addressing each of the barriers that currently impede the development of commercial wind power, the project will clear the path for a sustainable wind energy market. Project activities will strengthen the capabilities, awareness and support of key decision-makers at all 3 government levels so that innovative and transparent market development frameworks can be successfully designed and implemented. It will furthermore install permanent regional and national level training programs, and develop a critical mass of support service companies. The result will

contribute to the consolidation of a coherent national program for the promotion of commercial wind energy, with an articulated strategy backed by reliable data, a revised legal and regulatory framework, and a strengthened commercial lending environment. The active involvement of state governments, who see wind energy as a new opportunity for economic growth in their regions, will ensure the growth of regional wind energy markets, and will assist in the replication of project activities throughout the country. UNDP will provide technical, financial and administrative backstopping to the entire process.

### **Project Risks**

**66.** The project faces some risks, as described below, primarily involving various stakeholders. In order to avoid these risks, the project has been designed and will be structured so as to include the participation of and take into account the needs of all stakeholders. Wind energy development in Mexico enjoys strong political support. This is manifested by the efforts of the work group on regulatory changes (Ministry of Energy, IIE, CFE, and CRE) and public declarations made by Undersecretary Dr. Francisco Barnes de Castro, as well the expressed support in a letter sent by Mr. Barnes to Mr. Mohammed Al-Ashry. IIE has provided technical backstopping by its “Plan Piloto” that includes wind energy. Furthermore, public consultations have been held by the government to discuss the incorporation of renewables in the national grid. The following table summarizes some of the main project risks and describes abatement measures that will be adopted in order to avoid such risks.

<b>RISK</b>	<b>ABATEMENT MEASURES</b>
Insufficient commitment and cooperation from participating government institutions	A steering committee with the active participation of all relevant organizations will be formed to guide the implementation of the project. This committee will ensure that input from each government institution is considered throughout the implementation of the project.
Lack of interest on the part of turbine manufacturers for installing their equipment at the Regional Centre for Wind Energy Technology	The committee responsible for the regional centre will include representation from the private sector, including turbine manufacturers, and therefore they will be directly involved in designing the strategy for securing and installing turbines at the centre.
Insufficient private sector interest in constructing the 3 BD-WPP.	The project has been tailored with the interests of the private sector paramount. Companies have already been involved in discussions of the project and every effort will be made to ensure their continued involvement. In particular, data collection, feasibility studies and the bidding process will all be tailored to the needs and interests of the private sector.
Financing is not procured for the 3 pilot wind power plants	GEF funds will be targeted to reducing the financial risks of the project in order to gain the confidence of lending institutions. If this is insufficient, alternative-financing sources will be sought.
Lack of acceptability of wind farms by local communities	Actions will be carried out to achieve that landowners are able to negotiate their highest benefit without putting in risk the financial feasibility of the projects. This is very important because much of the

	<p>land in Mexico is owned by poor rural communities known as <i>ejidos</i>. Up to now, negotiations between project developers and landowners have originated high interest on the side of landowners for lending part of their land to construct wind power projects. The challenge is to establish a correct balance (win-win). For the case of La Ventosa, a first document on “land requirements, land leasing, and the potential job creation”, is right now in preparation by a Team integrated by Winrock International, Global Energy Concepts, and The American Wind Energy Association. Local participation consists in The Mexican Foundation For Rural Development, the Government of the State of Oaxaca and the IIE. This document has already launched discussion on the subject, improved or new versions in conjunction with facts will be used to develop best practices.</p>
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## **E. IMPLEMENTATION ARRANGEMENTS AND STAKEHOLDER PARTICIPATION**

### **Project Implementation**

**67.** A memorandum of understanding (MOU) is being elaborated between SENER, IIE and UNDP. The MOU determines that SENER, the Executing Agency, is delegating all implementing tasks to IIE, the Government Implementing Agency, according to the UNDP national execution modality (according to the UNDP Programming Manual, 6.2.2, paragraph 5). The project will be implemented by IIE with the support of the UNDP Mexico Country Office. The project will operate with quarterly payment advances transferred from UNDP Mexico to IIE. Procedures for the hiring of the project coordinator and administrator are outlined in the UNDP Manual for Nationally Executed Projects (Manual NEX). All other contracts are stipulated according to IIE hiring procedures together with the Manual NEX.

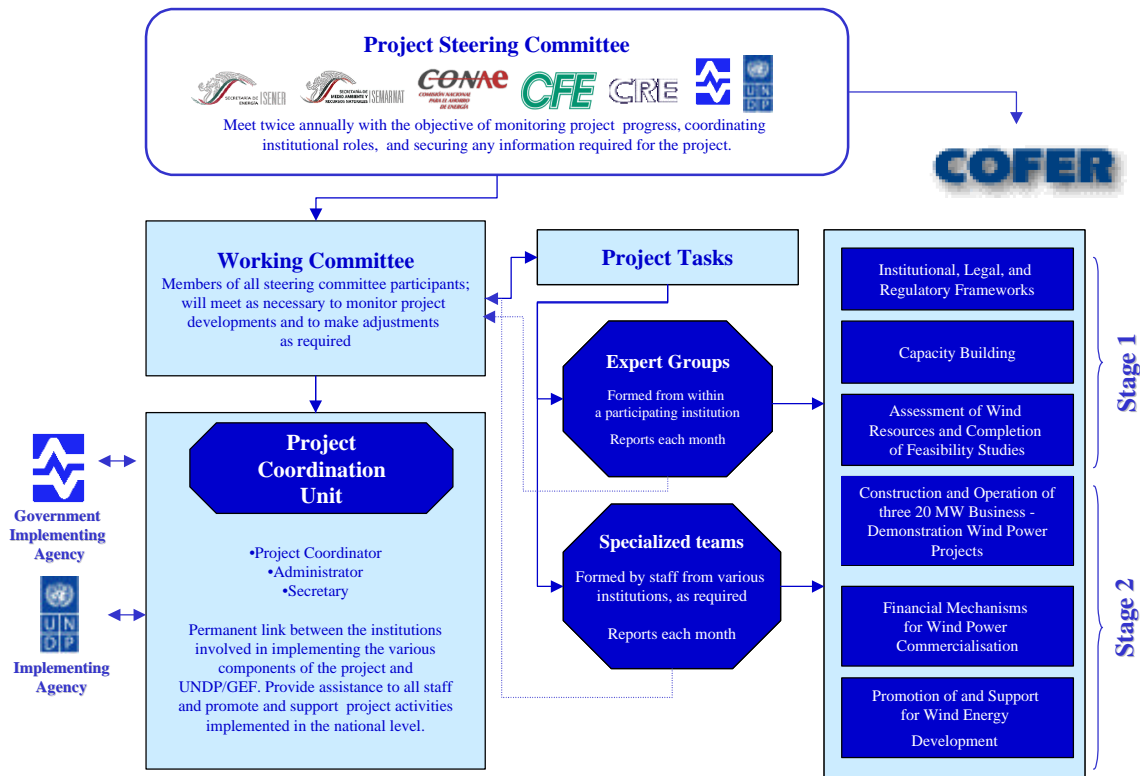
**68.** Project operational co-ordination and oversight will be provided by the Project Steering Committee, comprised of SENER officials, representatives of collaborating ministries, the project manager and project coordinator, selected national technical consultants and UNDP, as required. The Steering Committee will meet twice annually with the objective of monitoring project progress, coordinating institutional roles, and securing any information required for the project. The president of the Steering Committee will serve as the link to COFER, which includes representatives from industry associations, universities, ANES, and financial institutions. During the first meeting of the Steering Committee the creation of a formal reporting/feedback arrangement will be proposed for the explicit provision of opportunities for a range of industry stakeholders to be involved in the project throughout the various stages of its implementation. This arrangement will have to guarantee full transparency at the national and international levels. It is important to note that in addition, a Web Site for the project will be developed to inform everybody about the project, as well as constitute a permanent link with all interested national and international companies.

**69.** Between the meetings of the steering committee there will be follow up on behalf of a dedicated Working Committee assigned with membership stemming from all Steering Committee participants. Their first task will be to plan project execution together with the project co-ordination unit to be established, in accordance with the project goals, objectives, scope, and timeframes. The

working committee will meet as necessary to monitor project developments and to make adjustments as required. Technical project tasks will be assigned to Expert Groups formed from within a participating institution, or to Specialized Teams formed by staff from various institutions, as required. The leader of each of these groups or teams will report to the Working Committee with respect to the progress of their tasks. The president of the Working Committee will also sit in the Steering Committee.

**70.** The Project will establish a small general project co-ordination unit (PCU), with a project coordinator, administrator and a secretary. The project coordinator is responsible for day to day project administration and allocation of the financial GEF contribution according to the PCU-updated quarterly workplans and budgets approved by UNDP and IIE. The project coordinator will also be responsible for maintaining financial accounts and records. Concerning the government implementing agency, a special project manager will be assigned to take the responsibility of overall direction and supervision of all technical project activities and other activities within the government implementing agency, including production of technical documents, as well as overall direction and management of other project activities and contracts not covered by the PCU. The project manager coordinates the Expert Groups and Specialized Teams, and provides progress reporting to the Working Committee, Steering Committee, and the PCU, in order to comply with quarterly workplans and budgets updated by the PCU and approved by UNDP and IIE. This includes preparations of terms of reference for sub-contractors and consultants. Both the project manager and the project coordinator are responsible for applying the strict standards and rules established by UNDP for nationally executed projects.

**71.** The project coordinator will convene regular meetings between the government implementing agency (IIE) and UNDP in order to monitor project progress and identify and resolve any bottlenecks and improve the quality of interventions. In these meetings, IIE and UNDP reviews and authorizes the quarterly financial and progress reports, as well as actualised work plans prepared by the project coordinator. Figure 3 shows the project general organization.



**Figure 3.** General organization

**72.** The strategy for procuring the installation of wind turbines for the Regional Centre for Wind Energy Technology will also be proposed by the Working Committee and jointly approved by the Project Steering Committee and the committee responsible for the regional centre. The format and rules of operation will be defined and approved using the same process.

**73.** During the second phase of the project, US\$ 6 million from GEF funding is targeted to assist with the removal of economic barriers during the operation of the demonstration wind energy plants. GEF funds directed to this purpose will not be used to subsidize investment or construction of the wind power plants, but rather to remove economic barriers (or perceived risks) during the operation of the plants; for example, by reducing wheeling charges or providing premium to electricity production. It is expected that allocating funds in this manner will encourage investors to embark in the three business demonstration wind power plants and will increase confidence from financial institutions. Furthermore, it would set an example for potential government regulatory actions that could trigger the implementation of numerous wind power projects. Proponents of this project acknowledge that GEF funding to alleviate implementation of the three BD-WPP will not be replicable for additional projects within the framework of this Action Plan, and that if after improvements of legal and regulatory frameworks, similar funding for new projects is still necessary, it would have to come from national incentives (e.g., green pricing, effective reduction of wheeling charges, or others).

### Stakeholder Participation

**74.** Broad-based public consultations on the energy sector are currently underway in the context of the integration of the National Development Plan (with both the traditional 6 year and an innovative 25 year focus). Private sector agents are already in the process of identifying the most adequate

financial mechanisms for financing renewable energy development in Mexico. Preparations for the project have included consultations with the private sector and with international experts. Consistent with these consultations and documented best practices, public sector participation in the commercial stage of wind deployment (Phase 2) will be limited to providing appropriate financial incentives and a transparent legal and regulatory framework. Further stakeholder input was obtained at the international meeting in Cocoyoc (June, 2001), and at the Oaxaca Colloquiums. Oaxaca Colloquiums and other similar meetings and workshops will continue to serve as venues for discussion and input throughout the implementation of the project. Members of the National Council for the Promotion of Renewable Energy (COFER) have been actively involved in the preparatory stages of the project. Private consultations have also been held with the GEF secretariat and other implementing agencies, such as the World Bank and UNEP, both at the Cocoyoc meeting and via a recent mission to Washington.

## **F. INCREMENTAL COSTS AND PROJECT FINANCING**

**75.** The total costs of the GEF alternative are estimated at US\$ 89,531,000 of which GEF will provide US\$ 12,471,000 in two phases, or approximately 14% of the total. For Phase 1 of the project GEF will provide US\$4,736,000 for barrier removal while the incremental costs stand at US\$11,437,000 and for Phase 2 (pending phase 1 evaluation and additional approval by the GEF), the GEF is estimated to provide US\$7,735,000 while the incremental cost stands at US\$65,544,000. The Government of Mexico will fund a total of US\$ 5,200,000 co-financed by IIE, CONAE, CRE, CFE, SENER and SEMARNAT. State governments, private sector investors, and international financial institutions will fund the remainder. The bulk of GEF funds will be used in two main areas: in Phase 1, for removing institutional, legal, and regulatory barriers, and for capacity-building activities (US\$ 4.62 million), and in Phase 2, for removing economic barriers for the operation of the 3 wind power plants and for monitoring and data-collection at the plants (US\$ 7.86 million). GEF funds will also support each of the other outputs of the project. Wind turbines for the Regional Wind Technology Centre will be in kind-contributions from project developers or wind turbine manufacturers (US\$ 4.5 million). Additionally, US\$ 13.4 million will come from project developers for the implementation of the three model wind power plants in Phase 2. An additional US\$ 53.6 million is to be sought from international financial sources as primary funding for the 3 commercial-scale wind power plants. Private investors will also support data collection activities in Phase 1. A detailed breakdown of these costs is given in the following table.

Outputs	Phase 1 (Million US\$)			Phase 2 (Million US\$)			TOTAL
	GEF		Co-financing and Parallel Financing	GEF		Co-financing and Parallel Financing	
<b>Output 1</b>		SENER & CONAE	0.100				
		CRE	0.050				
		IIE	0.050				
	<b>0.9875</b>		<b>0.200</b>				<b>1.1875</b>
<b>Output 2</b>		PI (Wind Turbines)	4.500		IIE	0.700	
		IIE	0.300		SENER & CONAE	0.150	
					CFE	0.100	
	<b>2.625</b>		<b>4.800</b>			<b>0.950</b>	<b>8.375</b>
<b>Output 3</b>		IIE	0.700		IIE	0.400	
		PI	0.360		CONAE	0.150	
		Semarnat	0.200		Semarnat	0.100	
		State Gov.	0.300		State Gov.	0.100	
		CFE	0.300		CFE	0.100	
	<b>0.9975</b>		<b>1.860</b>	<b>0.2635</b>		<b>0.850</b>	<b>3.971</b>
<b>Output 4</b>					IIE	0.300	
					SENER & CONAE	0.300	
					CRE	0.050	
					PI	13.400	
					Financing	53.600	
				<b>6.667</b>		<b>67.650</b>	<b>74.3175</b>
<b>Output 5</b>					CRE	0.030	
					SENER & CONAE	0.180	
				<b>0.615</b>		<b>0.210</b>	<b>0.825</b>
<b>Output 6</b>		SENER & CONAE	0.054		SENER & CONAE	0.164	
		CRE	0.014		CRE	0.050	
		Semarnat	0.014		Semarnat	0.020	
		CFE	0.014		CFE	0.020	
		IIE	0.120		IIE	0.180	
	<b>0.126</b>		<b>0.216</b>	<b>0.189</b>		<b>0.324</b>	<b>0.855</b>
<b>TOTAL</b>	<b>4.736</b>		<b>7.076</b>	<b>7.735</b>		<b>69.984</b>	<b>89.531</b>
<b>Grand Total Phase 1 + Phase 2</b>				<b>GEF</b>	<b>Co-financing</b>	<b>TOTAL</b>	
				<b>12.471</b>	<b>77.060</b>	<b>89.531</b>	

## G. MONITORING, EVALUATION AND DISSEMINATION

76. The project will be monitored and evaluated according to standard UNDP rules for nationally executed projects, although for some components special arrangements will be made. The project coordination unit (PCU), under direct responsibility of the project coordinator, will elaborate and provide key monitoring and evaluation documentation. This unit is responsible for day to day project consistency with established budgets and work plans, including allocation of the GEF-contribution. Furthermore, the PCU is responsible for continuous up-dating and reporting of financial and progress information. Specifically, a quarterly review and reporting cycle will be established with the delivery of performance reports consisting of financial and progress reports as well as proposals for updated work plans. The documentation will be subject to approval, potential adjustments and subsequent implementation in the regular meetings held between IIE and UNDP. In those meetings,

any bottlenecks occurring in implementation will be addressed and resolved. One of the initial activities in the work plan specifies appropriate performance benchmarks. These benchmarks will be established prior to project implementation in order to enable effective monitoring of project progress, and to create a sound basis for informed crucial management decisions.

**77.** A detailed schedule of project reviews will be developed by the project management, in consultation with project implementation partners and representatives of the participating communities, during the early stages of project initiation, and incorporated in the Project Inception Report. Such a schedule will include methodologies and tentative time frames for Tripartite Reviews, Steering Committee Meetings, Participatory Monitoring and Evaluation of the Project by the participating communities, The project will be subject to UNDP/GEF Monitoring and Evaluation rules and practices, including preparation of the annual harmonized Project Implementation Review (PIR) / Annual Project Report (APR).

### **G. 1. Monitoring and reporting**

**78.** The PCU will develop criteria for participatory Monitoring of the project activities in consultation with the PSC. Appropriate participatory mechanism and methodology for performance monitoring and evaluation will be established at the very outset of the project. Monitoring and Evaluation activities will be based on the Logical Framework Matrix. The overall Monitoring and Evaluation format for the project will follow the instructions and guidelines of the UNDP-GEF M&E Unit and will be laid out in detail at the Inception Workshop to be held within the first three months of project start-up.

**79.** The project will be subject to a Tripartite Review (TPR) at least once every twelve months by the Government of Mexico, the executing agency and UNDP, the first such meeting to be held within the first twelve months of the start of full implementation. In accordance with GEF requirements, Quarterly progress reports will also be provided during the course of the project to both UNDP-Mexico and the UNDP-GEF Regional Coordinating Unit (RCU). Separate reviews of each site component to be conducted. Monitoring and Evaluation Indicators will be built into the project in consultation with UNDP/GEF.

**80.** In particular, the project team will be responsible for the preparation and submission of the following reports:

#### **(a) Progress Reports**

National Progress Reports as per requirement of GEF will be prepared as and when required and will be submitted to the Regional Project Coordinator (UNDP-GEF, RBLAC), UNDP Mexico and to the Executing Ministry.

#### **(b) Project Inception Report**

The inception report prepared by the project team will take place no later than three months after project start-up. The report will include a detailed work plan with clear indicators and corresponding means of verification for the first year of the project, fine tuning of TORs for project professionals, TORs for sub-contractual services, progress to date on project

establishment and start-up activities, amendments to project activities/approaches, if any. The report will be submitted to UNDP Mexico, UNDP-GEF RCU and the Government of Mexico.

**(c) Annual Project Report (APR)/ Project Implementation Review (PIR)**

APR/PIR in a prescribed format will be prepared and submitted annually by the project management as per guidelines set for the same. APR/PIR will inform the TPR meeting and should therefore be circulated to TPR participants well in advance.

**(d) Project Terminal Report**

The final APR/PIR will be regarded as the Project Terminal Report for consideration at the terminal tripartite meeting. The draft report will be distributed sufficiently in advance to allow in-house review and technical clearance by the GEF prior to the terminal tripartite review.

**G. 2. Evaluation**

**81.** In accordance with UNDP/GEF M&E procedures, during the last six months of implementation the project will carry out an independent final evaluation of Phase 1 to assess project achievement of objectives and impacts and document lessons learned. Terms of Reference for this evaluation are available in Annex L. A resulting deep analysis of the project progress, along with impact assessment and evaluation of the changing national context, will serve as a major input for the proposal of a potential second project phase.

**82.** This reporting cycle is complemented by rigorous and well-tested internal mechanisms established at IIE for project monitoring and follow up, including the implementation of plans for quality assurance, quarterly financial and technical reports to the board of directors, and annual reports and reviews. At UNDP Mexico, an internal computerized follow-up system is continuously up-dated by the programme officer assigned to the project. Thereby, all major project events are documented and secured, including meeting records, pending issues and logic framework follow-up as well as communications between UNDP and the project agents. Subject to specific need, the indicated monitoring and evaluation budget lines may be used to fund short-term interventions of international consultants in order to solve bottlenecks.

**H. COMPLEMENTARITIES WITH OTHER GEF INTERVENTIONS**

**83.** Since 2001, UNDP has shared with the World Bank (and other GEF's implementing agencies) detailed information for this project initiative. Since early stages of project negotiation, UNDP-Mexico established a close consultative relationship with the World Bank's Mexico office. Next, discussions were held in Washington between representatives of SENER, UNDP, IIE and the World Bank to identify synergies and to agree upon information exchange mechanisms. Available budgets for UNDP's projects are in the low side compared with available budgets for projects sponsored by the World Bank; hence, UNDP's projects are not enough to support long-term actions to implement wind power at

the national level. Generally, it is acknowledged that available GEF budget is not enough to support long-term implementation of wind power in any country. That is why co-financing is required, associated co-financing is desirable, and the host country is required to establish long-term measures to fulfill a sustainable wind power market. Nevertheless, it is clear that the budget available for UNDP's projects is very useful to launch important initiatives on wind power implementation, especially those related to capacity building, which is a very important goal of GEF's Operational Program #6. Therefore, the Government of Mexico considers that the UNDP project constitutes a major contribution to the substantial effort that will be required to build more than 5,000 MW of wind power in the country. That is why the Government of Mexico later came to accept the engagement in an initiative from the World Bank, which is viewed as a logical continuation of the UNDP's project. While UNDP's project is focused on wind power, the World Bank's project will intend to implement other renewable energy technologies, besides wind power, which is also viewed as the best opportunity niche at this time. The World Bank project brief Executive Summary states that "the proposed project represents a long-term vision for renewable energy development in Mexico, and builds on the UNDP project that addresses policy, resource assessment, and technical capacity requirements. The World Bank project will address specific policy and analytical efforts related to least-cost energy procurement, technical issues concerning integration of renewables into the grid system and the potential for conjunctive operation with hydropower generation. As such, these efforts will augment the UNDP efforts, and do not overlap them. Fruitful discussions have been held with between the World Bank and UNDP on coordination of the projects. Further collaboration will be pursued during implementation of the respective projects, through direct communication between the agencies, sharing of key analytical outputs, and through communication with Mexican Government agencies".

**84.** UNDP, the World Bank, SENER and IIE have extensively analyzed synergies and have agreed on the following topics of cooperation between initiatives: 1) Methodologies and operational guidelines for the valuation of local and regional environmental externalities in power system resources, 2) Detailed load flow and grid stability analysis, 3) Standardized protocols and contract forms for CFE purchase, 4) Studies on the benefits from the integration of wind and hydro technologies, 5) Detailed study on the potential benefits of electricity generation with wind power in Mexico.

**85.** Other complementary initiatives include the development of cross-sector instruments that link biodiversity conservation efforts (3 Priority Ecoregions Project, OP 12) with the rational use of energy, especially renewables. These efforts are currently being summarized in a working paper of the IIE on Energy Management Plans (ordenamientos energéticos) and have been shared with SEMARNAT and the National Commission on Protected Areas.

**86.** Talks are currently underway with UNEP on the possible role of IIE as a regional centre of excellence for renewable energies (Global Solar and Wind Resource Assessment). Mexico would not receive GEF funding under the proposed participation, but the IIE would play a regional role in training and providing technical assistance for renewable energy development in other countries in LAC.

87. Finally, it is expected that the barrier removal activities of the first stage of this project will also help pave the way for other grid-connected renewable energy technologies, especially regarding contract and pricing issues.

## **I. LINK TO UNDP CCF AND REGIONAL INITIATIVES**

### **UNDP Initiatives**

88. At the national level, UNDP's Country Cooperation Framework (CCF) for Mexico supports interventions that combine natural resource use with environmental protection measures. The UNDP is assisting the Government of Mexico in meeting its commitments under the key international environmental conventions by leveraging funding and supplying technical and administrative assistance to effectively implement actions towards this end. The current administration has recently defined a joint environmental strategy with the UNDP consisting of four focal areas: (i) sustainable national development plans, (ii) water and forestry, (iii) sustainable energy and (iv) ozone. This project initiative aimed at promoting the national level development of commercial wind markets in Mexico is situated within the strategy for sustainable energy, which focuses on securing, within the national energy market, important niches for commercial applications of sustainable energy solutions. The initiative also fits in well with the regional and global emphasis on energy and climate change, which are supported through the regional UNDP program on energy and climate change, and the global energy and atmosphere program.

89. The current project proposal has incorporated lessons learned from various UNDP/GEF project interventions especially with respect to state and provincial level government involvement and market development. It also builds upon a successfully demonstrated private-public partnership piloted by the UNDP in its sector policy interventions within its national poverty alleviation program in Mexico as a best practice.

90. In the Mesoamerican region, there are several climate change projects currently under development through UNDP-GEF, including three regional projects (one on adaptation and two on renewable energies) and 7 country-specific projects for renewable energy development. UNDP country office programming personnel have met in twice in 2001 (Honduras, Panama) to identify and promote synergies in the regional portfolio.

### **Plan Puebla-Panamá**

91. Mexico's President Vicente Fox announced a regional development initiative known as the Plan Puebla-Panama whose objective is to reduce the regional differences in standard of living between Mexico's poorest southern states and its more-developed regions by taking advantage of similarities between the southern states and its neighbouring countries in Central America. The plan will involve the federal government, the state governments of 9 southern states (Puebla, Veracruz, Tabasco, Campeche, Yucatan, Quintana Roo, Guerrero, Oaxaca and Chiapas) and the governments of all seven Central American countries, along with private sector businesses and international financial institutions. Priority will be given to actions and policies in three main areas: a) the promotion of economic investments

leading to job creation; b) infrastructure projects such as highways, ports, airports, rail, and electricity generation, c) measures that will improve the safety of citizens and their property.

**92.** Since several of the best sites for wind energy generation are located in these southern states, it is expected that the Plan Puebla Panama may have positive repercussions on this project, by bringing new investment into the region, improving local infrastructure, creating new productive demand for electricity in the region, and creating closer links with Central American countries (and therefore a potentially much larger area for project replication). Established channels of interchange between IIE and Central America include the Ibero-American Net of Wind Energy as well as previous interchange with Guatemala, Honduras, El Salvador and Costa Rica. The potential implications of the Plan-Puebla Panama have been built into the strategy for the promotion of wind energy industries in the State of Oaxaca.

**93.** Although conceived as an investment framework to promote regional integration, PPP offers an initially interesting opportunity for mainstreaming renewable energy into the regional planning process. Issues such as energy security, grid security and investment opportunities in renewables might be explored through the diverse projects currently under development in the region (see above).

## **PEMEX**

**94.** PEMEX, Mexico's national oil and gas company, has recently launched an internal CO2 trading system, which meant to increased awareness within the company of the opportunities for reducing greenhouse gases emissions and the further implementation of the Clean Development Mechanism (CDM). This experience could assist in opening up renewable energy markets and emissions trading taking into account that last international negotiations (COP-6.5) allows to the CDM, renewable energy projects with maximum output capacity equivalent up to 15 megawatts. Representatives of PEMEX's plant in Salina Cruz (Oaxaca) have expressed their interest in installing a wind power plant in the region, in part as a GHG reduction project, but also as a public relations initiative that could help improve the company's image. IIE representatives recently met with officials from PEMEX to discuss this possibility.

## **J. LEGAL CONTEXT & BUDGET**

**95.** This project document shall be the instrument referred to as such in Article 1 of the Standard Basic Assistance Agreement between the Government of Mexico and the Special Fund, then the United Nations Development Programme, signed by the parties on 23rd July 1963. The host country-Implementing Agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the government co-operating/Executing Agency described in that Agreement. Nothing contained within this document or in contractual documents signed in light of this document, will be interpreted as an explicit or tacit renouncement of the immunity of jurisdiction, privileges, exceptions or other immunity enjoyed by UNDP in virtue of the Convention of prerogatives and immunities of the United Nations, to which

the Government of Mexico is signatory. The Government of Mexico will assume the risks associated with the operations initiated by this project, and will respond to any claims made by third parties against UNDP, their employees or other people delivering project services in their name. This disposition will not apply in the circumstances where UNDP and the Government of Mexico can prove that the complaints and the corresponding responsibilities are consequences of serious neglect or international misconduct on behalf of the people mentioned.

**96.** The following types of revisions may be made to this Project Document with the signature of the UNDP Resident Representative, provided he or she is assured that the other signatories of the Document have no objections to the proposed changes:

(a) Revisions or additions to any of the annexes of the project document;

(b) Revisions which do not involve significant changes in the immediate objectives, outputs or activities of a project, but are caused by the rearrangement of inputs already agreed to or by cost increases due to inflation; and

(c) Mandatory annual revisions which rephrase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility.

## GEF INPUTS BUDGET

Sbln	Description	Implementing		Total	YEAR 1	YEAR 2
<b>010</b>	<b>PERSONNEL</b>					
<b>011</b>	International Consultants					
011.01	Tec. Consultancy	SENER	Net Amount	90,000	45,000	45,000
<b>011.99</b>	Line Total	-----	Net Amount	90,000	45,000	45,000
<b>013</b>	Administrative Support					
013.01	Secretary PCU	SENER	Net Amount	21,880	10,940	10,940
<b>013.99</b>	Line Total	-----	Net Amount	21,880	10,940	10,940
<b>015</b>	Monitoring and Evaluation					
015.01	National traveling expenses	SENER	Net Amount	8,000	4,000	4,000
015.02	Monit.,eval.,supervision(Proj.Mgr.)	SENER	Net Amount	10,000	5,000	5,000
015.03	Monit.eval.supervis.national(Outp2)	SENER	Net Amount	45,000	15,000	30,000
<b>015.99</b>	Line Total	-----	Net Amount	63,000	24,000	39,000
<b>016</b>	Mission Costs					
016.01	National traveling expenses	SENER	Net Amount	6,500	2,500	4,000
016.02	International traveling expenses	SENER	Net Amount	25,000	15,000	10,000
016.03	Meetings (Outp.1)	SENER	Net Amount	3,500	2,500	1,000
016.04	Monitoring & execution (Outp3)	SENER	Net Amount	75,000	45,000	30,000
<b>016.99</b>	Line Total	-----	Net Amount	110,000	65,000	45,000
<b>017</b>	National Consultants					
017.01	Project coordinator for the PCU	SENER	Net Amount	177,856	88,928	88,928
017.02	Administrator PCU	SENER	Net Amount	29,642	14,821	14,821
<b>017.99</b>	Line Total	-----	Net Amount	207,498	103,749	103,749
<b>019</b>	<b>PROJECT PERSONNEL TOTAL</b>	-----	Net Amount	492,378	248,689	243,689
<b>020</b>	<b>CONTRACTS</b>					
<b>021</b>	Contract A					
021.01	Management Assistant	SENER	Net Amount	88,032	44,016	44,016
021.02	Sr.research frameworks(Outp.1)	SENER	Net Amount	264,418	132,209	132,209
021.03	Assist. research framework(Outp.1)	SENER	Net Amount	79,088	39,544	39,544
021.04	Design &prep. educ.campaign(Outp.1)	SENER	Net Amount	150,000	150,000	
021.05	Reproduction promot.mtrl.(Outp.1)		Net Amount	60,000	60,000	
021.06	Edition & print.educ.mtrl.(Outp.1)	SENER	Net Amount	13,000	13,000	
021.07	Gral.supervis. RWTC(Outp2)	SENER	Net Amount	135,156	67,578	67,578
021.08	Assist.supervis.RWTC (Outp.2)	SENER	Net Amount	79,088	39,544	39,544
021.09	Civil work ctrl.room&build(Outp.2)	SENER	Net Amount	150,000		150,000
021.10	Rd.constr.&turbine.found.(Outp2)	SENER	Net Amount	200,000		200,000

021.11	Buried electr.lines,transf.(Outp2)	SENER	Net Amount	250,000		250,000
021.12	Electr.work for ctrl.room&(Outp2)	SENER	Net Amount	125,000		125,000
021.13	Interconnection line(Outp2) (Annex C)	SENER	Net Amount	600,000		600,000
021.14	Transport of wind turbines(Outp2)	SENER	Net Amount	70,000		70,000
021.15	Install.&commiss.of turbines(Outp2)	SENER	Net Amount	70,000		70,000
021.16	Land use rights (Outp.2)	SENER	Net Amount	20,000	20,000	
021.17	Geotechnical studies (Outp.2)	SENER	Net Amount	50,000	50,000	
021.18	Jr.research; eval&formul.(Outp3)	SENER	Net Amount	135,156	67,578	67,578
021.19	Assist.research; eval&formul.(Outp3)	SENER	Net Amount	79,088	39,544	39,544
<b>021.99</b>	Line Total	-----	Net Amount	2,748,026	853,013	1,895,013
<b>029</b>	SUBCONTRACTS TOTAL	-----	Net Amount	2,748,026	853,013	1,895,013
<b>030</b>	TRAINING					
<b>032</b>	Other Training					
032.01	Promotional seminars (Outp.1)	SENER	Net Amount	60,000	30,000	30,000
032.02	Promot.meet.: project form.(Outp3)	SENER	Net Amount	20,000		20,000
032.03	Training personnel RWTC(Outp2)	SENER	Net Amount	15,000		15,000
032.04	Seminars courses (Outp. 2 y 6)	SENER	Net Amount	87,000	68,500	18,500
<b>032.99</b>	Line Total	-----	Net Amount	182,000	98,500	83,500
<b>039</b>	TRAINING TOTAL	-----	Net Amount	182,000	98,500	83,500
<b>040</b>	EQUIPMENT					
<b>045</b>	Equipment					
045.01	Furniture for RWTC(Outp.2)	SENER	Net Amount	15,000		15,000
045.02	Instrument.,ctrl.,monitor.(Outp2)	SENER	Net Amount	150,000		150,000
045.03	600-700kW wind turb.(Outp2)	SENER	Net Amount	500,000	500,000	
045.04	Vehicle pick-up(Outp2)	SENER	Net Amount	30,000	26,000	4,000
045.05	Support for project execution (Annex H-I)	SENER	Net Amount	236,800	118,400	118,400
045.06	Anemometer&aces.data rec.(Outp3)	SENER	Net Amount	200,000	200,000	
045.07	Work station,complem.equipm.(Outp3)	SENER	Net Amount	20,000	20,000	
045.08	Vehicle sedan (Outp3)	SENER	Net Amount	20,000	16,000	4,000
045.09	Specialized software (Outp3)	SENER	Net Amount	15,000	15,000	
045.10	Digital maps (Outp3)	SENER	Net Amount	20,000	20,000	
<b>045.99</b>	Line Total	-----	Net Amount	1,206,800	915,400	291,400
<b>049</b>	EQUIPMENT TOTAL	-----	Net Amount	1,206,800	915,400	291,400
<b>050</b>	MISCELLANEOUS					
<b>053</b>	Sundries					
053.01	Data transmiss.via cellular (Outp3)	SENER	Net Amount	12,000	6,000	6,000
053.02	Charges land use:anemometer(Outp3)	SENER	Net Amount	20,000	10,000	10,000
053.03	Sundries (Outp3)	SENER	Net Amount	4,796	2,398	2,398
053.04	Sundries (Outp2)	SENER	Net Amount	130,000	130,000	
053.05	Publication of biddings (Outp3)	SENER	Net Amount	10,000		10,000
053.06	External evaluation (Annex L)	SENER	Net Amount	50,000		50,000
053.07	Annual audit	SENER	Net Amount	10,000	5,000	5,000
<b>053.99</b>	Line Total	-----	Net Amount	106,796	23,398	83,398
<b>059</b>	MISCELLANEOUS TOTAL	-----	Net Amount	106,796	23,398	83,398
<b>099</b>	<b>BUDGET TOTAL</b>	-----	<b>Net Amount</b>	<b>4,736,000</b>	<b>2,139,000</b>	<b>2,597,000</b>

## CO-FINANCING INPUTS BUDGET



### United Nations Development Programme

EOL - Wind - Phase 1

Budget " A"



Co-financing in-kind: Government of Mexico and private sector

Executing Agency: SENER - Secretaría de Energía

#### Government of Mexico

Sbln	Description	Implement	Funding	Total	YEAR 1	YEAR 2
<b>016</b>	<b>Mission Costs</b>					
016.01	General national traveling expenses	SENER	IIE	30,000	15,000	15,000
016.02	General international traveling expenses	SENER	IIE	10,000	5,000	5,000
<b>016.99</b>	<b>Line Total</b>	-----		<b>40,000</b>	<b>20,000</b>	<b>20,000</b>
<b>017</b>	<b>National Consultants</b>	-----				
017.01	Project Manager	SENER	IIE	294,488	147,244	147,244
017.02	Executive personnel involved in negotiations	SENER	IIE	206,765	103,396	103,396
017.03	General engineering RWTC(Outp2)	SENER	IIE	49,562	49,562	
017.04	Detailed engineering RWTC(Outp2)	SENER	IIE	46,062	46,062	
017.05	Preparation of TOR & specifications (Outp2)	SENER	IIE	42,070	42,070	
017.06	Prospection, negot&anemomet.install(Outp2)	SENER	IIE	20,223	15,804	4,419
017.07	Data processing and analysis (Outp3)	SENER	IIE	27,276	13,638	13,638
017.08	Anemometer data recov.maintenance(Outp3)	SENER	IIE	75,898	37,949	37,949
017.09	Research:formulat./eval.demo-projec.(Outp3)	SENER	IIE	136,924	68,447	68,477
017.10	Documentation wind project models (Outp3)	SENER	IIE	46,608	15,804	30,804
017.11	Geo. info. system on renew. energy(Outp3)	SENER	IIE	300,000	150,000	150,000
017.12	Preparation of TOR & specifications (Outp3)	SENER	IIE	99,124	49,562	49,562
017.13	Coord./negotiat. wind implementation	SENER	SENER	60,000	30,000	30,000
017.14	Participation in promotion and impl. Activ.	SENER	CONAE	40,000	20,000	20,000
017.15	Prep.&negot.interconn.model contrac(Outp1)	SENER	CRE	44,000	22,000	22,000
017.16	Research & reg. on environmental impact	SENER	SEMARNAT	40,000	20,000	20,000
017.17	Oaxaca gov.:conferences, planning	SENER	OAXACA	70,000	35,000	35,000
017.18	Wind resource eval. Pachuca (Outp3)	SENER	HIDALGO	12,000	6,000	6,000
017.19	Other state/municipal gov: conf.&planning.	SENER		200,000	100,000	100,000
017.20	Studies for La Ventosa wind development	SENER	IIE	45,000	30,000	15,000
017.21	Studies for integration to Nat. Electr. System	SENER	CFE	260,000	130,000	130,000
017.22	Conduction &supervision frameworks(Outp1)	SENER	IIE	20,000	10,000	10,000
017.23	Preparation of TOR & specifications (Outp1)	SENER	IIE	10,000	10,000	
<b>017.99</b>	<b>Line Total</b>	-----		<b>2,146,000</b>	<b>1,152,538</b>	<b>993,462</b>
<b>019</b>	<b>PROJECT PERSONNEL TOTAL</b>	-----		<b>2,146,000</b>	<b>1,152,538</b>	<b>993,462</b>
<b>030</b>	<b>TRAINING</b>	-----				
<b>032</b>	<b>Other Training</b>	-----				
032.01	Participation in IEA Wind impl.AgreemR&D	SENER	IIE	20,000	10,000	10,000
032.02	Seminars and conferences	SENER	IIE	10,000	5,000	5,000
<b>032.99</b>	<b>Line Total</b>	-----		<b>30,000</b>	<b>15,000</b>	<b>15,000</b>
<b>099</b>	<b>TOTAL IN-KIND GOV. CONTRIBUTION</b>	-----		<b>2,216,000</b>	<b>1,187,538</b>	<b>1,028,462</b>

**Private Sector**

<b>Sbln</b>	<b>Description</b>	<b>Implement</b>	<b>Funding</b>	<b>Total</b>	<b>2003</b>	<b>2004</b>
<b>040</b>	Equipment					
<b>45</b>	Equipment					
045.01	Anemometers & acc.for operat&data revov.		Several	160,000	80,000	80,000
045.02	Operations and missions		Several	200,000	100,000	100,000
045.03	Estimated contrib.wind turbines (Outp2)		Several	4,500,000	0	4,500,000
<b>045.99</b>	<b>Line total</b>			<b>4,860,000</b>	<b>180,000</b>	<b>4,680,000</b>
<b>049</b>	<b>Equipment total</b>			<b>4,860,000</b>	<b>180,000</b>	<b>4,680,000</b>
<b>099</b>	<b>Total private sector in kind contribution</b>			<b>4,860,000</b>	<b>180,000</b>	<b>4,680,000</b>

## **ANNEX A – INCREMENTAL COST ANALYSIS**

### **BROAD DEVELOPMENT GOALS**

The development goal being pursued by the Government of Mexico is the provision of electricity services to its population in the least-cost manner.

### **GLOBAL ENVIRONMENTAL OBJECTIVE**

The Global Environmental Objective of the project is to reduce greenhouse gas emissions associated with electrical generation by 4 Mt per year through the large-scale deployment of wind power in Mexico. In order to stimulate the development of the wind-energy market in Mexico, certain barriers must be removed. This project is designed to remove the identified barriers.

### **BASELINE**

The baseline scenario assumes that the expansion of Mexico's electricity capacity would involve little or no successful commercial development of wind resources over the coming decade, and the growing demand for electricity would primarily be met by building new combined cycle natural gas turbine plants. The underlying reasons for this development scenario are based on an inefficient energy market that does not incorporate the diverse externalities, both negative and positive, associated with electric generation from both traditional and alternative energy sources. Other factors contributing to this scenario include difficulties in technology adaptation, financial barriers, insufficient technical capacity and institutional failure.

Without a concerted national effort to remove fundamental market failures in the Mexican energy market, the development scenario for on-grid wind power in Mexico would most likely be limited to the continued operation and maintenance of the two existing wind power stations (1.6 and 0.6 MW), limited wind energy measurements, and support for pre-investment studies. The IIE would also continue with the design, specification and negotiation of a wind energy technology centre.

### **GEF PROJECT ALTERNATIVE**

The project will remove the existing barriers to wind energy commercialisation in Mexico in order to 1) facilitate the installation and operation of three business- model wind energy plants in Mexico with central grid connection, and 2) create a sustainable wind energy market in Mexico. It will launch a comprehensive barrier removal effort in order to lay the groundwork for the construction and operation of three 15-20 MW wind power plants. Initial activities will include a review of and revisions to the legal, regulatory and institutional framework; the construction and operation of a regional centre for wind energy technology; the development of a best practices manual, based on international standards adapted for local conditions; the assessment of wind resources at the most promising sites;

and the completion of detailed feasibility studies for several wind power plants. Once in operation, the wind power plants will be closely monitored, and operational data and experience gained at the plants will be widely disseminated for use in future developments. The project will be carried out in two phases, with the first phase initiating the process of barrier removal and laying the groundwork for the second phase. Phase 2, which involves, among other activities, the construction of three commercial wind plants, will only be carried out as planned if Phase 1 is judged to be successful. Otherwise, the resulting scenario will be evaluated and new strategies will be established in order to continue enhancing efforts to remove the remaining barriers. This strategy ensures an efficient use of resources, and provides a built-in review step for refocusing activities if and where necessary.

## SYSTEM BOUNDARY

The geographical boundary is the entire country of Mexico, however the project may also have positive impacts on the development of wind power in Central American countries, especially in view of the objectives of the Plan Puebla-Panama. Wind resource assessments will initially be carried out in the five most promising regions of Mexico, with the idea that the successful wind power development in these regions will lead to new initiatives to measure wind resources in other regions. The project will focus primarily on grid-connected generation, but will most likely have positive spill over effects on the development of wind power for self-supply as well.

## ADDITIONAL BENEFITS

Additional benefits of the project include improvements in localized air quality due to reductions in NO<sub>x</sub>, CO, VOC's and HC's, new investments and creation of jobs in rural areas, reduced dependence on fossil fuels and therefore price fluctuations and scarcity, and reduced transmission losses by decentralizing electricity supply. The project is envisioned, at the state and regional levels, as an opportunity to stimulate integrated regional development patterns, where both vertical and horizontal farm and off-farm productive links can be capitalised upon to revitalise rural and urban development in Mexico. The Governor of Oaxaca has already explicitly stated that the development of renewable energy supply and associated manufacturing capacities are included within its regional development strategy.

## COSTS

The total estimated costs of the project intervention come to approximately US\$89,531,000. The baseline costs are US\$12,550,000 and the incremental costs therefore total US\$76,981,000. Of this total, \$12,471,00 is being sought from GEF. This is divided between US\$4,736,000 for phase 1 barrier removal activities and a suggested phase 2 estimated to cost US\$ 7,735,000 (pending phase 1 evaluation and additional approval by the GEF). According to projections for installed MW of wind power, by 2009, that is 5 years after the start of a commercial wind energy market, the project will have resulted in an accumulated reduction of 3 Mt of CO<sub>2</sub>, at a unit cost of US\$2.63 per tonne, in terms of

GEF funds. By 2014, the total reduction will be 16.5 Mt, at a unit abatement cost for GEF of \$US 0.69 per tonne.

**Table A-1 Incremental Cost Matrix**

Project Outputs	Baseline	Alternative	Increment
<p>1. Enhanced institutional, legal and regulatory framework for wind energy</p>	<p>Attempts to review and improve the regulatory framework will likely continue to occur as they have in the past; however, without a coordinated and sustained effort along with the support of all institutions, it is expected that there would be no real change to the current framework, which will therefore continue to favour fossil fuel generation.</p> <p>Specifically, COFER will continue to provide advice and input to policy makers and other interested parties on the benefits of wind energy, and CRE will continue its efforts to improve the current regulatory framework in order to pave the way for private investment in self-supply projects.</p> <p>Phase 1: US\$25,000 Phase 2: US\$25,000 <i>Total Cost: US\$50,000</i></p>	<p>A thorough review of the current institutional, legal and regulatory frameworks that affect the electricity market in Mexico will be initiated and carried out.</p> <p>A series of potential amendments will then be identified and proposed that together would stimulate the development of wind energy in Mexico, based in part, on the experiences of other countries. These amendments will then be promoted among the appropriate government institutions, until an adequate framework has been developed that provides favourable conditions to wind energy generation.</p> <p>To facilitate these amendments, an educational campaign will be carried out simultaneously, in order to raise awareness, among state and government officials, of the economic, environmental and social benefits of wind power.</p> <p>Phase 1: US\$987,500 (GEF) US\$200,000 (GOM) <i>Total Phase 1: US\$1,187,500</i></p> <p>Phase 2: US\$300,000 (GEF) US\$110,000 (GOM) <i>Total Phase 2: US\$410,000</i></p> <p><i>Total Cost: US\$1,287,500 (GEF)</i> <u><i>US\$310,000 (GOM)</i></u> <i>US\$1,597,500 (total)</i></p>	<p>Institutional, legal and regulatory frameworks that will stimulate Mexico's wind energy market.</p> <p>Increased awareness among government officials of the benefits of wind energy.</p> <p>Phase 1: US\$1,162,500 Phase 2: US\$385,000 <i>Total Cost: US\$1,547,500</i></p>

<p>2. National and regional capacities established to support the development of wind as a viable energy supply source within the energy market</p>	<p>IIE and CONAE will continue their efforts in capacity building and information gathering, and university level courses will continue, but this on its own will not be adequate to develop sufficient technical capacity to develop the wind energy resources in the country.</p> <p>Phase 1: US\$150,000 Phase 2: US\$150,000 <i>Total Cost: US\$300,000</i></p>	<p>A regional centre for wind energy technology will be constructed with the involvement of CFE, IIE and private companies. The centre will be used primarily for gaining hands-on practical experience with a variety of commercial wind technologies operating under local conditions. The experience gained at this facility will also be used to produce a best practices manual whose objective will be to facilitate the integration of wind energy systems into the national grid. Information on international standards and best practices will be gathered and adapted for use in Mexico, to be used as input into the best practices manual.</p> <p>Other capacity-building activities to be carried out by the IIE and CFE include a series of training courses and promotional workshops in conjunction with public consultations on the benefits and impacts of wind power development.</p> <p>Phase 1: US\$2,625,000 (GEF) US\$ 4,500,000 (Private) US\$ 300,000 (GOM) <i>Total Phase 1: US\$7,425,000</i></p> <p>Phase 2: US\$ 950,000 (GOM) <i>Total Phase 2: US\$ 950,000</i></p> <p><i>Total Costs: US\$2,625,000 (GEF) US\$1,250,000 (GOM) US\$4,500,000 (private) US\$8,375,000 (total)</i></p>	<p>The operation and maintenance of a diverse range of wind turbines will be well understood at the local level.</p> <p>Mexican technicians and engineers trained in the operation and maintenance of a variety of wind turbines will be available to work on commercial wind projects.</p> <p>A best practices manual for Mexican conditions will be available. This manual will reduce risks during the development and operation of wind projects as well as facilitate understanding among local institutions (CFE, CRE) and developers.</p> <p>Performance data and specifications for diverse wind turbine technologies operating under Mexican conditions will be available to developers and manufacturers, thus allowing manufacturers to modify their equipment to suit Mexican conditions, where necessary.</p> <p>There will be an increased understanding in Mexico of wind energy and its social and environmental benefits.</p> <p>Phase 1: US\$7,275,000 Phase 2: US\$800,000 <i>Total Cost: US\$8,075,000</i></p>
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<p>3. Wind energy resources assessed at the sites with the highest commercial development potential in Mexico, and complete feasibility studies for 3 wind power plants</p>	<p>CFE and IIE will continue to analyse wind resources in Mexico, but these analyses will be limited in size and scope.</p> <p>Phase 1: US\$ 200,000  <i>Total Cost: US\$200,000</i></p>	<p>Regional potential for wind energy exploitation will be classified and mapped, taking into account protected and environmentally sensitive zones. Reference stations will be set up to evaluate wind energy resources at 15 promising sites in five selected states and the resulting data will be widely disseminated</p> <p>Comprehensive feasibility studies will be carried out for 3-5 potential sites for the construction of 15 - 20MW wind power plants</p> <p>A set of background studies that will provide generic information required by developers for future wind projects will be undertaken for the region of La Ventosa.</p> <p>Phase 1: US\$ 997,500 (GEF)  US\$ 360,000 (Private)  US\$1,500,000 (GOM)  <i>Total Phase 1: US\$ 2,857,500</i></p> <p>Phase 2: US\$ 263,500 (GEF)  US\$ 850,000 (GOM)  <i>Total Phase 2: US\$ 1,113,500</i></p> <p><i>Total Cost: US\$1,261,000 (GEF)  US\$2,350,000 (GOM)  US\$ 360,000 (private)  US\$3,971,000(total)</i></p>	<p>Detailed data on wind energy at 15 of the most promising sites in the country will be widely available</p> <p>Comprehensive feasibility and bankable studies for 3, 15 - 20MW wind power plants.</p> <p>Background studies for La Ventosa region providing information on environmental impact levels, wind energy potential, land ownership, infrastructure availability (roads, electrical lines) and potential electricity uses for the region, to be used by private investors for future projects.</p> <p>Phase 1: US\$ 2,657,500  Phase 2: US\$ 1,113,500  <i>Total Cost: US\$ 3,771,000</i></p>
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<p>4. Development and construction of three 15-20MW wind energy business models in distinct regional energy markets in Mexico</p>	<p>In the baseline ( this assumes a wind plant size of 20 MV, however this is open to confirmation during the implementation of phase 1 of the project), the amount of electricity generated by the 3 pilot wind power plants would be supplied by a 24 MW combined-cycle plant fuelled with natural gas, at an investment cost of \$500/kW or a total of US\$12,000,000. (Assumes a capacity factor of 75% for gas, and 30% for wind)</p> <p><i>Total Cost (equals phase2 costs since this output only applies in phase 2 of the project): US\$12,000,000</i></p>	<p>Private sectors companies will be selected to build the three wind plants through a competitive bidding process. Three demonstration plants will then be built and operated by the selected companies with technical support and monitoring provided by IIE and CONAE. Based on a capacity factor of 30% these plants will generate 158,000 MWh of electricity per year.</p> <p><i>Total Cost (equals phase2 costs since this output only applies in phase 2 of the project): US\$ 6,667,500 (GEF) US\$ 650,000 (GOM) US\$13,400,000 (private) <u>US\$53,600,000 (int'l pvt)</u> US\$74,317,500 (total)</i></p>	<p>Three 15-20 MW business-demonstration wind power projects will be built and in operation in three Mexican States ( note that the cost estimates here are initial estimates based upon a size of 20MW).</p> <p><i>Total Cost (equals phase2 costs since this output only applies in phase 2 of the project): US\$62,317,500</i></p>
<p>5. Introduction of appropriate financial mechanisms in the Mexican energy market to encourage commercial wind power development.</p>	<p>No new financial mechanisms will be introduced, although discussions of financial incentives will continue as they have for many years.</p> <p><i>Cost: US\$0</i></p>	<p>A variety of financial mechanisms for stimulating wind power development in Mexico will be analysed. One or two of the options will be identified as having the best potential for success and will be developed in greater detail for introduction at the national level.</p> <p><i>Total Cost (equals phase2 costs since this output only applies in phase 2 of the project): US\$315,000 (GEF) <u>US\$100,000 (GOM)</u> US\$415,000 (total)</i></p>	<p>New financial mechanisms will exist for encouraging the commercial development of wind power in Mexico.</p> <p><i>Total Cost (equals phase2 costs since this output only applies in phase 2 of the project): US\$415,000</i></p>

<p>6. Promotion of relevant wind power development information based on tested institutional and financial mechanisms</p>	<p>No significant promotion of wind power will occur.</p> <p><i>Cost: US\$0</i></p>	<p>A monitoring and evaluation system will be implemented at the new wind facilities to provide data for future developments. This data will then be incorporated into IIE's GIS website.</p> <p>A promotional campaign will be designed and implemented to enable widespread dissemination of information on wind energy to all of Mexico's regions.</p> <p>Phase 1: US\$ 126,000(GEF) US\$ 216,000 (GOM) <i>Total Phase 1: US\$ 342,000</i></p> <p>Phase 2: US\$ 189,000(GEF) US\$ 324,000(GOM) <i>Total Phase 2: US\$ 513,000</i></p> <p><i>Total Cost: US\$ 315,000(GEF)</i> <i>US\$ 540,000 (GOM)</i> <i>US\$ 855,000(total)</i></p>	<p>Operational data from existing wind plants will be accessible via the internet for use in project identification and planning.</p> <p>There will be increased knowledge of commercial wind power development throughout Mexico, in particular on the part of local and regional decision-makers.</p> <p>Industry will be well informed about opportunities for wind power business development and equipment manufacturing.</p> <p>Phase 1: US\$ 342,000 Phase 2: US\$ 513,000</p> <p><i>Total Cost: US\$855,000</i></p>
<p>Global Environmental Benefits</p>	<p>In the baseline scenario there the bulk of new electricity supply will be provided using natural gas, and therefore GHG emissions in Mexico's electricity sector will continue to rise as is projected.</p>	<p>Within 10 years, 2000 MW of electricity will be supplied by wind power, and there will be corresponding reduction in GHG emissions.</p>	<p>Global GHG emissions will be reduced by 4 Mt annually or a total of 100 Mt over the lifetime of the wind energy plants.</p>
<p>Domestic Environmental Benefits</p>	<p>There will be no or very limited development of wind energy in Mexico.</p>	<p>Within 10 years, Mexico will have a flourishing wind energy industry.</p>	<p>Trained personnel in wind energy development New jobs (est. 20,000) New investment in rural areas.</p>
<p>Costs</p>	<p><b><i>Total: US\$12,550,000</i></b></p>	<p><b><i>Phase 1: US\$ 4, 736,000(GEF)</i></b> <b><i>US\$ 4,860,000 (Private)</i></b> <b><i>US\$ 2, 216,000 (GOM)</i></b> <b><i>Total Phase1: US\$ 11,470,000</i></b></p>	<p><b><i>Phase 1: US\$ 11,437,000</i></b> <b><i>Phase 2: US\$ 65,544,000</i></b> <b><i>Total: US\$ 76,981,000</i></b></p>

		<p><i>Phase 2: US\$ 7,735,000 (GEF)</i>  <i>US\$ 13,400,000 (Private)</i>  <i>US\$ 53,600,000 (Intl. Inv.)</i>  <i>US\$ 2,984,000 (GOM)</i>  <b><i>Total Phase 2: US\$ 78,061,000</i></b></p> <p><b><i>Total Cost (Phase 1 and 2):</i></b>  <i>US\$ 12,471,000 (GEF)</i>  <i>US\$ 5,200,000 (GOM)</i>  <i>US\$ 18,260,000 (Private)</i>  <u><i>US\$ 53,600,000 (Int'l)</i></u>  <b><i>Grand-Total: US\$ 89,531,000</i></b></p>	
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## ANNEX B – PROJECT PLANNING MATRIX

NARRATIVE SUMMARY	OBJECTIVITY-VERIFIABLE INDICATORS	MEANS OF VERIFICATION	CRITICAL ASSUMPTIONS																																																							
<b>I. Development Objective</b>																																																										
<p><b>Development objective:</b> To reduce annual greenhouse gas emissions in Mexico through the installation and operation of commercial wind power plants on a large scale. The strategic goal is 2000 MW installed wind power capacity within ten years, with a total annual reduction of 4 Mt of carbon dioxide equivalent.</p>	<p>Wind power installed capacity, electricity generated from wind power, and avoided CO2 emissions.</p> <table border="1" data-bbox="537 500 1062 833"> <thead> <tr> <th>Year</th> <th>MW</th> <th>GWh/yr</th> <th>Mt ↓CO<sub>2</sub>/yr</th> <th>%ETP</th> </tr> </thead> <tbody> <tr><td>2006</td><td>60</td><td>158</td><td>0.12</td><td>0.06</td></tr> <tr><td>2007</td><td>135</td><td>355</td><td>0.27</td><td>0.12</td></tr> <tr><td>2008</td><td>229</td><td>602</td><td>0.46</td><td>0.20</td></tr> <tr><td>2009</td><td>346</td><td>909</td><td>0.70</td><td>0.28</td></tr> <tr><td>2010</td><td>492</td><td>1293</td><td>0.99</td><td>0.38</td></tr> <tr><td>2011</td><td>676</td><td>1776</td><td>1.36</td><td>0.49</td></tr> <tr><td>2012</td><td>904</td><td>2357</td><td>1.82</td><td>0.62</td></tr> <tr><td>2013</td><td>119</td><td>3130</td><td>2.40</td><td>0.78</td></tr> <tr><td>2014</td><td>1548</td><td>4068</td><td>3.10</td><td>0.95</td></tr> <tr><td>2015</td><td>1995</td><td>5243</td><td>4.02</td><td>1.17</td></tr> </tbody> </table> <p>MWh (assuming 30% average capacity factor) ↓CO<sub>2</sub> (assuming 766 ton /GWh) ETP (percentage of total national electricity production, assuming an annual increase of 5.6%)</p>	Year	MW	GWh/yr	Mt ↓CO <sub>2</sub> /yr	%ETP	2006	60	158	0.12	0.06	2007	135	355	0.27	0.12	2008	229	602	0.46	0.20	2009	346	909	0.70	0.28	2010	492	1293	0.99	0.38	2011	676	1776	1.36	0.49	2012	904	2357	1.82	0.62	2013	119	3130	2.40	0.78	2014	1548	4068	3.10	0.95	2015	1995	5243	4.02	1.17	<p>Data generated from the performance reports from new wind facilities, plus data from CFE on annual electricity production.</p>	<p>Without the project, new generation capacity would otherwise come from fossil fuels, specifically using natural gas in combined-cycle plants.</p> <p>However, if natural gas becomes scarcer or if prices increase significantly, fuel oil may once again become the preferred option, in which case emissions reductions would be higher.</p>
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<b>II. Immediate Objective :</b>																																																										
<p><b>Immediate Objective:</b> To reduce identified barriers to wind energy commercialization in order to:</p> <ol style="list-style-type: none"> <li>1) Facilitate the installation and operation of three model wind power plants in Mexico with central grid connection.</li> <li>2) Create a sustainable wind energy market in Mexico.</li> </ol>	<p>Three successfully operating 15 - 20 MW wind power plants by 2006 with power bought by CFE under regulatory improvements, or generated by self-suppliers under innovative modalities.</p> <p>Wind power capacity to be installed within the project's administrative life (2006, 60 MW); (2007, 135 MW), (2008, 229 MW).</p>	<p>Data generated from monitoring of wind facilities.</p> <p>Official documents from SENER on new capacity installed in Mexico.</p> <p>Official information from CRE.</p>	<p>Upon successful completion of Phase I per the final evaluation, the decision is made to continue with Phase II.</p> <p>The economics of Wind projects remain status quo or improve</p>																																																							

<b>Output 1: Enhanced institutional, legal and regulatory framework for wind energy</b>	<b>PHASE 1</b>		
<p>Review of legal, regulatory and institutional frameworks.</p> <p>Proposals for amendments or improvements to legal, regulatory or institutional frameworks.</p> <p>Promotional campaign.</p> <p>Monitoring and evaluation of output and activities</p>	<p>Group led by SENER has carried out full review of frameworks and proposes amendments (4th Quarter Year 1).</p> <p>Proposals include regulations on grid-access for wind power, PPA models for IPP, incentives to Wind Power development, and fitting financing modalities (1st Qtr. Year 2).</p> <p>Proposals are reviewed, cleared, and included into a formal decision-making pipeline (2nd Qtr. Year 2).</p> <p>A promotional campaign has been carried out, reaching most of the major decision-makers within the public sector, including Ministers, Congressman, key actors, and general public (begins 3rd Qtr. Year 1).</p> <p>Continuous monitoring and evaluation as described in project document as well as final evaluation.</p>	<p>Progress reports to the Working and Steering Committees.</p> <p>Proposals.</p> <p>Status of formal approval / negotiation of proposals.</p> <p>Evidences of presentations carried out to key decision-makers and Congressman.</p> <p>Evidences of general dissemination via Internet, CD's and brochures.</p> <p>Evidence as described in project document.</p>	<p>Cooperation and commitment from all implicated institutions.</p>
<b>Output 2: National and regional capacities established to support the development of wind as a viable energy supply source within the energy market</b>	<b>PHASE 1</b>		

Permitting process.	Permits and agreements required to build the RWTC are issued (CFE, CRE, environmental, local permits – land use, construction - ) (2nd Qtr. Year 1)	Status of permits and agreements	Reasonable timing of land permit processing RWTC.
Sub-contracts for construction of the RWTC.	Sub-contracts are endorsed for starting construction of the RWTC (3rd Qtr. Year 1).	Status of sub-contracts.	Reasonable timing of land permit processing RWTC.
Construction and commissioning of the RWTC.	The basic infrastructure for the RWTC has been constructed and commissioned (2 <sup>nd</sup> Qtr. Year 2).  Firm commitment attained (2 <sup>nd</sup> Qtr. Year 2)  Additional wind turbines for the RWTC are installed (2nd Qtr. Year 2).	Status of the Regional Wind Technology Centre.	The interest on the part of wind turbine manufacturers or project developers is confirmed  The Govt. of Oaxaca and technological institutes of Mexico show sustained interest in the development of wind as an alternative source of energy and become active stakeholders in the project.
Courses included within programming of Technical Institutions	Courses held at Technical Institutions (4 <sup>th</sup> Qtr. Year 2)	Records of courses held, number of trained people, test results.	
First workshops in the RWTC	The first two workshops on wind power technology held in the RWTC have achieved initial training of interested technicians in the operation of wind power plants in order to strengthen national capacities.	Records of workshops, number of trained people, tests results.	
Best Practices Manual	A First edition of the Best Practices Manual, including project formulation and evaluation, interconnection standards, land-tenure issues, and environmental practices, is complete (4 <sup>th</sup> Qtr. Year 2).  The Manual is widely disseminated using Internet. Besides, 100 CD copies of the Manual are distributed in meetings, seminars, and workshops (4 <sup>th</sup> Qtr. Year 2).	Status of the First Edition of the Best Practices Manual.  Evidence of dissemination of the First Edition of the Best Practices Manual via Internet and directly distributed.	

<b>Output 2 ....</b>			
Improved understanding of wind power technology on the part of key actors.	A course-workshop on the implementation of wind power is held in the RWTC. The course-workshop has enhanced the knowledge among key participants from SENER, CFE, CONAE, and CRE, as well as the private and academic sectors. The course covers all major topics on the implementation of wind power, including technical, environmental, economic, and social issues (4 <sup>th</sup> . Qtr. Year 2)	Formal evaluation of the Course-workshop on the implementation of wind power.	
Monitoring and evaluation of output and activities	Continuous monitoring and evaluation as described in project document as well as final evaluation.	Evidence as described in project document.	
<b>Output 2 ....</b>	<b>PHASE 2</b>		

<p>Training in operation and maintenance of wind power plants.</p> <p>Availability of performance data of wind turbines</p>	<p>A workshop on operation and maintenance of wind power stations held every year in the RWTC have enhanced the knowledge among technicians interested in working in wind power plants (Mid. 2006, Mid. 2007, and Mid. 2008).</p> <p>Performance data of wind turbines or specific wind turbine components are available to developers and manufacturers, according to confidentiality terms previously agreed. Scheduled from Early 2006 to Mid. 2008, according to the schedule agreed with wind turbine manufacturers or project developers that uses the RWTC.</p> <p>Note: The duration of any test is highly dependent on the type of test to be carried out. The type of test depends on the specific interest of the manufacturer or project developer.</p>	<p>Formal evaluation of the yearly workshops on operation and maintenance of wind power stations.</p> <p>Agreements with wind turbine manufacturers or project developers, and evidence of performance data reports submitted to the wind turbine manufacturers or project developers.</p> <p>Publications of releasable information.</p>	<p>The Govt. of Oaxaca and technological institutes of Mexico show sustained interest in the development of wind as an alternative source of energy and become active stakeholders in the project.</p> <p>The Govt. of Oaxaca and technological institutes of Mexico show sustained interest in the development of wind as an alternative source of energy and become active stakeholders in the project.</p> <p>Interest on the part of wind turbine manufacturers of project developers is confirmed.</p>
<p><b>Output 3: Wind energy resources assessed at the sites with the highest commercial development potential in Mexico, and complete feasibility studies for 3 wind power plants</b></p>	<p><b>PHASE 1</b></p>		

Generic Studies in order to facilitate the processing of wind projects	Draft chapter on social issues generated for the Best Practice Manual and methodology for packaging permits to speed the licensing of Wind Turbines and application of this methodology (2nd Qtr. Year 2).	Documents and exchanges with relevant institutions	Support will be easily garnered from all relevant institutions
Installation of anemometric reference stations. Wind energy resource evaluation.	Fifteen anemometric reference stations are installed and operating (3rd Qtr Year 1) Wind data is collected and wind energy resource is evaluated every two months at 15 sites in 5 states, according to specifications given in Section 2, Annex C (General Technical Specifications). Actualizations are carried out every two months after the 4th Qtr. Year 1.	Number of installed anemometers. Raw data files and computed result files allocated in the IIE's Web Site.	Land use permits are obtained. Climate Change does affect Mexico in the next 2 years. No critical assumptions.
One-year wind energy resource evaluation.	One-year wind energy resource evaluation is completed for fifteen promising sites (3rd Qtr. Year 2).	One-year computed results files allocated in the IIE's Web Site.	
Feasibility studies for three wind power model projects.	Three feasibility studies are completed for the development of three 15 - 20 MW to be operated under regulatory improved conditions or innovative modalities (3 <sup>rd</sup> Qtr. Year 2).	Status of comprehensive reports.	
Bidding bases for model projects.	Stakeholders and project developers have proven interest (4th. Qtr. Year 2).  General bidding bases for model projects are prepared and approved by the Steering Committee (3rd Qtr. Year 2).	Steering Committee Opinions on projects' feasibility.  General bidding bases. Meeting records of the Steering Committee Meetings.	Improved Regulatory conditions are implemented.  No critical assumptions.
Generic studies for La Ventosa.	Generic studies focused at environmental zoning, infrastructure development, grid-safety and planning of wind-power dissemination are carried out for La Ventosa (1 <sup>st</sup> Qtr. Year 1).	Status of special reports, and linked documents.	CFE and Semarnat are participating in the project.
Accessibility of wind resource information	Worldwide accessibility of wind resource information through internet (3 <sup>rd</sup> Qtr. Year 2).	Wind resource database feeds into IIE's Renewable Energy GIS.	No critical assumptions.
Monitoring and evaluation of output and activities monitoring and evaluation	Continuous monitoring and evaluation as described in project document as well as final evaluation.	Evidence as described in project document.	

<b>Output 3 .....</b>	<b>PHASE 2</b>		
Continuation of wind resource assessment at promising sites.	Using additional equipment, anemometric reference stations are installed and operated at new promising sites, at a rate of five new installations per year (Mid. 2006, Mid. 2007, Mid. 2008).	Records of number of new anemometers installed.  Wind Energy Database on IIE's Web site	Phase 2 of the project is approved.
Formulation and evaluation of new projects.	New wind power projects are formulated and proposed, at a rate of three projects per year (Mid. 2006, Mid. 2007, Mid. 2008).	Number and contents of new Wind-power Project Documents.	
Promotion of new projects.	Descriptions of potential projects are allocated in the IIE's Web Site, updating this information on a quarterly basis.	IIE's Web Site	
<b>Output 4: Development and construction of three 15-20MW wind energy business models in distinct regional energy markets in Mexico</b>	<b>PHASE 2</b>		

<p>Terms of reference, bidding bases, and detailed specifications for the construction of model projects.</p> <p>Bidders' selection.</p> <p>Construction and commissioning of three 15 – 20 MW model wind-power projects.</p> <p>Technical assistance.</p>	<p>Terms of reference, bidding bases, and detailed specifications for the construction of three wind-power model projects are completed and cleared.</p> <p>Three companies are selected through a competitive process to build 15- 20 MW wind power projects.</p> <p>Three 15- 20 MW model wind-power projects are constructed and commissioned.</p> <p>Technical assistance is provided by IIE and CONAE where needed.</p>	<p>Bidding documentation.</p> <p>Results of bidding processes.</p> <p>Status of the three 15-20 MW projects.</p> <p>Participation of IIE or Conae in the implementation of the three 15- 20 MW model wind power projects.</p>	<p>Phase 2 of the project is approved</p> <p>Call for tenders was successful</p> <p>Financial support is available.</p> <p>No critical assumptions.</p>
<p><b>Output 5: Introduction of appropriate financial mechanisms in the Mexican energy market to encourage commercial wind power development.</b></p>	<p><b>PHASE 2</b></p>		
<p>Review of financial mechanisms.</p> <p>Introduction of fitting financial mechanisms.</p> <p>Procedures and guidelines preparation.</p>	<p>Financial mechanisms are reviewed and analysed – one or more is selected as most appropriate.</p> <p>A sustainable financial mechanism for the development of wind power is established.</p> <p>Procedures and guidelines to facilitate the access to new financial mechanisms are published and disseminated.</p>	<p>Report on study of financial mechanisms.</p> <p>Linked formal documents.</p> <p>Contents of procedures and guidelines.</p>	<p>Sener is interested</p> <p>Sustained and full cooperation of government and international financial institutions.</p> <p>Financial mechanisms are available.</p>

<b>Output 6: Promotion of relevant wind power development information based on tested institutional and financial mechanisms.</b>	<b>PHASE 1</b>		
Support for linked promotional activities.  Monitoring and evaluation of output and activities	4 wind energy meetings, seminars, colloquiums, or conferences are supported with in-kind moderate contributions (e.g., brochures, posters, folders or specialists participation) (3rd Qtr. Year 2).  Continuous monitoring and evaluation as described in project document as well as final evaluation.	Meeting records, written agreements.  Evidence as described in project document.	No critical assumptions.
<b>Output 6....</b>	<b>PHASE 2</b>		
Monitoring and evaluation of the three model wind-power projects.  Best Practices Manual and Guidelines for the implementation of Commercial Wind Power Projects in Mexico  Full-Scale promotional campaign for wind power development.	IIE implements a monitoring and evaluation system for the three model wind power projects.  Lessons learned including the permitting process, financing arrangements, plant construction and system performance (technical and economical) are published in the form of a Best practices Manual / Guidelines for the implementation of commercial wind power projects in Mexico  A campaign for promoting full-scale wind power development in Mexico is designed and implemented.	Reports on acquired data, results an analysis.  Contents of the Best Practices Manual / Guidelines  National-wide promotional campaign.	Model wind power projects are implemented.  Model wind power projects are implemented.  Phase 2 of the project is approved.

## **ANNEX C – GENERAL TECHNICAL SPECIFICATIONS**

### **1) Construction and Commissioning of a Regional Wind-Energy Technology Centre (RWTC)**

#### Objective

To procure the construction and commissioning of a Regional Wind-Energy Technology Centre in Mexico targeted to facilitate capacity building at the national level.

#### Approach

The RWTC shall be similar to a 4 MW wind farm, but with the particularity that the wind turbines to install there shall be selected among different technological options. Besides, a twenty people meeting room shall be constructed to carry out workshops, courses, and any other meeting targeted at developing local capacity for wind energy development. An international consultant, with fitting profile, shall be hired for shorts periods for advising IIE on the implementation of the RWTC. This should guarantee that the RWTC would include modern features and elements regarding wind farms operation and construction.

#### Site description

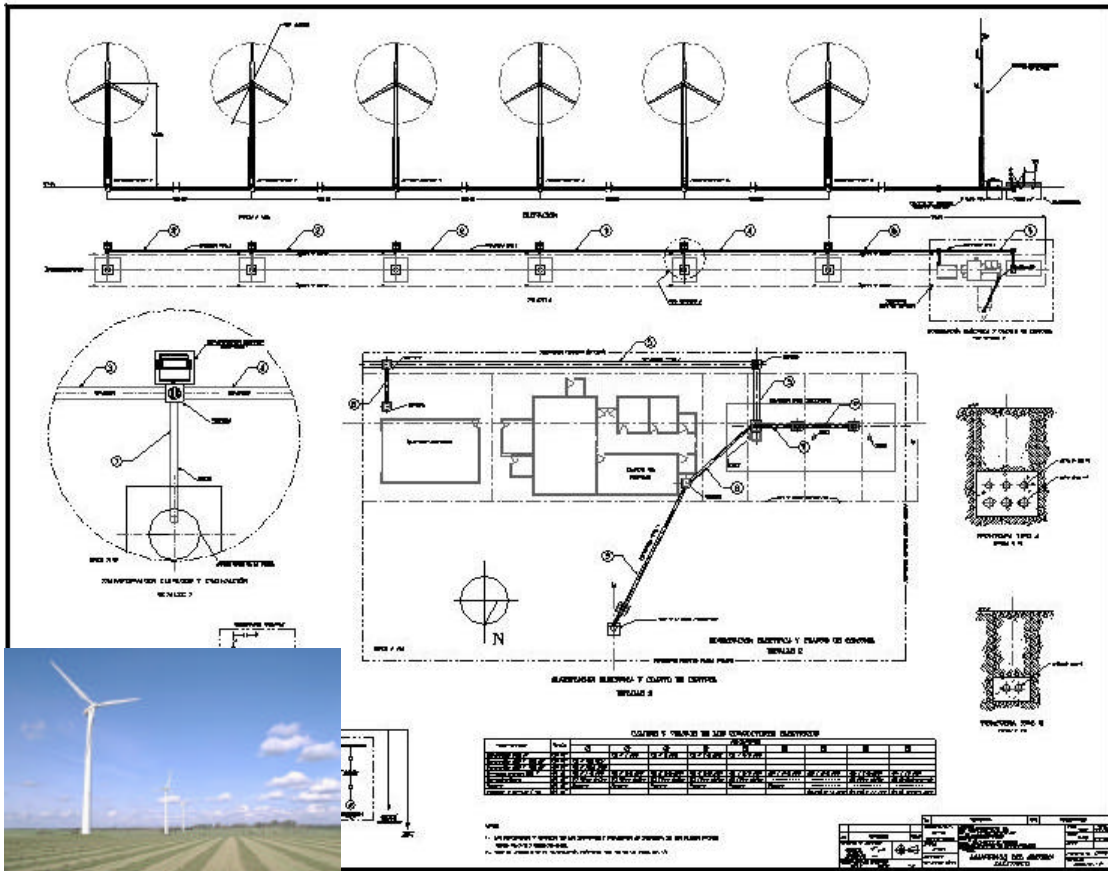
In principle, the RWTC would be constructed in La Ventosa, Juchitan, Oaxaca, in the south of the Tehuantepec Isthmus. Average annual wind speed in the site has been estimated up to 10 m/s at 50 meters above ground. This means that Class I wind turbines shall be required. The land selected for construction of the RWTC is a 950,000 km<sup>2</sup> terrain that is located close to local power lines connected to the network. It is a very plain terrain located less than 50 meters above sea level.

#### RWTC layout

Figure 1 shows the general layout for the RWTC. Its conceptual design is simple, because the terrain is plain, no important obstacles are present, and the wind direction is North during more than 85% of the time. Therefore a straight-line configuration is very suitable for locating wind turbines in the RWTC. Of course, these advantages are not casual because the land was selected to offer the best characteristics.

#### Interconnection with the network

It will be necessary, and convenient, to interconnect the RWTC to one of the medium voltage (13.8 kV) power lines in the area. There are several interconnection modalities at hand. The most suitable options consist of enforcing existing power lines of the local network that run close to the RWTC and connect to the Sto. Domingo or Juchitán substations, respectively. Both options imply the enforcement of existing power lines and poles. Given that the line caliber needs to be stronger than what presently exists, this implies the addition of new power lines and stronger poles. A third option is to construct a totally new power line. The associated investment range of these alternatives is approximated to between USD 250,000 – 500,000. Additionally, the interconnection necessitates new interrupters and protectors, valued between USD 80,000 and 100,000.



General Layout of the Regional Wind Technology Centre

Access and service roads

An access road already exists; as a matter of fact the land is located just at 100 meters from the main highway. However, the existing road must be reinforced. Inside the land for the RWTC, a straight-line road shall be constructed to allow installation and maintenance of the Wind Turbines.

Electric recollection line

An underground electrical line shall be installed along the 1,200 meters service road for collecting electricity produced by the wind turbines (after local transformation from 480 V to 13,200 v).

Control Room and complementary buildings

A typical control room shall be constructed for the RWTC, including complementary workshops, and a 20 people meeting room. The general layout or these buildings is shown in figure 2.



## General logistic for construction of the RWTC

Since the GEF budget to be allocated for RWTC is not enough to construct the whole facility, construction shall be undertaken in compliance with the next stages and logistic.

1. Land acquisition or wind rights procurement.
2. Interconnection agreement with CFE.
3. Environmental permit procurement.
4. Construction and operation permit procurement.
5. Interconnection line rights procurement.
6. Construction local permit procurement.
7. Land preparation.
8. Access road reinforcement.
9. Interconnection line.
10. Control room and complementary buildings construction.
11. Service road construction.
12. Foundations for the first wind turbine (600 – 750) kW
13. Tower installation for the first wind turbine.
14. Transformer installation for the first wind turbine.
15. Cabling for the first wind turbine.
16. Installation of the first wind turbine.
17. Test and commissioning of the first wind turbine.

At this point, the RWTC shall be in operation with only one wind turbine installed. In parallel, a negotiation process with several wind turbine manufacturers and project developers shall be carried out to engage additional wind turbines in-kind contribution. The in-kind contribution would be based in the interest of wind turbine manufactures to use the RWTC for evaluating wind turbine performance (as a whole or specific components) in local conditions. Therefore, it is expected that “in-kind contribution” from turbine manufactures or project developers would be tied to a set of specific conditions. In addition, there could be difficult to be selective regarding the type of additional wind turbines since it shall depend on availability from interested parties.

It is anticipated that in-kind contribution of additional wind turbines could require economic support for transportation and installation. Therefore, provisions to this end are considered in the GEF budget.

Every time a specific wind turbine manufacturer or project developer is interested in install a wind turbine at the RWTC, the installation and commissioning process shall continue from point 12 in the list above, incrementing the consecutive number for the wind turbine. It is expected that the installation and commissioning of the first wind turbine shall call the attention and interest of wind turbine manufactures or project developers, thus facilitating negotiations in the mentioned direction.

**2) Wind resource assessment at the sites with the highest potential in Mexico, and complete feasibility studies for model projects.**

Objectives

- a) Improve the quality, quantity and regional coverage of wind-energy resource data in the country, especially in the most promising regions for commercial wind power development within the next five years.
- b) Carry out detailed feasibility studies to formulate and evaluate five model projects considering innovative modalities or improved market niches.
- c) Carry out a set of background studies to provide generic information required by project developers for the formulation and negotiation of wind power projects in La Ventosa, Oaxaca.

**Wind resource evaluation**

**Reference stations**

Reference stations shall be installed using 40 meters towers to place cup anemometers and wind vanes at 20 and 40 meters above ground. See next photography.



Reference station for wind resource evaluation

### **Towers for reference stations**

The type of the towers shall be similar the ones used to install radio-communication antennas. Every tower shall have a lightning protection system, with a low resistivity ground. In compliance to national standards, the towers shall have alert lamps for air traffic. Electricity for these lamps shall be provided by a photovoltaic system with rechargeable batteries and a charge regulator. In compliance with national standards, the towers shall be painted in red and white with alternating colors every six meters.

### **Data Acquisition Systems**

Data Acquisition Systems (DAS) shall be used to carry out anemometric measurements. The DAS shall have two wind speed channels and two wind direction channels. They shall be fully programmable, allowing the user to set sample rates and a wide number of pre-processing instructions (e.g., average, maximum, standard deviation). The DAS shall have an uninterruptible power supply fed by a photovoltaic panel. In order to protect the DAS against solar radiation, rain, dust and corrosion; they shall be installed into a NEMA 4X shelter box. For high corrosive environments, corrosion inhibitors shall be installed inside the shelter boxes. The data acquisition systems shall be calibrated against references traceable to national or international patterns. They shall also have self-diagnosis routines to verify functional operation and calibration. These routines shall be activated automatically once a day and; also, the operators shall activate auto-diagnosis every time a visit to the stations is carried out.

Minimum specifications for the DAS / anemometers, shall be:

#### Wind speed

Accuracy: 0.1 – 0.2 m/s, in order to meet or exceed IEC standard 61400 part 12.

Resolution: 0.01 m/s

Sampling rate: 2 seconds

Averaging rate: 10 minutes

#### Wind direction

Accuracy: 1 degree

Resolution: 0.1 degree

Sampling rate: 2 seconds

Prevailing rate: 10 minutes

#### General

Operating Temperature: -25 to 60 °C

Minimum Warranty: tree years against defects in material and workmanship

System power requirements: 10 to 16 V c.d.

Calibration traceable to NIST or equivalent

Proven reliability: >98%

### **Transducers**

Worldwide widely used cup anemometers and wind vanes shall be used to measure wind speed and direction. All cup anemometers and wind vanes shall be calibrated before installation. Every year, the wind transducers shall be removed from towers to check their calibration in the IIE's calibrated Wind Tunnel.

### **Operation and data retrieval**

Depending on the location of the reference stations, they shall be operated by traveling to the site, via telemetry (cellular phone), or by trained local personnel. In any way, the raw data shall be picked-up as minimum once every two months. Every four months, it shall be carried out a visit to inspect and give preventive maintenance to each one of the installed reference stations, independently of which is their operation form.

### **Raw data**

For each wind measurement height, wind speed and wind direction shall be sampled at a minimum frequency of 0.5 Hz (two seconds period). From this samples, average wind speed, standard deviation, maximum wind speed, and prevailing wind direction shall be acquired and stored every ten minutes.

Raw data shall be stored temporarily in non-volatile solid-state memories, in such a way that in spite of a total failure of the primary energy source for the DAS, the information is safe. Every 10 minutes a data arrangement shall be stored in non-volatile memory. These data arrangements (one for each height) shall consist of: Date, hour, average wind speed, standard deviation of the wind speed, prevailing wind direction, and maximum wind speed.

### **Data retrieval**

Depending on the type of operation selected for each wind-energy reference station, data retrieval could be carried out by interchanging storage modules or via cellular phone. Data in storage modules shall be read through a personal computer, dedicated peripheral and commercial software. In the case of the DAS to be operated via cellular phone, data retrieval shall be carried out every week; but anyhow, in site non volatile memories shall be used to guarantee data availability in spite any kind of telecommunication failures.

### **Data processing**

Data processing shall be carried out using ALEX, a comprehensive spreadsheet developed by the IIE in compliance with the best international practices. ALEX generates the following results:

Daily results:

- Average wind speed
- Wind speed standard deviation
- Maximum wind speed
- Wind prevailing direction

Monthly results:

- Average wind speed
- Wind speed standard deviation
- Maximum wind speed
- Wind prevailing direction
- Wind speed frequency distribution
- Shape Factor for the Weibull probability distribution function

- Scale Factor for the Weibull probability distribution function
- Hourly average wind speed pattern
- Average, minimum and maximum turbulence intensity

Both raw data and results shall be validated prior to use and publication. Annual reports including all information acquired during a whole year shall be carried out, including wind mapping around the reference station. Wind mapping shall be carried out using WaSP, developed by the RISO National Laboratories of Denmark. Alternative methods and models shall be used to verify results before publishing.

Wind-energy resource evaluation at the most promising sites shall be carried out in compliance with International Recommended Practices, as well as under an ISO9000 quality assurance system.

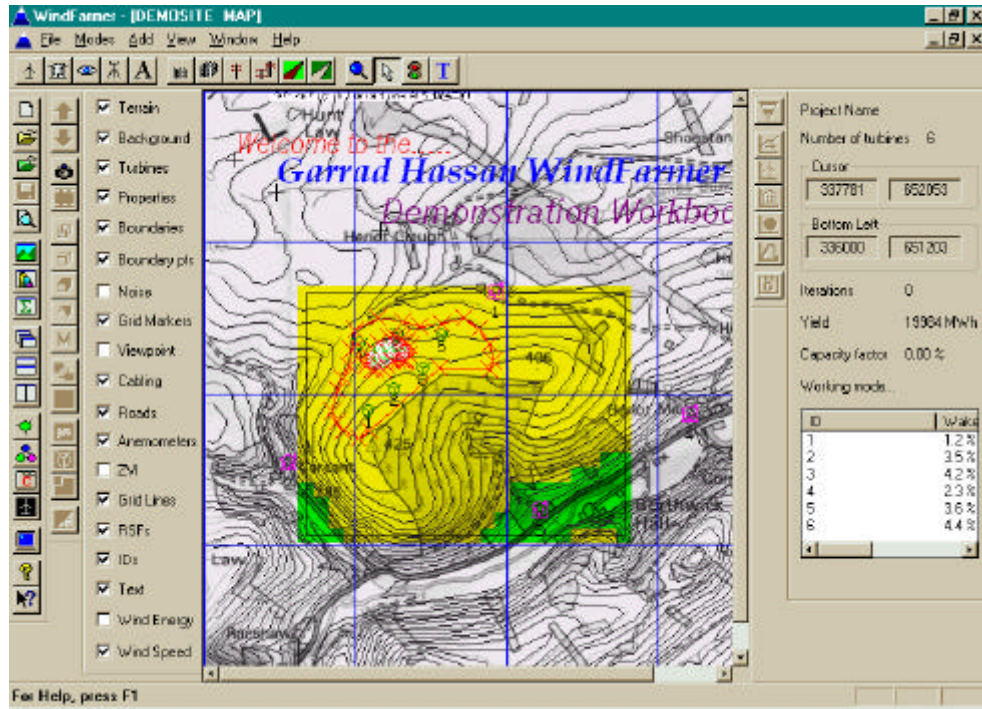
### **Wind-power project formulation and evaluation.**

Based in wind resource evaluation in conjunction with all the information to be gathered by the specialists, detailed project formulation an evaluation shall be carried out at each promising site. The studies shall cover all issues relevant to the commercial development of 15-20 MW wind power plants, including environmental impact, land tenure, financing, detailed resource assessment, transitional rate guarantees, etcetera.

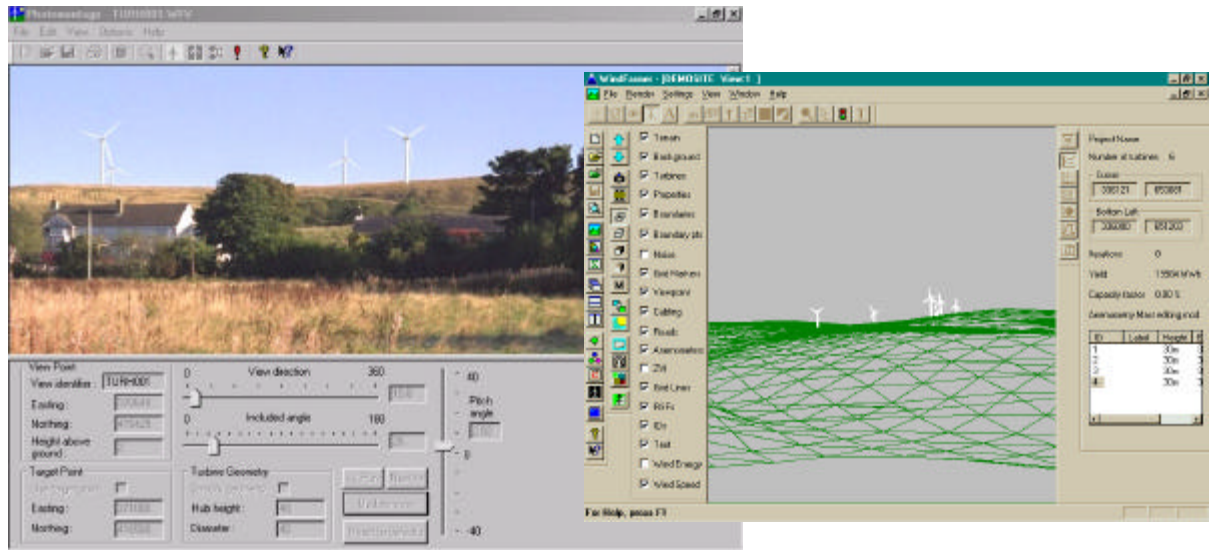
Project formulation shall be carried out only if a strong public support at the local level is achieved. To this end, promotion activities and meetings targeted to key actors (both people and institutions) shall be held at the local level.

Detailed project formulation shall depend on the opportunity niches to be identified, which in turn, shall depend on improvements to the institutional and regulatory frameworks to be undertaken under contract B.

For the technical formulation and evaluation of the wind power projects, specialized software shall be used (i.e., commercial software that is being used worldwide to this end). First, once the site has been located, a technical analysis / optimization shall be carried out regarding project layout and turbine location (see next figure).



Technical project analysis and optimization



Visual project analysis

Environmental analysis as well as others aspects affecting social acceptance (visual intrusion and noise) shall be carried out and reported in detail. Economic and financial analysis shall be carried out by both commercial software and a comprehensive spreadsheet known as EOLO, a proprietary development of IIE. EOLO has the advantage that it realizes

computations including local taxes and other obligations. Furthermore, EOLO is an open spreadsheet and therefore one can add or modify any computation. These shall facilitate the financial formulation / evaluation, in the sense that a set of sensibility analysis shall be carried out most likely in parallel with the formulation / evaluation of new incentives for wind energy.

All the information obtained shall be classified and published in the IIE's Web Site. In addition, the fitting information, incorporating information about protected and environmentally sensitive zones, shall be fed into the IIE's Geographical Information Systems (GIS) for renewable energy.

### **Generic studies for wind power development in La Ventosa**

A set of background studies that shall provide generic information required by developers for the implementation of future wind projects shall be undertaken for the region of La Ventosa.

A first document, which shall address all technical and non-technical aspects affecting wind power development in La Ventosa, shall be published. Based in this document, invitations shall be extended to several institutions and project developers to collaborate with specific information or studies focused to get a complete study for the zone.

First, Semarnat shall be invited to realize an environmental impact generic study for wind energy development in the zone. Second, a wind mapping effort for the whole zone shall be carried out, starting with an upper-air wind mapping effort (to be carried out by NREL, USA). The map shall be validated using available in surface wind data. Next, CFE and project developers shall be invited to provide information useful for complementing/improving the first wind map for La Ventosa. Depending on the first results, complementary methods or installation of new reference stations shall be carried out in order to achieve a reliable wind map.

Then, using the IIE's Geographical Information System a first planning effort shall be carried out, in such a way that it shall include aspects related to land ownership, land lending, infrastructure (road, electrical lines) and potential electricity evacuation measures.

## ANNEX D –WORK PLAN/TIMETABLE

### IMPLEMENTATION PHASE I: First two years

	PHASE I																							
	YEAR 1												YEAR 2											
ACTIVITIES	Months												Months											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>INCEPTION AND IMPLEMENTATION ACTIVITIES</b>																								
<b>1.1 Project formalization</b>																								
1.1.1 Conduct one or more stakeholders meeting for project presentation																								
1.1.2 Preparation, negotiation and signature of required agreements																								
<b>1.2 Institutional harmonization</b>																								
1.2.1 Integration of the Steering and Working Committees, and PCU																								
1.2.2 Benchmarks specification																								
1.2.3 Review of the general Work Plan																								
1.2.4 Integration of Specialised Teams and Expert Groups																								
1.2.5 Preparation of detailed work plans and time tables per outcome																								
<b>1.3 Personnel selection and hiring</b>																								
1.3.1 Development of statements of work																								
1.3.2 Call for candidates																								
1.3.3 Personnel selection and hiring																								
<b>1.4 Project monitoring and evaluation</b>																								
1.4.1 Inception Workshop and Report																								
1.4.2 Day to day project monitoring																								
1.4.3 Quarterly progress reports																								

	PHASE I																							
	YEAR 1												YEAR 2											
ACTIVITIES	Months												Months											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>1.4.4</b> Annual progress reports																								
<b>1.4.5</b> Annual audits																								
<b>1.4.6</b> Phase-one final external evaluation																								
<b>1.4.7</b> Preparation of Phase 2																								











## **ANNEX E – TERMS OF REFERENCE FOR PROJECT PERSONNEL**

### **POSITION: PROJECT COORDINATOR**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico

Budget Line: 017.01

Responsibilities and Duties:

A. The Project Coordinator shall be accountable for the:

- 1) Day to day project administration and allocation of the financial GEF contribution according to quarterly actualized workplans agreed by UNDP and IIE. Presentation of quarterly progress reports and work plans in conformity with the UNDP Manual for Nationally Executed Projects.

B. Responsibilities and duties:

- 1) Ensure achievement of day to day financial and administrative project issues.
- 2) Ensure financial sustainability of the Project, with the support of IIE and UNDP Mexico.
- 3) Supervise the preparation of quarterly financial reports, work plan actualisations, quarterly progress reports and the Annual Project Report (APR) as well as the Project Implementation Revision and the annual Project Implementation Review (PIR) and guarantee its timely presentation to the Project Steering Committee.
- 4) Convene the meetings of the working committee which is composed by members of all steering committee participants. The working committee meets as necessary to monitor project development and to make adjustments as required.
- 5) Convene the meetings of the Project Steering Committee, which meet as necessary with the objective of monitoring project progress, coordinating institutional roles, and securing any information required for the project.
- 6) Convene regular meetings with the project manager, IIE and UNDP, in which the project coordinator present the annual and quarterly work plans and technical and financial reports, according to the UNDP Manual for Nationally Executed Projects.
- 7) Forming part of the Project Monitoring and Evaluation missions.

- 8) Revise TORs with the Project manager, IIE and UNDP Project Staff members.
- 9) Execute procurement procedures.
- 10) Apply UNDP policies and procedures, within the framework of the Full National Execution modality, to all actions under his/her responsibility.
- 11) Ensure synergy between the Project activities of all the technical, administrative and financial areas as well as project consistency with the quarterly established workplans and budgets approved by IIE and UNDP.

Selection Criteria:

Project Coordinator				
Professional Background:	Proven and successful experience and broad knowledge in:	Abilities and/or skills in the following areas:	Personal qualities:	Hiring conditions:
<p>First degree, Master of Science and/or Ph.D. degrees in social sciences.</p> <p>Preferably with 10 ye7ars experience of successful leadership in the design and execution of international projects related to the fields of energy, environment or equivalent.</p>	<ul style="list-style-type: none"> <li>• Financial, material and human resources management</li> <li>• International projects management</li> <li>• Relations with actors of international stakeholders, such as governmental and political agencies, private and state owned enterprises, local and international experts, national and international lending and financing agencies, providers of renewable energy technology.</li> <li>• Excellent English and Spanish</li> </ul>	<ul style="list-style-type: none"> <li>• Positive and open leadership</li> <li>• High initiative</li> <li>• Management by objectives</li> <li>• Establishment, execution and follow-up of long, short and medium term goals</li> <li>• Negotiation and conflict resolution</li> <li>• Strategic planning and follow-up of work plans</li> <li>• High ability to relate with people of any level and representation</li> <li>• High ability for needs detection and decision making</li> <li>• Personnel management</li> <li>• Excellent use of language to communicate and to write reports in both English and Spanish</li> </ul>	<ul style="list-style-type: none"> <li>• Fully committed</li> <li>• Honest, great thrust and initiative</li> <li>• Charismatic</li> <li>• Convincing, congruent</li> <li>• Adaptable</li> <li>• Empathic</li> <li>• Highly responsible</li> <li>• Hard worker</li> </ul>	<ul style="list-style-type: none"> <li>• Live in or near Mexico City/ Cuernavaca</li> <li>• Full time availability</li> <li>• His/her activities will be executed within the UNDP and or IIE premises, and/or his own place of work</li> <li>• Availability to continuously travel inside Mexico and abroad</li> <li>• Selection through UNDP contracts committee</li> </ul>

**POSITION: ADMINISTRATOR**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico

Budget Line: 17.02

Responsibilities and Duties:

A. Under the supervision of the Project manager and Project Coordinator, the Administrator is responsible for:

1) Carrying out the project day to day administration. The activities of this position are to be made with the support of the Project Coordinator, Project manager, UNDP, the Project Staff, IIE, and vendors.

B. Responsibilities and duties:

1) Follow up the timely production of quarterly and annual project reports, to be submitted to the authorities or institutions when necessary.

2) Creating PCU project archives both in hard and electronic versions.

3) Participating in the organization of the National and International workshops for dissemination of project results and acquisition of other experiences.

4) Preparing the communications required by the project to UNDP, IIE, vendors, and consultants and other technical officer.

5) Preparing the annual records of communication activities and participation in international meetings.

6) Participating in meetings with the institutions, associations and individuals that will meet with the role of informing, discussing, and decision making on issues related to the project administration.

7) Presenting before the Project Coordinator, UNDP, Project Staff or any other institution when necessary, the state of project administration.

8) Preparing the needed project administration reports, to be submitted to the authorities or institutions when necessary.

9) Applying UNDP policies and procedures, within the framework of the National Execution modality, to all actions performed by him/her.

- 10) Participating in meetings of the Project Staff, in order to discuss the different activities related to the project administration.
- 11) Meeting regularly with the personnel of UNDP, IIE in his/her area to follow up and assess all the activities to be carried out to ensure compliance with their plans of action and contribution to the achievement of the Project outputs.

Selection Criteria:

Administrator				
Professional Background:	Desired experience and knowledge in:	Abilities and/or skills in the following areas:	Personal qualities:	Hiring conditions:
First degree, Master of Science and/or Major degrees in business administration, economics, electronics, industrial or systems engineering.	<ul style="list-style-type: none"> <li>• Preferably with 5 years of experience in the administration of technological projects.</li> <li>• Knowledge of UNDP procedures of project administration follow up</li> <li>• Knowledge of software oriented to project administration and to creation and maintaining of project archives</li> <li>• Relations with personnel and institutions involved in Project</li> <li>• Excellent English and Spanish</li> </ul>	<ul style="list-style-type: none"> <li>• High initiative</li> <li>• Organization of procedures to carry out the project administration</li> <li>• Establishment, execution and follow-up of the stages of the project administration</li> <li>• follow up and reports making on the project administration</li> <li>• High ability to relate with people of any level and representation</li> <li>• Negotiation and conflict resolution</li> <li>• High ability for needs detection and decision making on project administration</li> <li>• Excellent use of language to communicate and to write reports in both English and Spanish</li> </ul>	<ul style="list-style-type: none"> <li>• Fully committed</li> <li>• Honest, great thrust and initiative</li> <li>• Charismatic</li> <li>• Convincing, congruent</li> <li>• Adaptable</li> <li>• Empathic</li> <li>• Highly responsible</li> <li>• Hard worker</li> </ul>	<ul style="list-style-type: none"> <li>• Live in or near Mexico City</li> <li>• His/her full time activities will be executed within the premises of UNDP, SETRAVI, STE and/or in the premises of the transit and environmental authorities of the Mexico City government, and within any other premises related to his/her activities</li> <li>• High mobility capacities are required</li> <li>• Availability to take part in the project meetings as required</li> <li>• Selection through UNDP contracts committee</li> </ul>

**POSITION: SECRETARY FOR THE PCU**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico

Budget Line: 013.01

Responsibilities and Duties:

A. Under the supervision of the Project manager, the Secretary is accountable for:

1) Assisting the Project manager in all administrative work required for fulfilling UNDP's requirements. .

B. Responsibilities and duties:

1. Carry out activities in accordance with the Project Document and the rules and procedures established in the Project National Execution Management Manual of UNDP.

2. Collaborate in preparing budgets, planning and, in general, monitoring the project.

3. Participate in preparing Terms of Reference for personnel, advertising posts and co-ordinating personnel recruitment.

4. Assist in the formulation of the project's periodic work, travel and financial plans.

5. Assist in acting as liaison between the project and government dependencies, academic institutions, private institutions and NGO's, endeavouring to maintain the efficient inter-institutional co-ordination necessary if the project is to succeed.

6. Update and process pertinent information on all the proposals and ideas concerning the project presented to the Unit.

7. Assist in the preparation of reports.

8. Assist in preparing budget revisions, activity and financial reports on the project, and do whatever else is necessary for the project to be audited.

Selection criteria:

Professional Background: Bilingual Secretary.

Abilities and/or skills in the following areas: Positive; high initiative; ability to relate with people of any level, good use of language to communicate and write reports.

Personnel qualities: Fully committed, highly responsible, adaptable, hard worker.

**POSITION: TECHNICAL CONSULTANT ON IMPLEMENTATION OF THE REGIONAL WIND TECHNOLOGY CENTRE**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico

Budget Line: 011.01

Responsibilities and Duties:

The Consultant shall be accountable for:

- General review of the design and implementation strategy of the Regional Wind Technology Centre.

The Consultant shall be responsible for:

- Propose improvements on the design of the RWTC.
- Propose improvements to the implementation strategy RWTC.
- Identify and propose any improvement related with the incorporation of modern elements used for constructing, monitoring or operating wind power stations.
- Based on his knowledge and connections with wind power manufacturers or project developers, give some advice on strategies for acquiring additional wind turbines for the RWTC.

**Selection criteria**

Professional Background: Master of Science and/or Ph.D. in electrical or mechanical engineering, or aeronautics.

Proven successful experience and good knowledge in: complex and innovative wind power projects or wind power facilities. Preferably ten years experience in wind power research.

Abilities and/or skills in the following areas: Positive and open leadership; high initiative; high ability for needs detection and potential problem identification. Relations with actors from international research and demonstration wind power projects, Good English or Spanish.

Personnel qualities: Fully committed, honest, convincing, congruent, adaptable, empathic, and highly responsible.

Hiring conditions: Available to travel to Mexico twice and stay for 1 – 2 months each visit. Most part of the time staying in Cuernavaca and occasional travel to La Ventosa, Oaxaca.

## **PROJECT MANAGER**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico.

### In-Kind Contribution

#### **The Project Manager shall be accountable for:**

- Overall direction and supervision of all technical project activities, including production of technical documents, as well as overall direction and management of other project activities not covered by the PCU.
- Progress reporting to the Working Committee and Steering Committee, and UNDP's Project Coordination Unit.

#### **The Project Manager shall be responsible for:**

- Ensuring achievement of the project objectives in compliance with the Project planning.
- Preparing the technical inputs for procurement processes.
- Applying UNDP policies and procedures, within the framework of the Full National Execution modality, to all actions under his/her responsibility.
- Prepare detailed TORs resulting from integral revision by the Project Coordinator, IIE and UNDP Project Staff members.
- With the participation of UNDP, select the consultant/researchers, advisors, officers and the subcontracts.
- Coordinate all human resource project inputs, except for the PCU.
- Meet regularly with the personnel in his/her area to monitor and assess all the activities to be carried out to ensure compliance with their plans of action and contribution to the achievement of the Project outputs.
- Carry out overall direction and supervision of in-kind contribution and hired personnel (excluding the PCU personnel).
- Supervise the management assistant.
- Together with the project coordinator up date a General Work Plan.
- Prepare and up date ISO 9001 quality plans for the project.
- Review detailed work plans.
- Provide the PCU with all project relevant financial and other monitoring information required by UNDP project procedures.
- When necessary, present progress reports for the Working and Steering Committees.
- Direct and supervise the projects' technical and logistic activities within the government implementing agency.
- Direct and supervise required project negotiations on permits and cooperation.
- Propose and participate in negotiations for project implementation and engagement of additional contributions.

- Prepare progress reports for the government implementing agency.
- Prepare monitoring and evaluation missions, including the specification of TORs and handling of the subsequent recruitment process.
- Attend auditing processes, including those related to ISO9001 quality assurance system.
- Create the necessary relations among Mexican and international potential private partners, public governmental and political associations in order to obtain information required by the consultant/researchers and technical officers and as demanded by his/her responsibilities.
- Participate in the meetings of the Project Steering Committee, which meet with the objective of monitoring project progress, coordinating institutional roles, and securing any information required for the project.
- Participate in the meetings of the working committee which is composed by members of all steering committee participants. The working committee meets as necessary to monitor project development and to make adjustments as required.
- Participate in regular meetings between IIE, UNDP and the project coordinator in order to monitor project progress and resolve any bottlenecks, as well as to review the quarterly progress and financial reports.
- Coordinate ad-hoc expert groups formed from within a participating institution.
- Coordinate specialized teams formed by staff from various institutions as required.
- Organize National and International expert gatherings such as workshops for dissemination of Project results and acquisition of other experiences.
- Producing, reviewing and adjusting together with UNDP Mexico all technical documents for the project.
- Submit to the donors, government authorities, GEF and UNDP the Project technical reports.
- Define the publication and archives criteria for all material and documents produced by the Project.
- Present before the Project Coordinator, Project Steering Committee, IIE, Monitoring and Evaluation missions or any other Agency related to the associated research, the state of progress of the complete associated research, as well as, the partial and final reports and their conclusions, in GEF format required by the UNDP.

### **Selection criteria**

- Broad knowledge of the objectives and scope of the Plan of Action for Removing Barriers to the full-scale implementation of wind power in Mexico.
- Main technological arm on wind energy research and development of SENER.
- More than fifteen years experience in the wind energy subject.
- Broad knowledge of wind energy development worldwide.
- Broad knowledge of the Mexican social and economical situation.
- Broad knowledge of the Mexican Energy Sector.
- Broad knowledge of the Mexican, institutional, legal, and regulatory frameworks affecting wind power market.
- Broad knowledge of wind turbine manufactures, wind project developers, and Mexican Industry.

- Broad knowledge of barriers affecting progress on the implementation of wind power in Mexico.
- Broad knowledge of National Development Plans and Energy Sector Programs regarding sustainable development.
- International training on the implementation of wind power.
- Broad network of colleagues on wind energy at the national and international level.
- Trustworthy, committed, hard worker, high initiative, and proven honesty.
- Broad knowledge on ISO 9001 Quality Assurance Systems.
- Broad knowledge on international recommended practices and standards on wind-power.
- Strong institutional support.
- Fluency in Spanish and working knowledge in English.

## **ANNEX F – SPECIFICATIONS OF SUB-CONTRACTS**

### **CONTRACT: MANAGEMENT ASSISTANT**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico.

Budget Line: 021.01

Responsibilities and Duties:

#### **The Assistant shall be accountable for:**

- Assisting the Project Manager in all administrative work required for fulfilling UNDP's requirements.

#### **The Assistant shall be responsible for:**

- Carry out project general accounting for reporting to PNUD.
- Prepare all financial and administrative reports to PNUD.
- Organizing and maintaining all administrative documentation.

#### **Selection criteria**

- First Degree or Master Degree in Business Administration.
- Proven successful experience and broad knowledge in: Business Administration. Preferably 10 years of experience in business administration.
- Abilities and/or skills in the following areas: positive; high initiative; ability to relate with people of any level, good use of language to communicate and write reports.
- Personnel qualities: Honest, fully committed, empathic, responsible, convincing, congruent, adaptable, hard worker.

## **CONTRACT OUTPUT 1: PLAN OF ACTION FOR IMPROVING THE INSTITUTIONAL, LEGAL, AND REGULATORY FRAMEWORKS AFFECTING WIND POWER DEVELOPMENT.**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico.

Budget lines: 021.02, 021.03, 021.04, 021.05, 021.06

### **The contractor should be accountable for:**

- Review the current institutional, legal, and regulatory frameworks affecting wind energy development in Mexico.
- Prepare proposals on potential amendments.
- Follow-up the implementation of potential amendments.
- Carry out a promotional campaign for wind energy implementation in Mexico.

### **The contractor shall be responsible for:**

- Hire a senior researcher and a junior researcher on institutional, legal, and regulatory frameworks affecting wind power development (GEF budget lines 021.03, 021.04).
- Conduct and supervise required research on institutional, legal, and regulatory frameworks affecting wind power development (GEF budget lines 021.03, 021.04).
- In close cooperation with the Working and Steering Committees, identify, discuss, and evaluate potential amendments (GEF budget lines 021.03, 021.04).
- Prepare proposals on potential amendments (GEF budget lines 021.03, 021.04).
- In close cooperation with the Working and Steering Committees, evaluate proposals and develop a final version (GEF budget lines 021.03, 021.04).
- Prepare terms of reference and specifications for subcontract, consisting in edition and printing of proposals (GEF budget line 021.07).
- Prepare terms of reference and specifications for subcontract, consisting in design and preparation of provisions for an educational campaign, and reproduction of materials (GEF budget lines 021.05 and 021.06).
- Prepare and hold promotional seminars.
- Encourage submission, negotiation, follow-up and implementation of potential amendments.

### **Selection criteria**

- Broad knowledge of the objective and scope of the Plan of Action for Removing Barriers to the full-scale implementation of wind power in Mexico.
- Knowledge of current state of wind energy research and development of SENER.
- More than fifteen years experience in the wind energy subject.
- Broad knowledge of wind energy development worldwide.
- Broad knowledge of the Mexican social and economical situation.

- Broad knowledge of the Mexican Energy Sector.
- Broad knowledge of the Mexican, institutional, legal, and regulatory frameworks affecting wind power market.
- Broad knowledge of wind turbine manufactures, wind project developers, and Mexican Industry.
- Broad knowledge of barriers affecting progress on the implementation of wind power in Mexico.
- Broad knowledge of National Development Plans and Energy Sector Programs regarding sustainable development.
- Broad knowledge of the political situation and status of initiatives affecting the electricity market in Mexico.
- Broad network of colleagues on wind energy at the national and international level.
- Trustworthy institution within the public sector.
- Full commitment and proven honesty
- Broad knowledge on ISO 9001 Quality Assurance Systems.
- Broad knowledge on international recommended practices and standards in the subject of wind-power.
- Strong institutional infrastructure.

## **CONTRACT OUTPUT 2: CONSTRUCTION AND COMMISSIONING OF A REGIONAL WIND-ENERGY TECHNOLOGY CENTRE (RWTC)**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico.

Budget lines: 021.07, 021.08, 021.09, 021.10, 021.11, 021.12, 021.13, 021.14, 021.15, 021.16, 021.17

### **The contractor should be accountable for:**

- Design a Regional Wind-Energy Technology Center
- Procure construction and commissioning of the Regional Wind-Energy technology Center.

### **The contractor shall be responsible for:**

- Carry out studies to locate an appropriate location to build the RWTC.
- Design the RWTC including civil, electrical, communications, and any other elements.
- Incorporate modern elements in accordance with recommendations of the technical international consultant (GEF budget line 011.01).
- Negotiate and procure all necessary permits and rights to build the RWTC.
- Negotiate and procure all necessary agreements to operate the RWTC.
- Prepare terms of reference and detailed technical specifications for subcontract, consisting in civil works for the control room and complementary buildings; road construction and wind turbines foundations; buried electrical lines and transformers; and electrical works for the control room and complementary buildings (GEF budget lines 021.10, 021.11, 021.12, 021.13).
- Prepare terms of reference and detailed specifications for subcontract, consisting in construction and commissioning of the interconnection line (GEF budget line 021.13).
- Prepare terms of reference and detailed specifications for subcontract, consisting in transportation of wind turbines (GEF budget line 021.15)
- Prepare terms of reference and detailed specifications for subcontract, consisting in installation and commissioning of wind turbines (GEF budget line 021.16).
- Prepare terms of reference and detailed specifications for subcontract, consisting in acquisition of land use rights for the RWTC (GEF budget line 021.17).
- Prepare terms of reference and detailed specifications for subcontract, consisting in geo-technical studies for the RWTC (GEF budget line 021.18).
- In close cooperation with the Project Coordinator, prepare bidding bases, and subcontractors selecting criteria, in order to guarantee a clearness competitive bidding process.
- Proceed as the technical consultant in the bidding process for selecting subcontractors.
- Supervise all works carried out under subcontracts (GEF budget line 021.08 and 021.09).
- Specify and purchase all required monitoring equipment, instrumentation, furniture, and accessories for the RWTC.

- Procure training for the RWTC operators.
- Hire a General Supervisor and an Assistant supervisor for the RWTC (GEF budget lines 021.08 and 021.09).
- In close cooperation with the Project Coordinator, prepare and carry out missions for monitoring and evaluation of the project.

### **Selection criteria**

- Broad knowledge of the objectives and scope of the Regional Wind Technology Center, and the Plan of Action for Removing Barriers to the full-scale implementation of wind power in Mexico.
- Knowledge of current state of wind energy research and development of Sener.
- More than fifteen years experience in the wind energy subject.
- Broad knowledge of wind energy development worldwide.
- Broad knowledge of the Mexican social and economical situation.
- Broad knowledge of the Mexican Energy Sector.
- Broad knowledge of the Mexican, institutional, legal, and regulatory frameworks affecting wind power market.
- Broad knowledge of wind turbine manufactures, wind project developers, and Mexican Industry.
- Trustworthy institution within the public sector.
- Full commitment and proven honesty.
- Strong institutional support within the public sector.

### **CONTRACT OUTPUT 3. WIND RESOURCE ASSESSMENT AT THE SITES WITH THE HIGHEST POTENTIAL IN MEXICO, AND COMPLETE FEASIBILITY STUDIES FOR MODEL PROJECTS.**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico.

Budget lines: 021.18, 021.19

#### **The contractor should be accountable for:**

- Improve the quality, quantity and regional coverage of wind-energy resource data in the country, especially in the most promising regions for commercial wind power development within the next five years.
- Carry out detailed feasibility studies to formulate and evaluate five model projects considering innovative modalities or improved market niches.
- Procure a set of background studies to provide generic information required by project developers for the formulation and negotiation of wind power projects in La Ventosa, Oaxaca.

#### **The contractor shall be responsible for:**

##### Wind resource evaluation

- Integrate and coordinate a specialized team led by the Project Manager, to carry out a discussion to identify the most promising areas in Mexico for commercial wind power development within the next ten years.
- Prepare a procedure and reporting formats to carry out prospecting missions aimed at identifying specific sites where anemometers could be installed to monitor wind energy resource.
- Carry out prospecting missions to identify specific sites where anemometers could be installed to monitor wind energy resource, in such a way that data will be useful to assess wind energy resource within a sizeable land section around the reference station (i.e., to install reference stations).
- Carry out agreements with landowners in order to obtain permits to install and operate reference stations.
- Specify and purchase data acquisition systems, cup anemometers, wind vanes, towers, aviation obstruction lightings, lighting protection systems, data retrieval modules, specialized software, digital maps, vehicle, work station, peripherals, and all accessories required for installing and operating reference stations, as well as carrying out data processing and wind mapping.
- Install and operate reference stations.
- Maintain reference stations in excellent conditions, including calibration.
- Validate raw data prior to processing.
- Process raw data in order to obtain wind resource assessment attending to international recommended practices or standards.
- Validate wind energy resource assessment results prior to their periodical publication.

- Publish, every two months in the IIE's Web Site, raw data and results for each reference station.
- Carry out complete wind energy resource assessment reports, every time a year of data recovery is accomplished, for each reference station.
- Publish in the IIE's Web site, annual results on wind energy resource assessment at the most promising areas in Mexico.

Detailed feasibility studies to formulate and evaluate five model projects considering innovative modalities or improved market niches.

- Prepare a guide to identify opportunities and compile information useful for formulating model wind power projects.
- Carry out missions for identifying opportunities for formulating model wind power projects.
- Compile all essential information including available infrastructure, local development plans, environmental conditions, land tenure status, social circumstances, and any other information required.
- Analyze and organize all useful information to formulate wind power projects, and to publish it in the IIE's Web site, in order wind project developers worldwide may use it to formulate its own projects.
- Identify opportunities to formulate model wind power projects, within the promising areas.
- Held a number of meetings with potential stakeholders in order to promote the proposed model projects.
- Carry out detailed studies to weight up overall feasibility of the model projects.
- Document comprehensive feasibility studies to facilitate the evaluation of proposed model projects.
- Present and discuss the progress on the formulation of model projects to the Working and Steering Committees.
- In consensus with the Working Committee and UNDP-GEF, select the three most promising projects to carry out detailed evaluation prior to eligibility decision.
- Carry out detailed formulation and evaluation, including financial proposal, for the selected projects.
- In consensus with the Working Committee and UNDP-GEF, establish a set of rules, terms of reference, specifications, bidding bases, and selecting criteria, in order to guarantee a clearness competitive bidding process.
- Participate as a technical consultant in the bidding process for selecting contractors to build and operate model wind-power projects.

Procurement of a set of background studies to provide generic information required by project developers for the formulation and negotiation of wind power projects in La Ventosa, Oaxaca.

- In close cooperation with the Government of the state of Oaxaca, the contractor shall prepare a first document including generic information to formulate and evaluate wind power projects in La Ventosa.
- Publish the document in both, printed format and via the IIE's Web site.
- Based in this document, the contractor shall encourage other institutions and private developers to contribute with additional information or comprehensive studies in order to extend the scope of the first document.
- Publish via the IIE's Web site, each additional contribution.
- Prepare a second edition of the document, including enhanced information, lessons learned, recommendations, and best practices.

### **Selection criteria**

- Broad knowledge of the objective and scope of the Plan of Action for Removing Barriers to the full-scale implementation of wind power in Mexico.
- Locally-based office with sufficient capacity to provide maintenance.
- Knowledge of current state of wind energy research and development of SENER.
- More than fifteen years experience in wind resource assessment and the whole wind energy subject.
- Broad knowledge of wind energy development worldwide.
- Broad knowledge of the Mexican social and economical situation.
- Broad knowledge of the Mexican Energy Sector.
- Broad knowledge of the Mexican, institutional, legal, and regulatory frameworks affecting wind power market.
- Broad knowledge of wind turbine manufactures, wind project developers, and Mexican Industry.
- Broad knowledge of barriers affecting progress on the implementation of wind power in Mexico.
- Broad knowledge of National Development Plans and Energy Sector Programs regarding sustainable development.
- Broad knowledge of the political situation and status of initiatives affecting the electricity market in Mexico.
- Broad network of colleagues on wind energy at the national and international level.
- Trustworthy institution within the public sector.
- Full commitment and proven honesty
- Broad knowledge on ISO 9001 Quality Assurance Systems.
- Broad knowledge on international recommended practices and standards in the subject of wind-power.
- Strong institutional infrastructure.

# ANNEX G - MARKET ANALYSIS OVERVIEW

## 1. Introduction

It is well-known that energy policy, both at the national and international levels, has an important effect on electricity markets, and consequently on the competitiveness of diverse electric-generating technologies. In fact, energy policy guides the electricity market in reference to national and international circumstances on a number of topics, including availability of energy sources, state of the art of technological options, domestic technology production, operational risks (e.g., fuel cost volatility, safety), and others. At the international level, mechanisms to drive electricity markets can include access to concessionary loans; while at the national level, laws, regulations, and planning, are the main means adjust the electricity market.

For many years, the electricity market worldwide was based on “no matter what, but cheapest and easy” way to generate electricity. Just two or three decades ago, awareness of the global environmental impact of that policy arose, and thus the concept of sustainable development was linked to electricity production, and widely promoted. As a result, a meaningful effort to diversify the energy mix in order to reduce CO<sub>2</sub> emissions was undertaken by most industrialized countries.

The primary energy source considered for mitigating climate change was natural gas, while the development and promotion of technologies for exploiting non-conventional energy sources (wind, solar, and biomass) was encouraged and supported. Combined-cycle gas turbines were envisaged and implemented as an *immediate solution*, since at present *they offer the highest commercially available plant efficiencies, and emit less sulfur dioxide, carbon dioxide, and particulate matter than oil and coal*<sup>35</sup>. As it is shown in Table 1, at present, combined-cycle gas turbines also offer the lowest investment cost, and the lowest levelised production cost, latter obviously, does not take into account external costs.

Basically, over the last years, the electricity market worldwide has been redirected to increase considerably the exploitation of natural gas. Today, it is said<sup>1</sup> that “*In the industrialized world, natural gas is increasingly becoming the choice for new power generation because of its environmental and economic advantages*”. However, it is well-known that natural gas is not everlasting, and that combined-cycle gas turbines are not CO<sub>2</sub> emission free.

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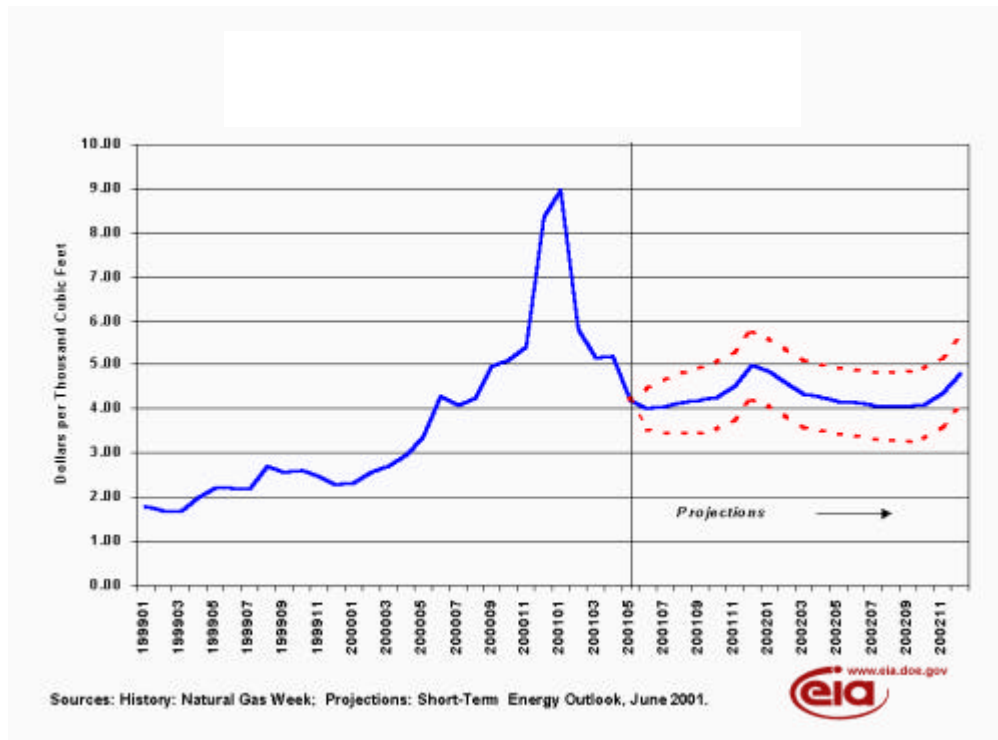
<sup>35</sup> *International Energy Outlook 2001*. EIA/USDOE. [www.eia.doe.gov/oiaf/ieo/index.html](http://www.eia.doe.gov/oiaf/ieo/index.html).

**Table 1.** Comparison of economic indicators of different electric-generating technologies<sup>36</sup>

Technology	Capacity (MW)	Investment cost (USD/kWh)	Levelised production costs (USD¢/kWh)
Oil	37.5	1,316	6.6
Gas fired	42.5	586	9.0
Combined-cycle gas turbine	272	480	2.85
Diesel	18.7	1,286	5.46
Coal	350	1,420	4.0
Geothermoelectric	26.95	1,165	3.6
Hydroelectric	46	1,358	4.82
Wind	20	800 – 1,200	3.2 – 9.2

## 2. General outlook

As it is shown in Figure 1, the cost of natural gas has been rising considerably as a result of increased exploitation. Cost volatility came about by the end of 2000. At present, uncertainty with respect to short and medium term costs is a major concern. In December 2000, contingency measures were adopted in some countries in order to guarantee the economic viability of new combined-cycle gas turbine projects.



**Figure 1.** Natural Gas Spot Prices

<sup>36</sup> Costos y Parámetros de Referencia para la Formulación de Proyectos del Sector Eléctrico (COPAR). Comisión Federal de Electricidad. 1999.

Meanwhile, over the past two decades, wind power technology has improved considerably as a result of intense R&D efforts and operational experience. From 1981 to 1998 wind energy production costs were reduced by a factor of four. Efforts in some industrialized countries to establish favorable legal and regulatory frameworks for the implementation of wind energy and other renewable energies, have led to a wind power capacity of more than 17,000 MW installed worldwide. At present, wind energy is the most cost effective option among the non-conventional electric-generating technologies. According to the conclusions of an international study<sup>37</sup> : “*Wind energy is presently cost competitive in locations with good wind resources (compared to oil, coal, diesel, hydro, and nuclear). The present cost level is around 4.7 USD cent/kWh. The projected cost of wind energy in 2020 is 2.5 USD cent/kWh. This projection is based on an installed capacity of 80 GW by 2010 and 1,200 GW by 2020*”.

In general, if external costs are not considered, then the current levelised production cost of electricity from wind turbines is higher than that of electricity from combined-cycle natural gas turbines. However, on the other hand, it is well known that wind is endless and wind power plants are practically CO<sub>2</sub> emissions free<sup>38</sup>. Furthermore, wind is cost free and neither cost volatility nor cost uncertainty can be expected at anytime.

Combined cycle natural gas power can generate electricity through anthropogenic will, while wind power generation is weather reliant. At present, intermittence is considered the most important limitation of wind power once significant penetration into electric grids is attained. At low penetrations levels, this does not signify a major problem since wind power output is seen by the electrical system as an “innocuous negative load”. Nevertheless, at present, wind power generation is predictable to a certain degree. A number of efforts are being carried out to improve “Wind Forecasting Techniques” in order to best integrate wind electric potential into scheduling and dispatch decisions made by an energy provider<sup>39</sup>.

On the other hand, the fossil fuels giants (e.g., Shell International), are supporting research studies aimed at improving the environmental performance of combined-cycle natural gas power plants<sup>40</sup>. For instance, they say that “*Hydrogen is expected to be the prime energy carrier of the future with the potential to replace carbon longer-term. Hydrogen is currently expensive to make and difficult to store. We are working with International Fuel Cell, to develop and sell fuel processors. These convert fossil fuels to hydrogen emitting CO<sub>2</sub> and water. They provide a bridge to emerging technologies, encouraging new fuel cell applications and paving the way for future investment in hydrogen storage and distribution systems. Fuel cells could also produce electricity from natural gas without the release of CO<sub>2</sub>. Shell is a partner with Siemens Westinghouse trailing a solid oxide fuel cell power plant in Norway. The plant burns natural gas producing CO<sub>2</sub> and steam. The CO<sub>2</sub> can be stored underground without **release to the atmosphere***”<sup>5</sup>. Wind power researchers are also considering the use of regenerative fuel cells to store energy over a number of days<sup>2</sup>. But, anyway, what will be the final cost of the resulting combinations?

More comparisons of combined-cycle gas power plants versus wind power plants can be done, that include issues such as location, pollution, visual intrusion, employment creation, regional development, social acceptance, economy of scale, and so forth.

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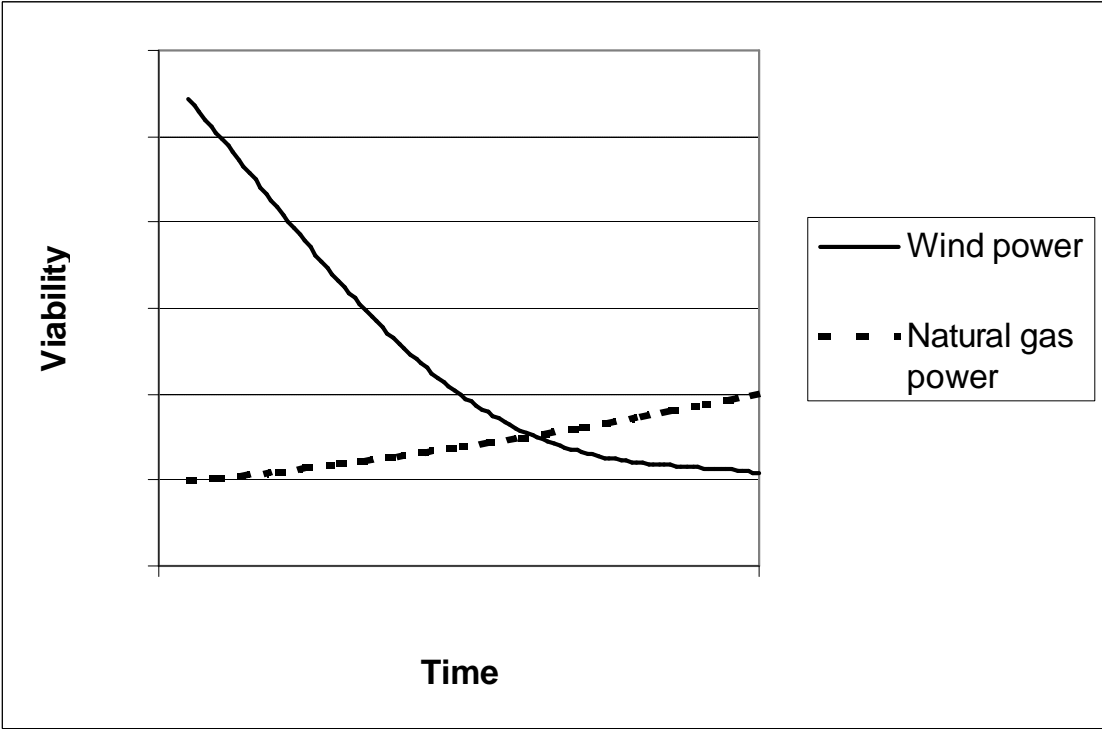
<sup>37</sup> Long Term R&D Needs 2000-2020. 35<sup>th</sup> IEA Topical Expert Meeting. Implementing Agreement for Co-operation in the Research and Development of Wind Turbine Systems. International Energy Agency. The Netherlands. March 2001.

<sup>38</sup> Excepting emissions during manufacture of wind turbines and construction of wind power plants.

<sup>39</sup> Wind Forecasting Techniques. 33 Meeting of Experts. Implementing Agreement for Co-operation in the Research and Development of Wind Turbine Systems. International Energy Agency. Boulder, U.S.A., April 2000.

<sup>40</sup> People, planet & profits. The Shell Report. [www.shell.com](http://www.shell.com). 2001.

All things considered, it can be envisaged that a viability cross-over will come about some point in time over the next 20 years. Basically, the occurrence of this event is a function of the relationship between natural gas savings through exploiting wind energy (and other renewable and non renewable energy sources), and improving wind power technology through the results of R&D based on commercial implementation experience (see Figure 2).



**Figure 2.** Cross over viability of wind power and natural gas power

At the end of the day, the general conclusion will be that combined-cycle gas turbine power plants and wind power plants **should complement each other** in order to achieve best results and the whole benefits of energy diversification aimed at sustainable development.

Therefore, as it has been envisaged by most of the industrialized countries, a learning process on the implementation of wind power has to be under way, right now. This learning process has to do with planning, legislation, regulation, standardization, financial support, business development, and of course, local capacity building on a number of technical issues such as understanding how to deal with wind-power intermittence and other common concerns. No matter what country you are from; today, this learning process is unattainable without a strong national political will combined with international aid or co-operation. European countries co-operate on wind power research and implementation under the framework of the European Commission. Co-operation between most countries of the International Energy Agency is carried out under the framework of the “Implementing Agreement for Co-operation in the Research and Development of Wind Turbine Systems”. Both frameworks incorporate mechanisms for co-operation with developing countries.

In developing countries, the learning process for the implementation of wind power must be carried out under a business-development scenario combined with substantial R&D actions and local capacity building measures. Lack of one or more of these components will lead to gaps that most

likely would become problems or constraints. At present, wind power R&D in developing countries must be conveniently focused to understand, evaluate, and adopt practices, methods, and standards, on the several topics of wind power implementation (e.g., assessment of wind energy resource, planning of wind power deployment, integration into electrical grids, application and evaluation of wind forecasting techniques, detailed understanding of wind turbine options, technical feasibility studies for wind power plants, and so on). Local capacity building must be focused to develop the essential capable human resources that will conduct wind power implementation at the national level, as well as the domestic personnel that will support issues like technology transfer, operation and maintenance. Business-development must include promotion, formulation and establishment of suitable legislative, regulatory and financing frameworks, as well as, promotion of domestic industry participation to increase internalization of economic and social benefits.

### 3. Economics of wind power

As is stated by the Danish Wind Turbine Manufacturer Association<sup>41</sup>, “*there is no such thing as a single price for wind energy*”. And also, there is not a single levelised production cost (LPC) for wind energy. The main reasons for that are:

- Investment costs can differ from site to site, depending on topography, soil conditions, distance to the nearest existing road, distance to the nearest power line, cost of getting a mobile crane to remote sites, and voltage and capacity of the nearest power line (i.e., grid reinforcement and/or voltage transformation requirements). Likewise, prices for wind turbines of the same rated capacity vary depending on rotor diameter, tower heights, and manufacturer. At present it is widely accepted<sup>2,6</sup> that the average investment cost for modern wind power plants is around 1,000 USD per installed kW.
- Maintenance costs of wind power plants vary depending on the selected wind turbine type, and its reliability. At present, an average operation and maintenance cost of around 0.01 USD/kWh is frequently chosen for computing wind power economic indicators.
- Obviously, electricity production from wind power plants is strongly dependent on the availability of wind energy resources at the installation site. Furthermore, the specific wind turbine capability for transforming wind into electricity<sup>42</sup> influences electricity production considerably, selection of the right wind turbine as a function of wind regime is essential, and last but not least, correct location and distribution of wind turbines over a wind power plant (specially in complex terrains) is also critical.

The ratio of the electricity generated by a wind power plant over a period of time to the electricity that the plant would have generated if it had operated at its rated capacity during the same period is known as the capacity factor<sup>43</sup>. Capacity factors for most of the wind power plants installed worldwide are from 20 to 40%. Therefore, annual electricity production for 20 MW rated wind power plants could be from 35 to 70 GWh.

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<sup>41</sup> Danish Wind Turbine Manufacturers Association. [www.windpower.org](http://www.windpower.org)

<sup>42</sup> Represented by the “power curve”

<sup>43</sup> It is also defined as the ratio of the average power produced by a wind turbine to its rated power (usually taken over a period of time)

The levelised production cost (LPC) is given as the ratio of the total discounted cost and the total discounted utilized electricity<sup>44</sup>, i.e.:

$$LPC = \frac{I + \sum_{t=1}^n (OM_t + RC_t)(1+r)^{-t} - SV(1+r)^{-n}}{\sum_{t=1}^n AUE_t(1+r)^{-t}} \quad (\text{Currency/kWh}) \quad [1]$$

Where:

- I Investment cost
- OM<sub>t</sub> Operation and Maintenance cost during year *t*
- RC<sub>t</sub> Retrofit cost<sup>45</sup> during year *t*
- SV Salvage value after *n* years
- AUE<sub>t</sub> Utilized energy during year *t*
- r* Discount rate given as the rate at which the nominal rate (*i*), exceeds the inflation rate (*v*), i.e.:  $r = (i - v) / (1 + v)$
- n* Economic lifetime
- t* Year index

Therefore, it is obvious that the levelised production cost of electricity from wind power plants (*wind power LPC*), is highly project dependent. From equation 1, it can be noted that for wind power plants having the same discounted total cost, the *wind power LPC* will be reduced to half if electricity production is doubled over the plant economic lifetime.

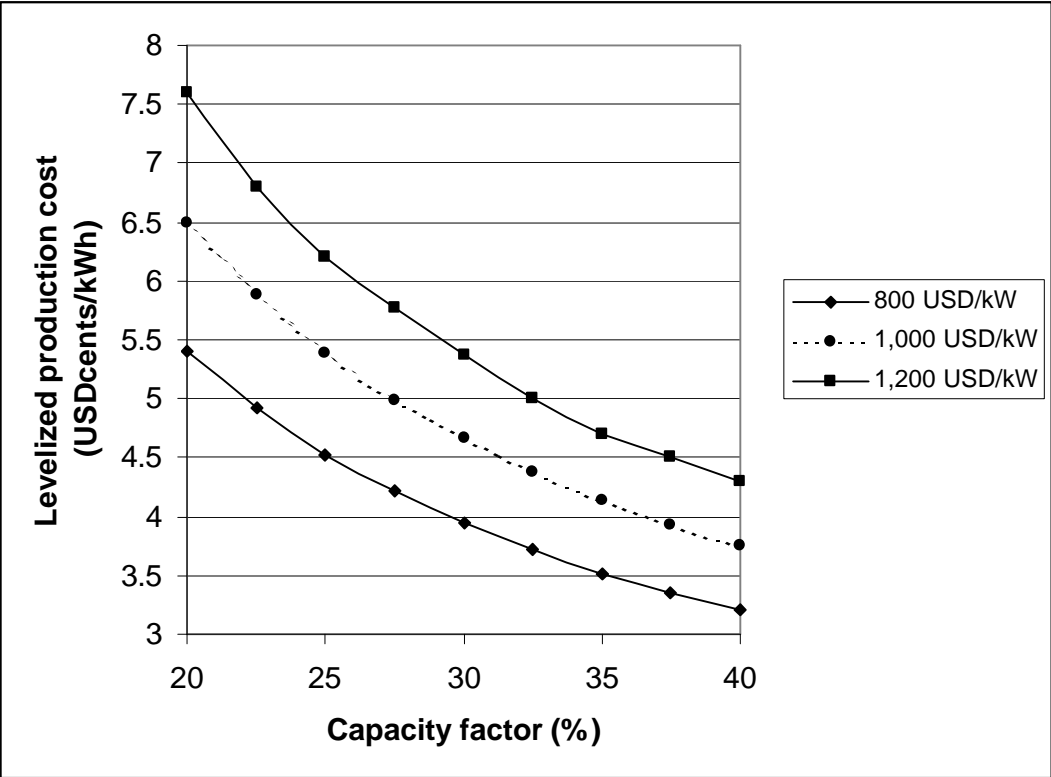
Assuming parameters listed in Table 2, sensibility plots for *wind power LPC* versus capacity factor, for investment costs from 800 to 1,200 USD/kW, are shown in Figure 3 (discount rate = 7%), and Figure 4 (discount rate = 10%).

**Table 2.** Assumed parameters for wind power basic-economic-analysis

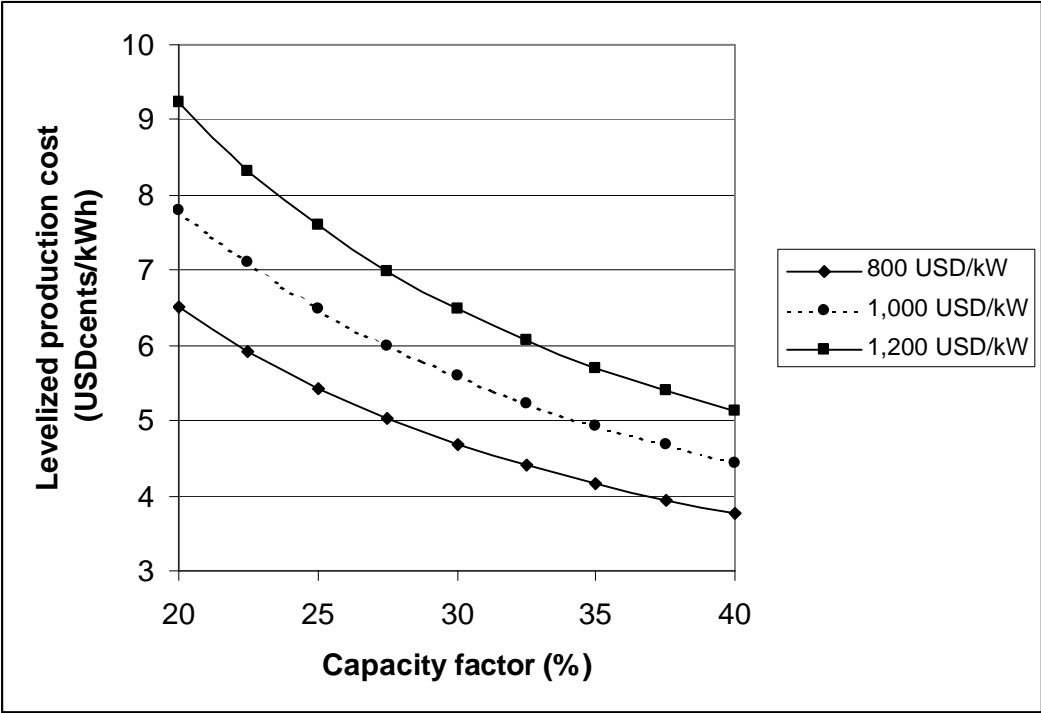
Investment cost	800 –1,200	USD/kW
Wind power plant rated capacity	20,000	kW
Capacity factor	20-40	%
Lifetime	20	Yr
Maintenance costs	0.006	USD/kW
Operation costs (including land lending)	0.004	USD/kW
Retrofit cost	750,000	USD
Retrofit year	10	
Discount rate	7-10%	%

<sup>44</sup> Estimation of cost of energy from wind energy conversion systems. Expert group study on recommended practices for wind turbine testing and evaluation. Implementing Agreement for Co-operation in the Research and Development of Wind Turbine Systems. International Energy Agency. 2<sup>nd</sup> Edition. 1994

<sup>45</sup> The need and costs for replacements or major repairs during the adopted lifetime. This is dependent on numerous factors as the wind turbine, the wind conditions (turbulence intensity), the weather, effectiveness of preventive maintenance.



**Figure 3.** Wind power LPC versus capacity factor for parameters assumed in table 2, and discount rate = 7%



**Figure 4.** Wind power LPC versus capacity factor for parameters assumed in table 2, and discount rate = 10%

## 4. Financial analysis

### 4.1 Basic considerations

Following the discussion of the economics of wind power in previous section, it is clear that in order wind power projects attain business-feasibility in developing countries, concessionary loans are essential, since it cannot be expected that governments will be able to set high buy-back prices for electricity from wind.

Therefore, in a first step it is assumed that concessionary loans from clean-energy multilateral or bilateral financial institutions can be granted to investors in emerging wind power markets. Assumed (or expected) concessionary loan conditions are: 12 years repayment period, 7.5% interest rate, and 20% equity participation.

In Mexico, in accordance with current laws, the income tax rate is 34%. Ten percent of annual net profit has to be disbursed to company employees. A ten year depreciation period is allowed for power plants.

Taking into account the numbers listed in Table 3, a first scenario was made for computing the minimum buy-back price for wind energy projects (MBB-WE) considering discount rates of 7 and 10%. This MBB-WE was computed to comply with the following conditions:

- Rate of return = Discount rate
- Benefit / Cost = 1
- Net present value = 0

**Table 3.** Parameters considered for business-feasibility scenario of wind power projects in Mexico

Investment cost	1,000	USD/kW
Wind power plant rated capacity	20,000	kW
Capacity factor	30-40	%
Lifetime	20	Yr
Maintenance costs	0.006	USD/kW
Operation costs (including land leasing)	0.004	USD/kW
Retrofit cost	750,000	USD
Retrofit year	10	
Discount rate	7-10%	%
Equity participation	20	%
Debt	80	%
Loan period	12	yr
Loan interest rate	7.5	%
Tax rate	34	%
Disbursement profit obligation	10	%
Depreciation period	10	yr
Construction period	6	Months

Therefore, the computed minimum buy-back price for wind power projects corresponds to the minimum fixed reimbursement for all kWh produced by a wind power plant that investors would have to receive in order the project does not generate any economic deficit, but also not any profit. This, of course, takes into consideration the assumed loan conditions and taxes.

#### 4.2 Initial results

Figure 5 shows the minimum buy-back price for wind power projects as a function of the capacity factor. In the legend box, (1,000) and (1,200) correspond to investments costs of 1,000 and 1,200 USD/kW respectively.

Note that a 10% discount rate corresponds to the business as usual scenario<sup>46</sup> in Mexico for electric power projects, while a 7% discount rate corresponds to the short term expected scenario<sup>47</sup>. If investment cost variability and discount rate uncertainty is combined, then an “average” plot can be envisaged from Figure 5 as the area between plots MBB(DR=7%)(1,200) and MBB(DR=10%)(1,000).

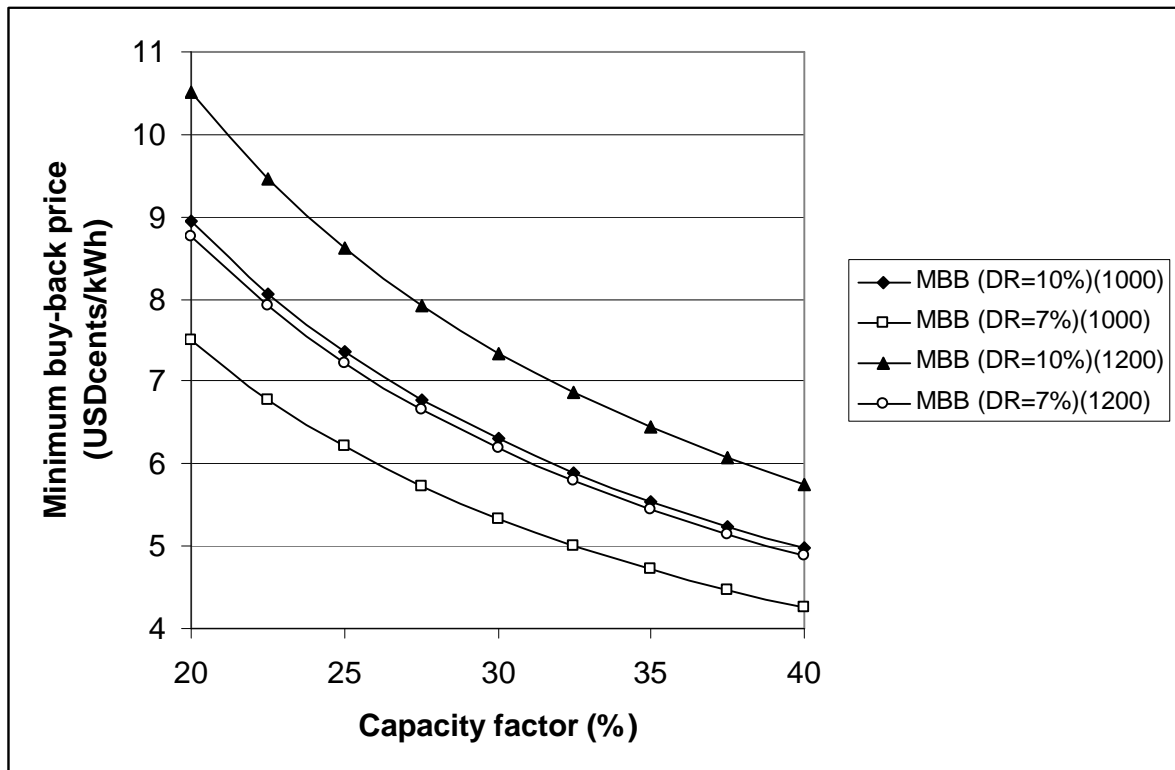
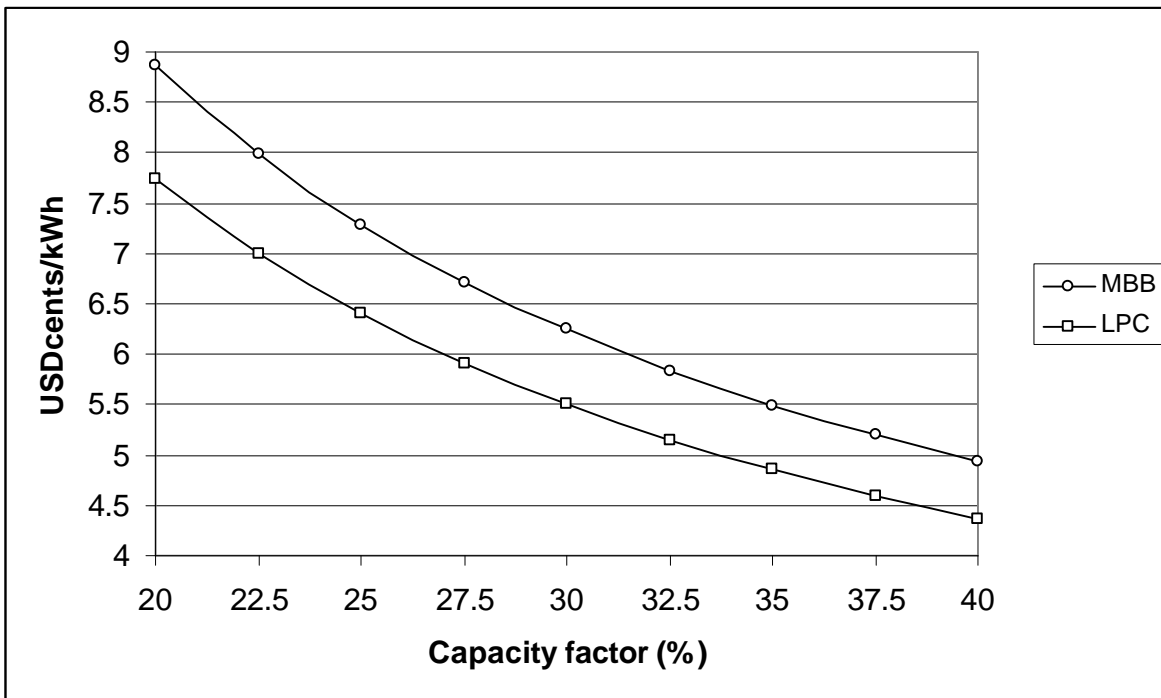


Figure 5. Minimum buy-back prices for wind power projects

<sup>46</sup> Discount Rate usually taken by the Federal Electricity Commission for computing economic indicators of electric power projects.

<sup>47</sup> As a matter of fact, present economic indicators for Mexico indicate this tendency.



**Figure 6.** Minimum buy-back price (MBB) and levelised production cost (LPC) for “average projects” (Investment cost = 1,100 USD/kW, Discount rate = 8.44%)

The narrow area between plots MBB(DR=7%)(1,200) and MBB(DR=10%)(1,000) shown in Figure 5, can be represented by an *average project* having an investment cost of 1,100 USD/kW and taking into account a discount rate of 8.44%. Figure 6 shows the minimum buy-back price and the levelised production cost for this *average project*, as a function of capacity factor.

Next, a Business Feasibility Buy-Back Price (BFBB) for *average wind power projects* was computed in order to comply with selected business-feasibility indicators listed in Table 4.

**Table 4.** Chosen Business Feasibility Indicators

Rate of Return (overall)	10.87%
Internal Rate of Return (on equity)	18.4%
Benefit / Cost	1.16
Average Debt Service Factor	1.24
Repayment period	5.08 years
Net present value	3,600,000 USD

Therefore, BFBB corresponds to the fixed reimbursement for all kWh produced by a wind power plant that investors would have to receive in order the project can be profitable. Figure 7 shows the BFBB resulting plot in reference with the levelised production cost (LPC) for the whole range of capacity factors considered in this approach.

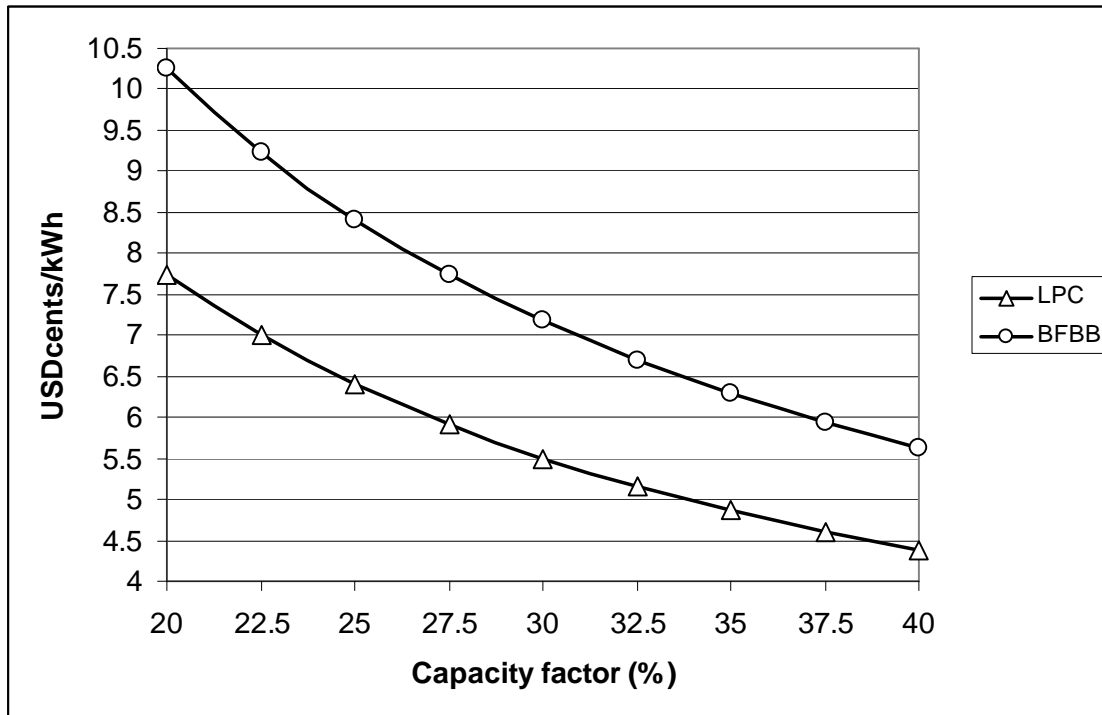


Figure 7. Business Feasibility Buy-Back Price for average wind power projects

### 4.3 Overview of present legal and regulatory frameworks for electricity generation in Mexico

In order to facilitate understanding of this overview, as well as how it relates to wind power opportunities, private electricity-generation allowed by the Mexican Law on Electricity<sup>48</sup> is sorted as follows:

- Independent power production
- Small power production
- Self-supply power production

#### Independent Power Production (IPP)

IPP is permitted for addition or substitution of power plants in order to satisfy electricity requirements at the national level. Electricity from all IPPs must be sold to CFE, the only institution allowed to sell electricity to national consumers (export notwithstanding). CFE is responsible for carrying out detailed studies to this end, as well as to propose a *Planning Document*<sup>49</sup> to the Ministry of Energy (Sener). Every year, Sener reviews and approves a new version of the *Planning Document* proposed by CFE. The resulting *Planning Document*, must include projections and planning for the next decade. According to current regulations, IPP corresponds to power plants rated at 30 MW or more.

<sup>48</sup> Ley del Servicio Público de Energía Eléctrica

<sup>49</sup> Documento de Prospectiva del Sector Eléctrico Mexicano

According to the approved 1999–2009 *Planning Document*, in the IPP modality there is an opportunity for private investors for installing around 14,228 MW from 2005 to 2009<sup>50</sup>. This document points out that 12,490 MW could come from combined-cycle, 1611 MW from hydro, 5 MW from geothermal and 122 MW from internal combustion. Awareness of environmental issues is currently rising<sup>51</sup> and therefore an increased willingness to seek a moderated diversification of electricity-generation using renewable energy can be found in some official documents. This means that from the planning point of view, some reasonable and appropriate fraction of 12,490 MW could be directed to IPP wind power projects from 2005 on.

At present, in order an IPP project is approved, the project has to already be included in the working *Planning Document*, otherwise, it has to be equivalent to one already included. Project equivalence can be recognized if the generation capacity of the alternative project is congruent with provisions established in the *Planning Document*; and furthermore, if the project is considered to be suitable for satisfying some of the technical solutions recommended by CFE.

Electricity buy-back prices for IPPs are established by means of a case by case, agreement with CFE, but in any case, it is mandatory that all addition or substitution of electricity-generation capacity must be done by means of power plants that offer the lowest electricity long-term cost<sup>52</sup>. In addition, the project must offer optimum stability, quality and safety.

### **Small power production (SPP)**

Basically, SPP corresponds to private electricity-generation from power plants rated at less than 30 MW. For this modality CRE is also in charge for evaluating projects and granting permits, taking into consideration CFE's opinion. A small production area is defined by CRE such that a specific small power producer is not allowed to accumulate more than 30 MW of installed capacity in the area.

On request of investors, CRE can grant permits for construction and operation of small power production plants. In fact, CFE requires that the proponent present a permit issued by CRE, prior to signing an *Interconnection Contract*.

According to regulations, power purchase agreements (PPA) can be negotiated with CFE, but they have to be based on existing dispatching rules. Basic dispatching rules for external *producers* that have a previous agreement with CFE can be outlined as follows:

- The external producers must offer a price for capacity (kW) and for energy (kWh) in order that it can be considered for dispatching.
- Offers have to be made with five days in anticipation.
- External producers compete on the basis of costs.
- Dispatching is assigned in increasing order regarding unitary electricity cost at maximum plant efficiency or with respect to electricity price offered on a time of day basis.

Up to now, there are no small power producers in Mexico.

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<sup>50</sup> In fact, there was an opportunity to install 26,281 MW from 1999 to 2009, and from that 12,054 MW are already under construction or committed in order to satisfy required demand growth from 1999 to 2004.

<sup>51</sup> Within Sener, Conae, and other actors of the energy sector.

<sup>52</sup> Unitary cost of electricity over the lifetime of the power plant, including investment and financial costs, risks during construction, investment profitability, fuel costs, operation and maintenance costs and risks, and others (external costs are not take into account).

## Self-supply power production (SSPP)

According to the working *Planning Document*, it was projected that 4,306 MW will come from self-supply and co-generation projects over the period 1999-2009. From this, permits to built 2,542 MW have already been granted and commissioning has been planned from 2000 to 2004. Thus, 1,746 MW are considered as unspecified *additional projects* for the period 2005 – 2009. Therefore, part of this capacity could be satisfied by suitable wind power projects, since there are no restrictions regarding the technology selected by the producer (with exception of nuclear plants<sup>53</sup>).

Electricity prices to consumers vary from region to region, as well as time of day, sector (e.g., industrial, commercial.), and voltage. A complete set of tariffs is established for all cases, as well as rules for price increments. Table 5 shows average prices by sector to consumers by January, 2001.

**Table 5.** Electricity average prices for consumers by sector (January, 2001)

<b>Sector</b>	<b>Average price (USD/kWh)</b>
Large industry	0.051
Medium industry	0.069
Total Industrial	0.060
Commercial	0.137
Municipal	0.117
Agricultural	0.032
Domestic	0.071
<b>TOTAL</b>	<b>0.649</b>

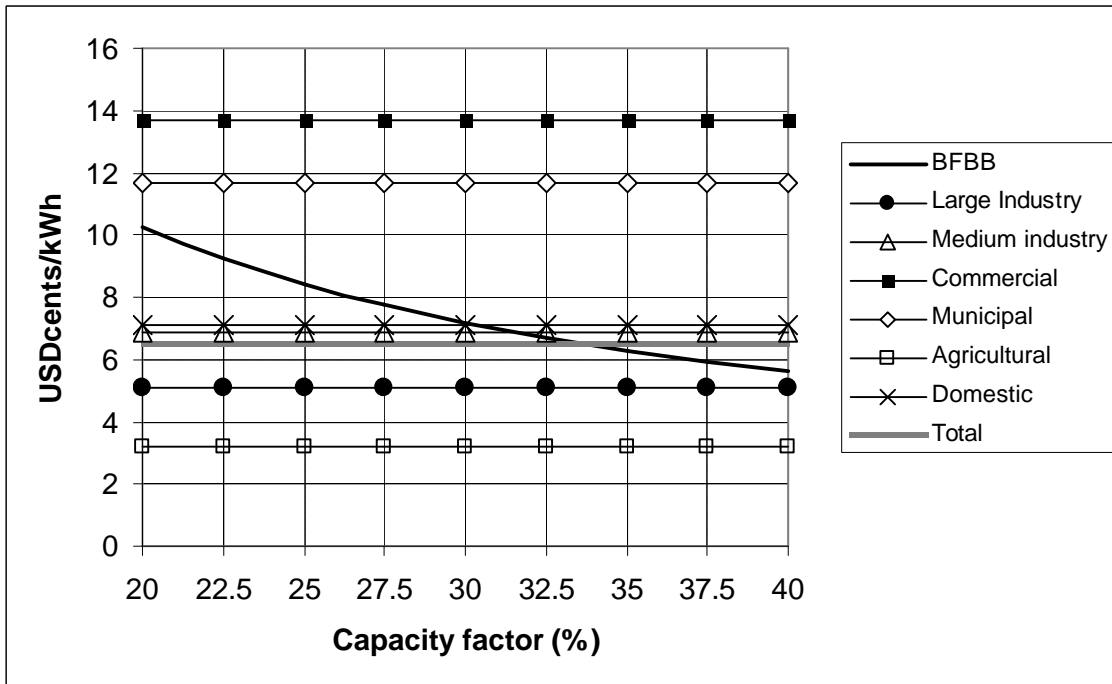
(1 USD = 9.48271 MXP, January, 2001)

Figure 7 shows the average price of electricity for different sectors in comparison with the estimated Business-Feasibility Buy-Back price for wind power projects over a range of capacity factors.

From Figure 7, it can be envisaged that for self-supply purposes a wide niche of opportunity exists in the commercial and municipal sectors (the last includes public lighting and potable and residual water pumping at the municipal level). Opportunity niches for wind power projects can also be envisaged for the domestic and medium-industry sectors for capacity factors from 30 - 32.5 % and above. The current electricity price for the large-industry sector is under the BFBB for capacity factors between 20 to 40 %. Subsidized electricity for agricultural purposes (including water pumping) eliminates the economic-feasibility of any wind power project in this sector.

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<sup>53</sup> Of course, some other projects could be not approved on the basis of environmental and safety risks.



**Figure 7.** BFBB compared to electricity average price by sector

Although a number of opportunity niches for self supply wind power projects can be seen in figure 7, the following constraints exist:

- Wheeling charges can considerably reduce the economic feasibility of self-supply wind power plants, depending on the distance between the generation source and the load. The current methodology for computing wheeling charges includes both fixed and variable costs, and considers the direction electric current.
- Excess electricity produced by a self-supply power plant can be purchased by the CFE under the terms of a previous agreement. However, additional *agreements* on the basis of monthly auction-sale processes are necessary in order that CFE considers offers for dispatching electricity from a specific producer. Accepted offers are included in a *Delivery Program* where buy-back prices are established depending on time of day and marginal costs over a specific region (at present, marginal costs vary from 4 to 9 USD cents/kWh). Electricity that is *out of range* ( $\pm 10\%$  of agreed quantity) fed into the grid is paid at reduced rates (85% of the base price<sup>54</sup>). *Automatic reception* of excess electricity is allowed, in two modalities: notified and not notified. To this end, CFE informs IPPs regarding estimates of the buy-back price to be paid during the next day, on a time of day schedule according to projected marginal costs. If somebody wants to qualify for *notified automatic reception*, electricity has to be offered to CFE earlier than 18:00 hours of the previous day, indicating the time of day the electricity will be generated. Electricity delivered under the *notified automatic reception* is paid at 90% of the base price. *Not notified automatic reception* is paid at 85% of the base price.
- Other *traditional* charges like those for capacity backing and attached services (e.g., frequency and voltage regulation) also affect the economic feasibility of self-supply power projects.

<sup>54</sup> The base price is computed at the end of the day that the electricity was used, in relation with incurred costs.

Therefore, it can be envisaged that, under present regulations, opportunity niches for self-supply wind power projects in Mexico are reduced to projects attainable in good windy sites located very close to an electric load, and as long as a significant amount of electricity generation matches to electricity consumption.

#### 4.4 Preliminary conclusions

- There is an important niche of opportunity for integrating wind power into Mexico's electricity generation mix. From the planning point of view, at least some reasonable and appropriate fraction of 12,490 MW could be directed to IPP wind power projects from 2005 on. In addition, some part of 1,746 MW, expected to come out from self-supply and co-generation projects over years 2005 to 2009, could be also directed to wind power projects. Thus, it sounds rational to point out that, removing existing barriers to the implementation of wind power in Mexico, could lead to around 2,000 MW of installed wind power capacity over the years 2005 to 2015.
- In order that wind power projects are suitable for business purposes, access to soft loans will be required (e.g., 7.5% interest and 12 years repayment period).
- Under present electricity legislation and regulation frameworks:
  - There is no chance for undertaking IPP wind power projects rated at 30 MW or more, unless the *Planning Document for the Electricity Sector* includes wind power projects of this type.
  - Although it is possible to undertake IPP wind power projects rated at less than 30 MW, it is very risky from the economical point of view, basically due to existing dispatching rules.
  - There is an economic opportunity niche for self-supply wind power projects within the municipal and commercial sectors. In fact, the average price for electricity in both sectors is considerably higher than the estimated business-feasibility buy-back price for wind energy. However, in order these projects can be successful, it will be necessary to meet excellent technical-economic conditions, due to existing regulations to buy excess electricity.
- In order to remove existing barriers to the implementation of wind power in Mexico it is necessary to undertake assiduous and coordinated actions within the national institutional framework. Improvements on wind power technology as well as commercial forces by themselves will not led to establish a sustainable wind power market in Mexico (at least within the next 15 years).
- In order to built the first business-demonstration wind power projects in Mexico (once the major barriers are removed) it will be necessary to support them by means of contingent financial assistance aimed at reducing perceived risks linked with most innovative activities.
- Implementation of wind power in Mexico depends on both national and international willingness to achieve enhanced conditions in order to support sustainable development. In fact, there is not any country in the world that has achieved substantial progress in wind power implementation without the support of international policies, technical cooperation and financial assistance.

## **ANNEX H – AGREEMENT BETWEEN UNDP AND THE GOVERNMENT FOR THE PROVISION OF SUPPORT SERVICES FOR MEX/02/G31**

1. UNDP and the Government hereby agree that the UNDP country office may provide such support services at the request of the Government through its institution designated in the relevant programme support document or project document, as described below.
2. The UNDP country office may provide support services for assistance with reporting requirements and direct payment. In providing such support services, the UNDP country office shall ensure that the capacity of the Government-designated institution is strengthened to enable it to carry out such activities directly.
3. The UNDP country office may provide, at the request of the designated institution, the following support services for the activities of the programme/project:
  - (a) Identification and/or recruitment of project and programme personnel;
  - (b) Identification and facilitation of training activities;
  - (c) Procurement of goods and services.
4. The procurement of goods and services and the recruitment of project and programme personnel by the UNDP country office shall be in accordance with the UNDP regulations, rules, policies and procedures. Support services described in paragraph 3 above shall be detailed in an annex to the programme support document or project document, in the form provided in the Attachment hereto. If the requirements for support services by the country office change during the life of a programme or project, the annex to the programme support document or project document is revised with the mutual agreement of the UNDP resident representative and the designated institution.
5. The relevant provisions of the agreement between the Special Fund and the Government of Mexico, signed on the 23<sup>rd</sup> of February 1961, including the provisions on liability and privileges and immunities, shall apply to the delivery of such support services. The Government shall retain overall responsibility for the nationally managed programme or project through its designated institution. The responsibility of the UNDP country office for the provision of the support services described herein shall be limited to the provision of such support services detailed in the annex to the programme support document or project document.
6. Any claim or dispute arising under or in connection with the provision of support services by the UNDP country office in accordance with this letter shall be handled pursuant to the relevant provisions of the SBAA.
7. The manner and method of cost-recovery by the UNDP country office in providing the support services described in paragraph 3 above shall be specified in the annex to the programme support document or project document.
8. The UNDP country office shall submit progress reports on the support services provided and shall report on the costs reimbursed in providing such services, as may be required.

9. Any modification of the present arrangements shall be effected by mutual written agreement of the parties hereto.

## **ANNEX I - DESCRIPTION OF UNDP COUNTRY OFFICE SUPPORT SERVICES FOR MEX/02/G31**

1. Reference is made to consultations between IIE, the institution designated by the Government of Mexico and officials of UNDP with respect to the provision of support services by the UNDP country office for the nationally managed project MEX/02/G31 Action Plan for Removing Barriers to the Full Scale Implementation of Wind Power in Mexico.
2. In accordance with the provisions of the letter of agreement and the project document, the UNDP country office shall provide support services for the Project as described below.
3. For a description of the support services to be provided see table below. With regards to the schedule for the provision of the support services see the work plan of the project document for reference on implementation plan.
4. The total agreed costs of the support services are 236,800 USD for the two years first-phase project duration (5% flat fee), as budgeted within the GEF input budget in the project document. Note that this amount covers exclusively the support costs directly related to executing the GEF allocated project budget. Any additional funds administrated by UNDP and/or where UNDP delivers execution support services beyond their basic obligations, a mutual agreement must be reached between UNDP and the funding agency on the support service fee to be charged by UNDP.
5. UNDP will be reimbursed according to a preliminary agreed schedule of project implementation. This schedule of compensations can be adjusted if any changes are made to implementation speed and intensity of delivery of execution support services as these are described in this standard annex of agreement.
6. Table – Areas where UNDP may provide Support Services:

1. Recruitment of project staff
2. Assist supervision of project staff work
3. Assist recruitment of consultancies (short and long term)
4. Assist supervision of consultancy work
5. Project Co-ordination
6. Financial Management and Accountability:
7. Technical Reporting
8. Monitoring and evaluation
9. Training/ workshop
10. Awareness
11. Equipment
12. Office premises

7. Functions and responsibilities:

a) **UNDP, within the norms for nationally executed projects:**

Revise staff terms of reference, search for staff candidates advertisement, website, rosters), interviews of candidates together with IIE representative, preparation of short lists together with recommendations

Revise the invitation to compete for consultancy contracts (advertisement, website, rosters) together with IIE representative of candidates and the preparation of invitations to bid for the sub-contracts, final evaluations of offers submitted under the guidance of pre established rating systems, with the purpose to present a short list for final decisions.

Prepare and sign on behalf of the executing agency and the government implementing agency, the project contracts according to the terms of reference agreed

Advise in the administration of the staff, consultancy and equipment contracts, to ensure the fulfillment of the terms of each contract

Liaise with IIE on a regular basis (monthly and according to performance delivery), assist follow up and supervision of project contracts, including salary, consultancy fees and other payments authorized by the government implementing agency related to the project and the budget administrated by UNDP, making sure that the norms and requirements of UNDP are respected

Pay the project contracts according to the amounts estimated in direct payment request received from the government implementing agency, as stipulated in the respective contracts

Assist associated staff of government implementing agency and the PCU on financial disbursement and reporting requirements, financial monitoring and record keeping, financial reporting and budget revisions as outlined within the UNDP manual on nationally executed projects

Ensure progress reports are prepared and submitted in a timely manner (according to payment modality and agreed procedures)

Participate in meetings with the government implementing agency, participate in steering and working committee meetings to ensure effective project implementation, supervision of the coordination of different project co-financier, the leveraging together with the government implementing agency and the PCU, of required and additional project funding as possible

Participate in additional project monitoring/site visits, ensure development of clear guidelines for assessing project progress and impact, making appropriate arrangements for the logistical and technical support of the external evaluation team and mission and review the evaluation reports

**b) IIE will assume the following responsibilities as government implementing agency:**

Execute the project to ensure quality delivery of outputs to meet project objectives.

Submit as far as possible to UNDP all the pertinent information relating to the contracting of staff, sub-contracts and equipment, so as to facilitate the process of drafting terms of reference and assist in the evaluations of possible candidates and preparation of short lists.

Prepare the adjusted terms of reference for all project staff and consultancy contracts, together with the technical specifications for the goods to be acquired

Analyze and approve, according to need, the procurement document and the summaries with justification for contract recommendation presented to UNDP for evaluation.

Present to UNDP in writing and according to the payment modality, the applications for each contractual need involving delivery of goods and/or services towards the project, together with the terms of reference or complete technical specifications, with estimated dates and place of delivery.

Accept or reject the goods and services contracted following the specifications/terms established in each case and for each process. In cases where IIE decides to reduce the amounts of goods and services stipulated before such are delivered, IIE will take upon itself all the risk and the compromises deriving from such decisions.

Supervise the work of the consultants, revise and approve the performance deliveries of these according to pre established benchmarks.

Present to UNDP, with fundament in the administration of each contract or buying order, the payment of the corresponding cost of each good and/or service item as terminated or accepted by IIE, also including the operative costs that UNDP necessarily have had to incur in order to support these deliveries, including the cost of storage, customs clearance, packaging, insurance and transport cost within the country and other recurring costs necessary to ensure that prompt and timely delivery.

Assume the responsibility for the handling of goods acquired within the project, once these are delivered to the place of destine. The goods that are procured through UNDP after the specific request of the IIE will become property of the IIE once they receive them.

Cover the costs of operation and maintenance of the goods that are acquired within the project, including the costs related to demands or indemnization sought related to the utilization of those.

Assume all the risks related to the project operations, related to the execution of the project, the delivery of the financing to the project from the Government of Mexico

and the overall responsibility for responding to complaints from third parties towards UNDP related to the project, their functionaries or other people that are delivering services within the project context. However this responsibility will not be assumed if IIE and UNDP can substantiate that the complaints and/or responsibilities are a result of serious neglect and/or intentional negative behavior on behalf of the people involved.

## ANNEX J - RESPONSE MATRIX TO COUNCIL MEMBER COMMENTS

Comments from the Constituency of Australia/ Republic of Korea/New Zealand	UNDP response
<p>1. In addition to those activities already underway, the positive engagement of local communities in wind farm developments through employment opportunities, improvement of local infrastructure of community-level investment opportunities could be considered as part of the best practice manual proposed in Phase 1.</p>	<p>Much of the land in Mexico is owned by poor rural communities and held by communal entities known as <i>ejidos</i>. A correct balance on land negotiation will bring important economic benefits to landowners, not only in cash but also in employment opportunities, and as a consequence, in social harmonization. The work to identify best practices is already under way, and key findings will be incorporated in the Best Practice Manual. The experience in Oaxaca will be very valuable for other States in similar situations. (Paragraph 57). Also, compared to pure private interests, the UNDP project enrolment facilitates land issues.</p>
<p>2.The proposal discusses in some detail the electricity market in Mexico, specifically the electricity tariffs applied to different power users (retail price), the Levelised Production Costs (LPC) and the Business Feasibility Buy Back Price (BFBB) i.e. the price required by the investor from the bulk sale of power. The difference between wholesale and retail prices is not made clear, as exemplified by the following statement – “...for a wind project with a capacity factor of 33.5%, the BFBB price coincides with the total average price for electricity (6.49 USc/kWh in Mexico”. From this statement it appears a direct comparison between wholesale and retail electricity process is being made – which (if this were the case) would not be appropriate.</p>	<p>Certainly, the remark is entirely right. A better indicator for comparison could be the average marginal cost of electricity production in a specific region. For “La Ventosa”, this is about 4-5 USc/kWh. On the other hand, recent studies have shown that expected capacity factors for La Ventosa are from 30 to 52%. In addition, at present some wind project promoters mention low investment costs (900 USD/kW); if that is true, the economic situation could be different. In conclusion, this kind of uncertainties is one of the reasons that detailed studies will be carried out to assess the economic feasibility of model but specific wind projects. (paragraph 32 and Annex G: Paragraph 4 in “Self-supply power production (SSPP)”)</p>
<p>3. The current model for project implementation does not appear to directly include industry representation in the Project Steering Committee and we wonder whether an indirect reporting link to COFER (the Advisory Council for the Promotion of Renewable Energy which includes industry representatives) is sufficient. It may be useful to set up a formal reporting/feedback arrangement that explicitly provides opportunities for a range of industry stakeholders to be involved in the project throughout the various stages of its implementation.</p>	<p>We will put this observation into consideration of the Project Steering Committee in order to define the most appropriate and transparent means of implementing the formal reporting/feedback arrangement to industrial players. One option is via the Chamber of Electrical Industry. In addition, a Web Site will be installed and provide a permanent link with foreign companies. (Paragraph 59)</p>
<p>4. There is a potential pathway to feed the</p>	<p>Positively, the results of the project will be fed</p>

<p>results of this project into neighbouring countries in Central America with similar geographical and institutional issues. For example the southern states of Mexico have a significant wind resource in common with neighbouring countries, allowing the potential for effective transfer of technology and information throughout the region</p>	<p>into neighbouring countries in Central America, as well as South America. Channels include the Ibero-American Net of Wind Energy, including IIE and a number of Latin American countries plus Spain and Portugal. Furthermore, Mexico has a specific cooperation agreement with El Salvador, Costa Rica, Guatemala, and Panama. (Paragraph 77)</p>
<p><b>Comments from Switzerland</b></p>	<p><b>UNDP response</b></p>
<p>1. The successful development and implementation of such a project depends upon the actual changes at regulatory level as well as from financial incentives to make the wind energy a sustainable attractive technology for project developers. The required changes have to be endorsed at a political level. The project document does not provide enough detail to judge how real are the chances of success.</p>	<p>Wind energy development in Mexico enjoys strong political support. This is manifested by the efforts of the work group on regulatory changes (Ministry of Energy, IIE, Comisión Federal de Electricidad and Comisión Reguladora de Energía) and public declarations made by Undersecretary Barnes as well the expressed support in a letter sent by Barnes to Mohammed Al-Ashry. IIE has provided technical backstopping by its “Plan Piloto” that includes wind energy. Furthermore, public consultations have been held by the government to discuss the incorporation of renewable energies in the national grid. (Paragraph 57)</p>
<p>2. Integration of wind energy systems in the global energy system would need further development to optimise the load of the systems.</p>	<p>This core issue is mentioned in particular in the section “Barriers to Wind Energy Development” (Paragraph 34) and included in the study on different types of barriers. Specifically, grid safety is addressed in Output 2, in which a special study has been included. (Paragraph 46)</p>

## ANNEX K - RESPONSE MATRIX TO WORLD BANK/IFC COMMENTS ON MEXICO WIND

<b>Bank comments</b>	<b>UNDP response</b>
<p>We feel the proposal is generally well written and well presented. Several of its components will help provide learning and baseline work for longer term activities envisioned under an emerging Strategic Partnership effort that the Government of Mexico has asked the World Bank to help develop. Discussion of Partnership activities in Mexico are still at a very early stage, however would likely initially focus on efforts toward promotion of grid connected wind energy. We note that Council approval is being sought for Phase I of an envisioned II Phase Project at this time. As discussions progress further with the Government of Mexico on participation in the GEF RE Strategic Partnership- elements of the second phase of this project should be considered more carefully together with the progress of SP efforts to ensure complementarity is maintained. Similarly, any near term discussions of the SP program for Mexico will ensure there is no overlap with the first phase of this project.</p>	<p>UNDP welcomes the Bank's support of the project and suggestions for close co-ordination between this project and the Bank's proposed Strategic Partnership. UNDP has maintained close contact with the Bank's work group on the Strategic Partnership during project preparation, and looks forward to continued and close co-operation.</p>
<p>We are supportive of the document's stated principle of limited support for energy production however, payment support on a per kWh basis can either be so small as to not be really meaningful to the producer, or if it's large enough to be meaningful, you can very quickly go through all available funds. Finding the middle ground on this can be very tough, and it will be a challenge to use such support judiciously and parlay it through innovative delivery and financing vehicles that addresses risks for current and future projects. The part of the package that we think we can make work with high-level government commitment is a combination of government intent, recognition of environmental externalities, recognition of the diversity values of wind (especially as a partial hedge against gas price hikes), magnet to attract future CDM flows, and helping broaden the industrial base. These features will perhaps be more responsive to government commitment</p>	<p>The financial support mechanisms to be used (if needed) in Phase 2 will be identified and evaluated during the first several years of project implementation. The first areas of consideration for engaging full Government commitment include creation of employment, inclusion of environmental externalities and energy security issues. UNDP agrees that the Bank can provide important support for these issues in Mexico as work continues on the Strategic Partnership.</p>

and scale.	
<p>Also, while the 3 - 15-MW pilots proposed in Phase II can potentially help display some of the key modalities that will work for longer term support, a larger deliberate effort with higher level government buy-in and support could potentially unravel this more quickly. While it will still take considerable time, we believe it's possible to have much more than 45 MW well on the way within 5 years.</p>	<p>The expected installed capacity (45MW) is what is proposed as being needed for phase 2 support through the GEF project. It is possible that a significant increase in Mexico's installed capacity in wind power would take hold over the next five years, however if existing barriers are not removed, the point is moot.</p>
<b>IFC comments</b>	
<p>1. Within Phase 1 we are generally supportive of the institutional support to IIE to help it and other Mexican government agencies involved in the power sector to evaluate various regulatory and incentive schemes that would help to promote commercial wind energy development. In our view Mexico is best served by establishing a number of commercial wind projects as quickly as possible on the strength of the interest and financial commitments of private developers/operators rather than primarily via government agency efforts such as those proposed by IIE through this UNDP/GEF project. We think there is a possibility that policy changes could overtake the two year time frame for Phase 1. CFE has considerable experience with competitive tendering for commercial IPP projects or awarding PPAs to commercial developers whose proposed projects fall within an acceptable pricing band. Once the necessary political and regulatory decisions are taken at the national level – wind projects could be tendered for and awarded in less than two years. There may also be a need for IIE to help promote Mexico's wind resource potential to commercial developers once it is clear that appropriate regulatory changes have been made or are in process.</p>	<p>Support to IIE and other government agencies (CFE, CRE and SENER) in Phase 1 is targeted barrier-removal activities. Full private sector engagement is only possible if the regulatory and administrative framework is enabled to “level the playing field” for renewable energies, especially wind. IIE is the lead agency in the sector for GOM's renewable energy initiative, and therefore is expected to provide reliable and science-based information to the sector's regulatory (CRE) and operational (CFE) agencies, that would permit a full liftoff of renewable energy markets in Mexico. IFC is correct in identifying CFE as an agency with significant experience in carrying out competitive tenders for commercial projects, which is in fact one of its core functions. CFE will only be able to perform this function for wind projects when wind is considered to be a lowest-cost investment. Consequently, the barrier-removal activities in phase 1 concentrate on wind pricing, grid stability, and wind resource evaluations, as well as regulatory aspects such as environmental impact assessments and model contracts.</p>
<p>2. We do not think that it is a good idea to have IIE directly involved in wind monitoring at possible or promising project development sites where land rights are already held by potential private developers. Wind monitoring efforts are often the responsibility of private project developers who install their own anemometry equipment on land they have leased or optioned for possible wind development. We are aware</p>	<p>IIE's activities in this respect are complementary to private sector efforts and in effect they go more in the direction of the mapping effort that IFC later refers to. Evidently, private investors will carry out their own measurements before entering a project. Private sector agents from a number of countries that have participated in two symposia in Oaxaca have mentioned 2 years of</p>

<p>of several private developers holding land rights who have already accumulated sufficient site-specific wind data to initiate commercial wind developments if they are able to secure effective power off take and wheeling arrangements with the responsible authorities. As two years of reliable wind data is normally needed before commercial development can begin IIE may in fact further retard commercial wind development through its proposed approach in such instances. IIE's role should be focussed on helping to prepare national wind atlases or other more general scale wind resource monitoring (if such data is in fact not available from other sources) particularly to help distinguish high potential wind regimes from those with more moderate wind regimes.</p>	<p>wind data as necessary for them to enter into a deal. Hence IIE's efforts will not generate "drag" on the development of private investments in the wind sector in Mexico.</p>
<p>3. Again we do not think that IIE should be preparing detailed technical feasibility studies of potential sites. Enough is already known about Mexico's wind potential (including the existence of several world-class wind regimes such as that at "La Ventosa") that IIE's emphasis should be placed on providing support to improving the regulatory framework for commercial wind energy development rather than taking on tasks that could be performed by private sector development interests as is the case in many other countries which have actively developed their wind resources on a commercial basis. Once the necessary regulatory framework is decided upon IIE could support the selection of actual areas to be tendered for under competitive processes by CFE or the identification of potential commercial development sites where significant levels of pre-investment by private sector interests have already occurred rendering them available for competitively selected or sole source private development (if competitive pricing levels from such sites are available). It would seem to be a good idea to inventory the current efforts of commercial wind developers in Mexico to better assess the level of investment that has already been occurring before committing to a firm government policy on how to competitively award commercial wind projects to private sector interests.</p>	<p>Much is known about the wind potential, but not enough is known about the potential impacts on the grid. The facility proposed for Oaxaca in phase 1 is designed to generate information that is necessary to promote the commercial development of wind power in Mexico. IIE (nor GOM) does not propose to supplant information that is currently being generated or might be generated in the future by private enterprise, rather proposes to integrate a reliable source of first-hand data that is necessary for barrier-removal activities in the regulatory framework. The generation of a detailed wind resource inventory should not be viewed as a governmental attempt to supplant the role of the private sector. An appropriate analogy would be the petroleum sector, in which governments have detailed knowledge of their reserves, independently of the type of exploration and commercial contracts (public or private) that exist. Detailed inventories are a necessity for making the case for wind in a country such as Mexico, especially for a project focussed on CO2 reductions and energy security issues. To say that enough is known about Mexico's wind is simply not true.</p> <p>Finally, given the relatively small size of the wind market in Mexico, and the fact that many if not all private agents have been actively participating in government symposia on wind and other renewable energies, UNDP feels that the proposed inventory on current efforts is</p>

	unnecessary.
<p>4. We do not believe that there is a need for a "national technology display" as proposed in the project proposal. Commercial wind development has occurred in many countries comparable to Mexico without such facilities (e.g. 51 MW have been installed to date and are in commercial operation in several separate wind farms in Costa Rica, 54 MW in Morocco and 69 MW in Egypt). What is more important is to allow commercial developers the opportunity to establish operational experience at Mexican sites. This can only be facilitated by adopting the noted regulatory changes that are still needed.</p>	<p>IIE (for aspects related to the need to confirm stated performance specs). See above comments (response to IFC comment no. 3). Further information can be provided to IFC regarding the need for the facility in Oaxaca. As mentioned above, one of the basic tools needed for the barrier-removal activities consists of a reliable data base of information generated in situ, including factors relevant to grid stability, real-time power generation, availability and costs.</p> <p>Finally, both Egypt and Costa Rica are mentioned as successes by IFC, and it should be noted that privately developed wind power in both countries benefited from technology displays and pilot projects underwritten by co-operation agencies and other international support.</p>
<p>5. While the noted training activities to expose Mexican engineers and other technicians to wind energy technology is laudable, it should be noted that the fastest way to encourage training of Mexican workers in wind technology is to create the regulatory basis for a thriving commercial wind industry. The wind industry on a worldwide basis has demonstrated its ability to identify, hire, and train local workers where commercial conditions warrant. Similarly, wind turbine and related equipment manufacturers are more likely to establish local manufacturing and assembly facilities in Mexico once local demand for their equipment reaches a minimum critical level. Mexican engineers and entrepreneurs are similarly unlikely to seek to engage in the wind business until it is seen to be a viable and established business sector.</p>	<p>In accordance with its institutional mandate, UNDP promotes sustainable human development. While it is clear that private sector agents have demonstrated ability to hire and train workers, it is equally true that countries with sector-specific science and technology programs are generally more successful at attracting foreign investment (Human Development Report 2001, Chapter 5, UNDP). Poverty reduction and long-term energy stability are also issues that are treated under this project, in accordance with UNDP's mandate. In this respect it is important to note that national capacities for energy security should be developed and strengthened over the long term, not only in terms of adequate market instruments (characterised by short-term interests), but also in terms of long-term planning and investments in training and technology (World Energy Assessment, UNDP 2000).</p> <p>Finally, in all countries where wind industry has thrived there has been strong state interest with subsidised research, training and industrial development programs.</p>
<p>6. As noted earlier, we do not see the need for the construction of three 15 MW "business demonstration" wind power projects if these projects are to be managed and controlled by</p>	<p>Please see above responses to World Bank comments. Phase 1 will dedicate resources to identify the most appropriate financial stimulus for phase 2, if needed. The 15 MW</p>

<p>IIE or other Mexican government agencies. What is needed is to facilitate competitive tendering for a number of commercially promising wind energy developments under commercially viable PPAs by CFE (Note: it is important to distinguish between a competitive bidding scheme where CFE prepares the site tender specifications and a system where private developers are allowed to bid their own sites on which they have already retained land rights and been monitoring wind levels). There are also legitimate questions as to whether the interests of Mexico to most quickly develop its enormous wind resource potential are best served by concentrating initial commercial wind development in Oaxaca where a number of world-class wind sites are already known and well -delineated or whether it makes sense to simultaneously promote development in several other states. Given the sizeable wind potential in Oaxaca and the level of ongoing development efforts there it might make sense to concentrate initial commercial development efforts there for a time. There are also important questions to be resolved about the appropriate role for possible financial incentives in Mexico's wind energy development efforts. As GEF is unlikely to be able to support such financial incentives on an ongoing basis both for policy and financial reasons it is important for the Mexican government to decide on the most appropriate framework for promoting commercial wind development on an accelerated basis. IIE's studies and analyses of this question (including the possible role which carbon offset financing could play) could help contribute to a sensible national policy position to be codified in national legislation and regulations.</p>	<p>demonstration projects would not be controlled by IIE, rather are envisioned as trial operations for larger competitive tenders to be carried out by CFE. The right balance between Government competitive bidding schemes (required under law) and private developers bidding their own sites will be evaluated in Phase 1. It should be noted that private sector response to the project has been generally favourable, and that private sector agents will have active participation in an advisory capacity during phase 1.</p> <p>As detailed in the project brief, Oaxaca is not the only state to be promoted under the project. Zacatecas, Hidalgo, Veracruz, Baja California, Tamaulipas, Quintana Roo and other states are also mentioned, and GOM strategy takes into account that some regional markets may not require efforts beyond basic barrier-removal strategies.</p> <p>UNDP welcomes IFC's observation that IIE can play a key role in contributing to a sensible national policy, as the project strategy is defined by IIE's mandate on renewables to provide reliable information based on science to promote national dialogue and appropriate policy inputs.</p>
<p>7. Given the importance of transmission facilities in evacuating wind energy from commercial wind farms and related technical concerns (e.g. transmission bottlenecking, predominant patterns of energy flow, reactive power, etc.) it may be useful for IIE to concentrate its efforts on helping to study and resolve such issues via simulations or other studies. This would seem to be quite consistent with their organizational mandate and institutional comparative advantages.</p>	<p>Current capacity for carrying out simulations is quite advanced in IIE and CFE, however site-specific information is required to fine-tune the model. The investment in the facility in Oaxaca is deemed to be a cost-effective manner to provide this information, which then can be extrapolated to other promising regions in the country.</p>

<p>We feel the estimated budgets for Phase 2 are not representative of realistic financing plan for commercial wind projects, however acknowledge that this phase is not being submitted for approval right now. Given the high wind regime at La Ventosa, the willingness of commercial developers to invest equity as well as the possibility of multilateral finance institutions such as IFC and commercial bank participation in the financing of such projects, it is not clear at this stage what form of concessional finance would be needed and in what amounts. This renders estimates of the GEF Phase 2 contribution as premature at this stage. We would therefore suggest that any post- phase 1 GEF funding request deferred until such time as it is clear what path commercial wind energy development in Mexico will be taking. The key effort under this project should be devoted to facilitating the necessary policy and regulatory changes at the national level in Phase 1. In our view commercial wind projects such as those suggested for Phase 2 are best left to private sector developers and financiers operating under a reliable regulatory framework provided by CFE similar to those for other private power projects.</p>	<p>IFC's comments are consistent with the project strategy. UNDP will be sharing information with other IA and EA during the execution of phase 1. As mentioned above, GOM has an explicit strategy for private sector engagement during the project's first phase, and private sector agents will participate in an advisory capacity during the initial stage of the project. As specified in the project document, GEF financing for phase 2 will only be considered following a full evaluation of the effectiveness of barrier-removal activities under phase 1. Results of this evaluation will be shared with IFC, World Bank and IDB in addition to other relevant agencies.</p>
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## **ANNEX L – TERMS OF REFERENCE FOR FINAL EVALUATION**

Project: Action plan for removing barriers to the full-scale implementation of wind power in Mexico.

Budget Line: 53.06

### **Background**

1. In preparation for the potential second phase of the project a thorough evaluation of the first phase will be conducted. The overall objective of this study is to assess results, impacts and pertinence of phase 2.
2. Tentatively, the project study consists of two components:
  - a. An assessment of project coverage*, carried out as a desk study, to consider the progress of technology applications and other barrier removal efforts in the project for its emphasis and relevance in meeting both global environmental objectives and the development priorities Mexico: and
  - b. Thematic reviews*, on the specific barrier removal efforts of the project, to identify project level success.

### **Scope of the Final Evaluation**

3. The overall objective of the final evaluation will be to assess how the project addresses the country and global environmental objectives, and will cover the following elements:
  - a. Identify and document the basis or framework, if any, on which the project has evolved, paying attention to policy and strategic considerations in Mexico, development needs of Mexico, including the state of the wind energy sector.
  - b. Identify the major stakeholders in Mexico who have been involved in developing the project, and assess their level of involvement and contribution to development of the project.
  - c. Identify influence of the project on:
    1. barriers to the introduction of large-scale grid-connected wind energy;
    2. national capacity development and knowledge of suitable technology as well as the impact on the grid;
    3. wind resource assessments;
  - d. Identify future directions for GEF involvement in wind energy in Mexico as indicated by the various stakeholders.

## **Mode of Work**

4. The final evaluation is to be conducted based on the following components:
  - a. a consultant/s would be hired to begin work, based on available documentation, meetings with relevant stakeholders and put together a draft report.
  - b. The UNDP GEF team would be invited to participate.

## **Output**

5. The following outputs will be produced from the final evaluation. Each report shall not exceed 20 pages, plus relevant annexes.
  - a. Draft report from the country consultant.
  - b. Consultant written materials and notes on the project covered under the evaluation.
  - c. Final evaluation report.