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MOBILIZING CLIMATE INVESTMENT

Annex 5 - Wind Power in Mexico

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CONTEXT

Mexico has significant renewable energy resources, including as much as 40,000 MW of wind energy (SENER 2006). Nonetheless, in 2004 less than five percent of Mexico's installed energy generation capacity was from renewable energy sources other than large hydropower, and wind energy accounted for less than one percent (World Bank 2006). An unfavorable policy, legal, and institutional framework was a major barrier to commercial development of renewable energy. The state-owned utility Federal Electricity Commission (CFE), the only electricity buyer, was legislated to buy at the lowest cost and had no obligation to buy renewable energy. Furthermore, regulatory restrictions prevented significant private sector development under the self-supply modality (AMDEE 2011; UNDP 2003),¹² especially for intermittent technologies such as wind power (CCAP 2012). Further barriers included lack of sufficiently detailed wind resource data; lack of industry expertise in the development and implementation of wind power projects; and the high perceived investment risks associated with wind projects, which undermined investor confidence in the financial viability of the wind power market (UNDP 2003).

EFFORTS TO CREATE AN ENABLING ENVIRONMENT

Efforts by the government of Mexico to promote wind energy have been under way since at least the early 1990s. The Electrical Research Institute (IIE), the research wing of the Energy Ministry (SENER), has been conducting wind energy research since the early 1980s (UNDP 2003). In 1994 CFE established a 2MW demonstration wind project, La Venta I, the first grid-connected wind power in Mexico. In 1997, SENER established an advisory council to assist the government in identifying strategies for addressing barriers to renewable energy in Mexico (UNDP 2003). In the late 1990s and early 2000s IIE—in collaboration with other government agencies—organized several international meetings on wind energy, which brought together government, private sector, and multilateral and bilateral funding agencies as well as experts from around the world. Mexican companies were designing and manufacturing wind turbines and parts by the late 1990s, and by 2000 the state government of Oaxaca began promoting wind energy as a way to create jobs and attract foreign investment (UNDP 2003).

In 2001 the Energy Regulatory Commission (CRE) issued a model contract for the interconnection of intermittent energy sources to the national electricity grid to better enable wind and solar energy to penetrate the market (UNDP 2003). IIE estimated in the early 2000s that if barriers to wind energy were addressed, 490 MW of wind energy capacity could be installed by 2008 and 2,000 MW by 2013, with significant economic, environmental, and social (job creation) benefits (UNDP 2003). In 2002 SENER issued a policy directive requiring CFE to finance its own wind power generation. CFE thereafter launched a competitive bidding process for construction of an 83.3 MW turnkey wind farm and the necessary interconnection line to the grid (CCAP 2012). The project, La Venta II, was the first large-scale wind investment in Mexico, and CFE entered into an emissions reduction purchase agreement with the World Bank through the Clean Development Mechanism (CDM) (World Bank 2006a). The project was instrumental in building CFE's understanding of and capacity for wind projects (CCAP 2012).

BOX 1 | HIGHLIGHTS

- In the late 1980s and early 1990s the government of Mexico began to research and promote renewable energy. Its efforts included regulatory and institutional changes and international workshops on wind power. The state-owned utility Federal Electricity Commission established the first 2 MW demonstration wind project in 1994.
- In 2003 UNDP supported a project with \$4.7 million in GEF funding that aimed to address a number of policy and industry barriers to renewable energy investment, including developing a training center to build industry capacity for developing and operating wind projects and conducting wind resource mapping and feasibility studies.
- In 2006 the World Bank with GEF funding supported a project to scale up renewable energy development which included a \$5 million readiness component to strengthen the Energy Ministry and the Federal Electricity Commission, develop a pricing mechanism for renewables, and support policy development and a wind resource assessment. The project also provided support for a production incentive for the first five years of operation of a 103 MW wind farm (La Venta III). This wind farm was the first to be developed by an independent power producer (IPP).
- In 2008 the Mexican Congress passed a law to promote the use of renewable energy resources, which mandated the Energy Ministry and the Energy Regulatory Commission to develop a national strategy, including targets, regulations, and financing mechanisms to promote renewable energy.
- In 2009 the Clean Technology Fund provided concessional finance for the first two private-sector wind projects under the self-supply modality of \$15 million and \$30 million respectively.
- By 2012, wind capacity had grown from 2 MW in the early 2000s to 1,212 MW in operation and an additional 276 MW secured for construction. Private sector participation had grown from two projects with less than 1 MW combined capacity to over 17 projects in operation or under construction with a capacity of more than 1,600 MW. Total investment in the construction of wind power plants was an estimated \$2.4 billion.

In 2003 the U.S. National Renewable Energy Laboratory produced a wind resource atlas for the state of Oaxaca, which has the greatest potential for wind power development in Mexico. This assessment estimated that the state had the potential for 33GW of installed capacity (NREL 2003). In the same year the government—with support from UNDP—initiated a project that identified and aimed to address a number of policy and industry barriers to investment. In 2006 a World Bank-supported project began promoting the scale-up of renewable energy through a number of readiness activities, including tariff price support for a wind project to cover the additional cost of renewable electricity generation (box 2). The same year, the government launched an initiative to expand transmission infrastructure to facilitate the connection of wind parks to the national grid. Under this project, the costs of infrastructure development were distributed between the government and the private developers (MWEA 2011).

In 2008 the Mexican Congress passed a law to promote the use of renewable energy resources, which mandated SENER and CRE to develop a national strategy, including targets, regulations, and financing mechanisms to promote renewable energy (box 3). The law enlarged the private sector's role in renewable energy generation and shifted power away from CFE to SENER and CRE, which were more supportive of wind power and private sector involvement (CCAP 2012). In 2009 concessional finance from the CTF supported the first private wind power developers under the self-supply framework to reach financial closure (box 3) (IFC 2009; IDB 2009a). In 2010 a series of new regulations were issued by CRE to strengthen the regulatory framework for renewable energy projects in the self-supply modality, including reductions in the transmissions charges for private developers (AMDEE 2011).

BOX 2 | PROJECT FOR LARGE-SCALE RENEWABLE ENERGY DEVELOPMENT

In 2006 the Mexican government and the World Bank initiated a project for large-scale renewable energy development (PERGE) with \$25 million from GEF. The project sought to reduce policy and financial barriers to private sector investment in wind energy. It included a \$4.97 million³ readiness component comprising technical advice and capacity building for SENER and CFE; development of a pricing mechanism for renewables; and support for policy development and a wind resource assessment (World Bank 2006b). The project also provided \$20.4 million for a production incentive, in the form of tariff support of 1.1¢ per kWh for the first five years of operation of a 103 MW wind farm (La Venta III), developed by an independent power producer (IPP) (World Bank 2006b). The contract was awarded through a competitive bid process to Iberdrola, S.A., which developed the project at a cost of \$225 million, with 50 percent financing from the European Investment Bank.⁴ Through the bidding process for La Venta III, CFE gained experience working with IPPs to develop renewable energy projects. In 2008 it launched an expansion program to tender four additional 100 MW wind farms (Oaxaca I-IV) to IPPs, which did not require tariff support to be viable (although they all qualified as CDM projects) (CCAP 2012).



BOX 3 | RENEWABLE ENERGY DEVELOPMENT AND FINANCING FOR ENERGY TRANSITION LAW

In 2008 the Mexican Congress passed the Renewable Energy Development and Financing for Energy Transition Law, with the aim of promoting renewable energy resources. The law includes provisions that:

- Require SENER to set targets for renewable energy and engage with various stakeholders and sectors in developing renewable energy policy, and to incorporate environmental externalities into its cost estimates (CCAP 2012). Under the law, SENER developed a program to promote the use of renewable energy. It includes targets to increase renewable energy capacity from 3.3 percent to 7.6 percent (4,500 MW) of total installed capacity, with 2,500 MW of wind capacity (Borja 2009). It would increase renewable energy generation from 3.9 percent to 6.6 percent by 2012, and use renewable energy to electrify 2,500 off-grid communities (CCAP 2012; AMDEE 2011).
- Expanded CRE's autonomy to carry out functions previously overseen by CFE, including designing the regulatory framework for renewable energy; determining, in collaboration with SENER and the Finance Ministry (Hacienda), the rates to be paid by CFE to private renewable electricity producers; and drawing up contracts between CFE and private producers for renewable energy purchase.
- Require CFE to buy surplus energy generated by efficient renewable energy cogeneration or self-supply projects and pay compensation based on CFE's least cost prices, taking into consideration the externalities.⁵
- Require renewable energy projects greater than 2.5 MW to engage local communities, promote their social development, and to pay any relevant rents.
- Established a fund to finance renewable energy and energy efficiency projects. Approximately \$220 million (3 billion pesos) has been allocated to the fund on an annual basis from 2009 to 2011, although it has been mainly used for energy efficiency programs (AMDEE 2011).

The combination of a more supportive policy, legal, and regulatory environment; increased access to finance; and availability of new transmission capacity—combined with external factors such as declining prices of wind turbines—stimulated significant growth in the wind industry after 2008 (AMDEE 2011). In 2011, over 500 MW of wind projects were in operation (85 MW by CFE and 439 MW by self-suppliers and small producers). In addition, roughly 1,470 MW were in different stages of construction and were expected to come into operation between 2011 and 2013 (509 MW by IPPs under contract with CFE, and 959 MW for self-supply), as well as a further 461 MW in self-supply projects that had received generation permits from CRE but had not yet begun construction. Furthermore, a pipeline of at least 3,400 MW of committed wind energy was set to come on-line through 2016 (CCAP 2012). Private sector investment in wind energy has grown rapidly, from only two very small private sector wind projects in 2003, with less than 1 MW combined capacity (UNDP 2003), to more than 17 private sector wind projects in operation or under construction in 2011, including 12 under the self-supply modality and five IPP projects (CCAP 2012). By end of 2012, the total investment in the construction of wind power plants was an estimated \$2.4 billion (Borja 2013).

Mexico's success is a result of a strong commitment by the government—further evidenced by a climate change law passed in April 2012 that requires Mexico to generate 35 percent of electricity with clean sources by 2024, and make renewables economically competitive before 2020 (WWF Mexico 2012)—combined with timely support from its international partners for critical readiness activities as well as with concessional capital. However, the development of Mexico's wind industry has not been without its challenges. Some of Mexico's richest wind resources occur in the state of Oaxaca, which is also home to indigenous communities who have raised concerns about the extent to which affected communities have been consulted on wind power developments, and their social and environmental impacts (AIDA and CEMDA 2012). This highlights a real tension that will need to be addressed going forward if wind development is to be carried out in a sustainable and socially equitable manner.

ROLE OF INTERNATIONAL SUPPORT

While the government has actively promoted the development of wind energy and taken steps to attract private investment, international partners have helped make the case for renewable energy among government and industry and have supported efforts to create an enabling environment for investment. In 2003 the U.S. supported the development of a wind resource atlas for the state of Oaxaca, which has the highest potential for wind power development in Mexico. The same year, USAID conducted a feasibility study for the La Venta II project that demonstrated its viability (World Bank 2006a).

Also in 2003, UNDP implemented a GEF-funded project targeting barriers to wind energy in Mexico. The project involved readiness activities including:

- enhancing the institutional, legal, and regulatory framework for wind energy through a review of the existing framework and engaging with stakeholders to identify amendments that would stimulate wind energy development;
- building technical capacity for wind energy development through a training and demonstration center;
- reducing informational barriers to wind energy development through wind resources mapping, feasibility studies, project proposals, and project promotion; and
- disseminating relevant wind power development information (UNDP 2003).

The project, which was implemented through IIE, had mixed success. The training center was established as envisioned and became the first project to produce electricity under the small power producer modality in Mexico. The wind resource assessment provided useful data and the project contributed to strengthening industry expertise in wind energy. However, the project was not very transparent in sharing knowledge and its impact was limited by the fact that the training center did not make information freely available to industry.⁶

In 2006 the World Bank supported the PERGE project, which included readiness activities and tariff support for five years of 1.1¢ per kWh for a 101 MW wind farm (La Venta III), the first IPP-developed wind project in Mexico (World Bank 2006b). Through the bidding process, CFE gained experience working with IPPs to develop renewable energy projects. In 2008, four additional 100 MW plants were included in CFE's expansion program (Oaxaca I–IV) without needing tariff support (although they all qualified as CDM projects) (CCAP 2012).

The World Bank also provided technical support to SENER during the development of the renewable energy law.⁷ After its passage in 2008, a number of international institutions—including ESMAP, the World Bank, the Inter-American Development Bank (IDB), GTZ, the North American Development Bank, and USAID (IDB 2009)—provided technical assistance to design a regulatory framework to implement the law, which resulted in the issuance of new regulations in 2010 reducing transmissions charges for private developers of renewable energy (ESMAP 2010; IFC 2009).



In 2009 the Clean Technology Fund (CTF) endorsed a country investment plan for Mexico and subsequently approved two projects that included support for promoting wind energy development (box 4). The project approach was to support the first two or three private developers in the self-supply wind market to help establish a track record of performance and prove that such projects could be profitable (Transitional Committee of the GCF 2011). The CTF supported two such wind projects with concessional finance. These projects reached financial closure with additional finance from IDB and IFC. Subsequently, a number of self-supply projects have been developed with commercial finance. The IDB also provided technical assistance through CTF funds to strengthen the capacity of the state-owned development bank Nacional Financiera (NAFIN) for financing renewable energy (IDB 2009a). In 2011 CTF approved a \$70 million project to establish a renewable energy financing facility in NAFIN that would leverage similar amounts of lending from NAFIN and the IDB and enable scaled up financing for renewable energy projects (IDB 2011a).⁸ The project also included a technical assistance component to strengthen the financial and technical capacity of financial institutions and the private sector for wind projects and support assessments of the environmental and social impacts of wind power (IDB 2011a).

BOX 4 | CLEAN TECHNOLOGY FUND SUPPORT FOR WIND ENERGY IN MEXICO

In 2009 the Clean Technology Fund (CTF) endorsed a country investment plan for Mexico including public and private sector components to be implemented by IDB and IFC. The first project approved under the CTF investment plan provided \$15 million in concessional finance for the 67.5 MW “La Ventosa” wind farm, the first wind project to be developed under the self-supply modality. The project was unable to attract commercial finance and was closed with \$21 million in financing from IDB (IDB 2009b), \$21.5 million from IFC (IFC 2010a), and \$81 million from the U.S. Export-Import Bank (IFC 2010b; Transitional Committee of the GCF 2011; Venugopal et al. 2012). The second project approved under the investment plan provided \$30 million in concessional finance from CTF for the 250 MW “Eurus” self-supply project (IDB 2009a). This second investment was able to attract commercial funding, but needed \$55 million in additional finance from IFC (IFC 2010c) and \$50 million from IDB (IDB 2009b) to reach financial closure (Transitional Committee of the GCF 2011). These investments were followed by a 396 MW investment by a private developer under the self-supply framework that did not require any concessional finance and reached financial closure with commercial finance and a \$72 million loan from the IDB (IDB 2011b).

OBSERVATIONS AND INSIGHTS

Mexico has been successful in promoting wind energy development and strategic in its use of international support to achieve its renewable energy objectives. Insights from this case are the following:

- The government of Mexico has demonstrated strong leadership and has been the main driver of wind energy promotion in Mexico. Consistent support and various reforms to promote wind energy have given investors confidence in the government’s commitment to renewable energy.
- Strong technical knowledge and expertise in renewable energy in the government research institute, IIE, enabled early research and innovation that informed renewable energy policy and raised industry interest in wind power.
- Several international meetings and workshops that brought together various stakeholders were instrumental in raising awareness, sharing information among different actors, and promoting interest among industry and international partners in wind energy in Mexico.
- Legal and regulatory changes to promote private sector engagement in the wind sector were essential for the scale up of investment in wind energy; more than 95 percent of the wind capacity additions over the last ten years have come from the private sector.
- International support has played an important role in creating industry awareness and capacity and demonstrating the viability of wind projects under various financing models. The World Bank supported the first project to receive carbon finance and the first wind project to be developed by an IPP. UNDP supported a demonstration project that became the first small producer. CTF supported the first two projects under the self-supply modality. Each of these models was subsequently replicated by private sector developers without the need for international support.
- International support to strengthen the capacity of NAFIN for renewable energy projects has raised financial sector awareness and led to the creation of a financing facility that will use MDB financing to leverage additional financing from national institutions.

Table 1 | Milestones in the Development of Mexico's Energy Efficiency Sector

YEAR	MILESTONE	YEAR	MILESTONE
1992	Government of Mexico passed a law allowing limited private sector involvement in electricity generation.	2003	The action plan for removing barriers to the large-scale implementation of wind power in Mexico was initiated with \$4.74 million from GEF through UNDP. Activities included developing a training center to build industry capacity for developing and operating wind projects; conducting wind resources mapping and feasibility studies for wind projects; disseminating relevant wind power development information; and reviewing the policy framework to identify how to better stimulate wind energy development.
1993	The Energy Regulatory Commission (CRE) was formed as an advisory body to SENER. Subsequently in 1995, CRE was given the authority to regulate private-sector electricity generation in Mexico—duties previously performed by Federal Electricity Commission (CFE).	2004	The government issued a tax incentive allowing accelerated depreciation of investments in renewable technologies.
1994	The state-owned utility Federal Electricity Commission (CFE) established a small (2 MW), grid-connected demonstration project, La Venta I.	2005	Construction of the first large-scale wind farm, the CFE-owned 83.3 MW La Venta II, began following a competitive bidding process conducted by CFE.
1997	An Advisory Council for the Promotion of Renewable Energy was established within the Energy Ministry (SENER) to assist the government in identifying strategies to address barriers to renewable energy in Mexico.	2006	CFE entered into an emissions reduction purchase agreement with the World Bank through the Clean Development Mechanism (CDM) for the La Venta II project. The World Bank would purchase on behalf of the Spanish Carbon Fund Verified Emissions Reductions (VER) from the project for the period 2007-16 (total cost \$16,258,211) and on behalf of the Bio-Carbon Fund for the period 2017-19 (total cost \$1,215,000).
2000	The Electrical Research Institute (IIE), the research arm of SENER, carried out a Pilot Plan to Foster the Development of Renewable Energy. The plan looked at barriers to and options to promote various renewable energy technologies in Mexico, with the aim of informing a national policy on sustainable energy.	2006	CFE adapted its independent power producers (IPP) bidding procedures and PPA in order to allow for intermittent renewable energy IPPs.
2001	CRE issued the contract for the interconnection of intermittent renewable energy self-supply projects to the national electricity grid, with the idea of fostering the penetration of non-dispatchable sources of energy such as wind and solar. These rules established an energy bank to accommodate intermittency and determined wheeling charges.	2006	Government of Mexico (GoM) started to implement the “open season” initiative to expand transmission infrastructure to facilitate the connection of wind parks to the national grid. Under this initiative the costs of infrastructure development were distributed between CFE and private developers.
2002	SENER issued a policy directive requiring CFE to finance the construction of La Venta II, a utility-owned wind farm.		
2003	A wind resource atlas for the state of Oaxaca produced by the U.S. National Renewable Energy Laboratory (with funding from USAID) estimated that the state has the potential for 33GW installed capacity.		

Table 1 | **Milestones in the Development of Mexico’s Energy Efficiency Sector (continued)**

YEAR	MILESTONE	YEAR	MILESTONE
2006	The large-scale renewable energy development project (PERGE) was launched with a GEF grant of \$25 million through the World Bank. Readiness activities included technical advice and capacity building for SENER and CFE, developing a pricing mechanism for renewables, support for policy development, and a wind resource assessment. The project also provided tariff price support for the first five years of operation of a 103 MW wind farm built by an IPP. The contract for the wind farm was awarded through competitive bidding to a Spanish company and construction started in 2009 (also a CDM project).	2009	The Clean Technology Fund (CTF) endorsed a country investment plan for Mexico and approved two projects with \$15 million and \$30 million respectively to support private sector wind development under the self-supply framework.
2007	GoM launched its National Climate Change Strategy, which committed to integrate climate change into Mexico’s national development policy.	2010	New regulations were issued by CRE including reductions in wheeling charges for renewable energy self-supply projects.
2008	GoM passed the Renewable Energy Development and Financing for Energy Transition Law, with the objective to establish a national strategy and regulatory and financing instruments to allow Mexico to scale up renewable electricity generation.	2011	CTF approved a \$70 million project to help NAFIN establish a renewable energy financing facility to enable scaled-up financing for renewable energy projects. The project also included a technical assistance component to strengthen the financial and technical capacity of financial institutions and the private sector for wind projects and support assessments of the environmental and social impacts of wind power.
2008	CFE launched an expansion program to tender out a further four 102 MW plants under the IPP modality (Oaxaca I-IV), to begin operations in 2011.	2012	The Mexican Congress passed a climate change law that requires the country to generate 35 percent of electricity from clean sources by 2024 and make renewables economically competitive before 2020.
2009	The Special Climate Change Program was launched. It sets adaptation and mitigation goals and suggests a long-term mitigation scenario, aimed at reaching the “aspirational” goal of a 50 percent reduction of greenhouse gases emissions below 2000 levels by 2050.		
2009	A number of international partners—including ESMAP, World Bank, IDB, and others—provided technical support to assist in designing policies and regulations to implement the new renewable energy law.		

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ENDNOTES

1. In 1992 the government passed changes to the electricity law to allow private-sector participation in power generation for independent power producers (IPPs), which sell power to the grid, as well as for self-supply generation, or power production for export. IPPs with plants over 30 MW need to have long-term power purchase agreements, which are awarded through competitive bidding. Power produced by IPPs less than 30 MW (small producers)—as well as the surplus from self-suppliers—is sold to the grid at a variable tariff below the location's short-term marginal cost.
2. Personal communication with in-country expert.
3. The pre-investment component includes a \$3.9 million technical assistance and \$0.9 million project management consultancy funded by GEF and an additional \$0.25 million from CFE and \$0.12 million from the German government (BMZ/GTZ).
4. See: <http://www.eib.org/projects/pipeline/2009/20090486.htm>
5. Personal interview with in-country expert.
6. Personal interviews with in-country expert.
7. Personal interview with in-country expert.
8. Personal interview with in-country expert.

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