

**CASE STUDY:
WINDPOWER TECHNOLOGY: TO MAKE OR TO BUY?
LESSONS FROM MEXICO FOR CENTRAL AMERICA**

Introduction

Latin America is faced with decisions about how to increase energy access and meet rising energy demands while keeping attuned to escalating concerns about greenhouse gas emissions and climate change. Wind power is one of the technologies that is on the forefront of renewable energy options: the technology is relatively simple compared to other renewable energy technologies and the price has dropped considerably over the past few decades. On top of the low cost, there are many other advantages that make wind power attractive to Latin America: it requires no fuel that must be continually bought or produced, it has no emissions associated with its operation, it is not subject to volatility (and potential rise) of fossil fuel prices, and it is modular and rapid to install.

Despite these advantages, only about 59,000 MW of world electricity (by the end of 2005 and growing rapidly)ⁱ and 85.5 MW of Mexico's electricity (by the end of 2006)ⁱⁱ was produced by wind power. Mexico implemented its first large-scale wind farm in 2006 and has many small-scale wind turbines, which will be a primary means of meeting the country's goal of producing 8% of electricity with renewable sources by 2012.ⁱⁱⁱ One of the central choices in wind plant implementation is the decision of whether to import the turbines from abroad or produce them domestically. While this decision is partially complicated by the mix of private and public entities working within Mexico's energy sector, there are a variety of incentives that the government can offer to guide the decision. Wind power has many benefits that contribute to national development that are unaccounted for in the market cost, making it a good candidate for government incentives. What were the internal and external factors that caused Mexico to produce its wind turbines? This case study focuses on this issue and assesses other Latin American countries that are pursuing wind power: what lessons for the rest of Central America can be learned from Mexico's experience?

The Mexican Case

In the past, there have been considerable barriers to increasing the renewable energy supply in Mexico, but since 2004 the country has been instituting several measures to overcome these barriers. The barriers begin with the Constitution, which fails to promote renewables as it does with petroleum and large hydropower. The legislation not only failed to favor renewables, it also did not provide any incentives for development or investment. Likewise, there has been little support for renewables in the form of research and development funds, guidelines, technological norms, or databases of natural resources.^{iv} In 2004, Mexico's Electrical Research Institute and the UNDP started the Action Plan for Removing Barriers to the Full-Scale Implementation of Wind Power in Mexico (funded by the Global Environment Facility). Mexico accelerated the depreciation of investments in renewable energy technologies, began assessments on

wind resources, started proposals on the legal, regulatory, and institutional framework, and started a green development fund.^v These changes have attracted attention from investors. International support for large-scale development of clean technologies has also come from UNEP and the World Bank.^{vi}



Figure I. Location of Wind Turbines Installed in Mexico as of 2006^{vii}

The current situation looks much brighter than a decade ago. Mexico’s 2001 National Development Plan regards boosting the energy sector as a primary strategy to tackle poverty and Mexico’s Renewable Energy Program states that wind power is one of its areas of focus.^{viii} As of 2006, there were 85.5 MW of wind capacity installed, and there are three more projects planned.^{ix} The first wind farm, La Venta, was built on the Tehuantepec Isthmus, where the majority of Mexico’s wind resource is located. After a 600 kW turbine was installed in la Guerrero Negro, Mexico implemented its first large wind farm, La Venta II, and has plans for La Venta III. La Venta II has been registered as a Clean Development Mechanism under the Kyoto Protocol, allowing it to receive external funding.

Table I. Wind Turbine Installations in Mexico by the End of 2006^x

Location	Wind turbines	Capacity(MW)	Commissioning date	Owner
La Venta, Oaxaca	6 x 225 kW	1.57	1994	CFE
Guerrero Negro, Baja California del Sur	1 x 600 kW	0.60	1998	CFE
La Venta II, Oaxaca	98 x 850 kW	83.3	2006	CFE
TOTAL	105	85.5		

Although there have been many barriers to wind energy in the past, Mexico is now considered a “constructive” environment for the implementation of wind power,^{xi} and many private companies are interested.^{xii} In addition to the wind farms connected to the national electricity grid, there are also many individual turbines and smaller operations that are important for spreading energy access to rural regions. However, this case study focuses on the larger plants and the national scale.

Several factors led to Mexico’s decision to make its wind turbines domestically. The Federal Electricity Commission (Comisión Federal de Electricidad, or CFE) is responsible for almost all of the generation, transmission, distribution, and sales of electricity from the national grid. CFE contracted La Venta II to the Spanish company Iberdrola-Gamesa, paying it upon commission, and CFE became responsible for operation of the plant once constructed.^{xiii} All of the turbines for this project were produced in Mexico,^{xiv} even though Mexico’s liberalization over the past few decades has reduced financial barriers to importing turbines. There are several benefits and linkages to having a manufacturing plant located in Mexico, even if it is part of a foreign company like Gamesa. Along with jobs from the plant, there can be significant knowledge spillover and backward linkages. Mexico has the technical expertise and industrial capacity to produce wind turbines: already 750-kW electric generators for wind turbines are produced by a Mexican corporation, 5-kW turbines of a Mexican design are being manufactured, primarily for export, and over 200 companies located in Mexico could produce parts for the wind turbines.^{xv}

Benefits of Windpower

While the price of wind power is decreasing, it is still not cheaper than thermal power plants, the main electricity energy source in Mexico.^{xvi} The electricity sector does not operate in a vacuum, however, and there are considerable positive externalities and development benefits that make wind a more tempting option.

- **ENERGY SECURITY**—Current energy supplies that utilize fossil fuels are subject to volatility in market price, which is linked to the finite, decreasing supply. Mexico has a domestic supply of petroleum, but it is still subject to international market forces and prices. Wind power is an independent power supply that is more secure and helps diversify the country’s energy mix.
- **ENVIRONMENTAL**— While bird deaths and noise pollution are environmental concerns associated with wind farms, the environmental impacts are considerably less than those caused by thermal power plants. Wind power has the advantage of emitting no greenhouse gases during operation, an externality not always taken into account. Climate change is at the forefront of international concern, and both future environmental agreements and emissions caps are uncertain after the first Kyoto period ends in 2012. Additionally, reduced emissions can have significant health benefits.

- **SOCIAL/DEVELOPMENT**—More wind farms means more energy, which has the potential to increase energy access to many areas. Wind farms also increase local employment through the need for construction and the ongoing tasks of operations and maintenance. If Mexico continues to pursue the route of manufacturing wind turbines, this will provide even more jobs and additional science and technology spillover effects.
- **ECONOMIC**—More jobs and production translate into increased economic benefits. In a global market where many of Mexico's products are in competition with China, wind technology and other high-tech products prevents the country from lagging far behind its competitors.

Lessons for Central America

As illuminated throughout the Mexican case study, there are social, environmental, and economic reasons that will inspire countries to encourage wind energy development. Mexico is a step ahead of its neighbors to the South, so what lessons for Central America can be learned from Mexico? After the free trade agreements with the US, almost all countries are operating in an open, free-market environment, where products are largely subject to international competition. Yet substantial differences exist: Central America's economies are much smaller and less industrialized; Central America is less developed, so development benefits are especially pertinent; and on the whole, countries have not instituted the laws and incentives to foster wind power development.

Nicaragua, Costa Rica, El Salvador, and several Caribbean islands have significant wind resources, but their current capacity is low. The pursuit of wind power is a strategy that can be used to diversify energy sources, increase energy security, and increase supply while not increasing harmful environmental effects. Mexico's choice to produce its own wind turbines gives it the added advantages of fostering science and technology and increasing employment beyond operation and maintenance. The same could apply to Central America, but due to the smaller sized economies and lower total wind resources, it would be more difficult to reach economies of scale than in Mexico. Each country must weigh the research, development, and start-up costs in addition to whether they have sufficient manufacturing capability.

Conclusion and Implementation

For Central American countries that wish to develop wind power, there are several steps that should be taken. First, a national target for renewable energy technologies including wind should be declared to help drive policy development. Second, barriers to implementation should be addressed and removed or reduced as quickly as possible. This will include reducing incentives for fossil fuels, increasing them for renewables, and making implementation and connection to the grid easier. To attract investment, national laws need to assure a stable financial space and long-term dedication to wind. Finally, reaching out to multilateral financing for climate change action can help overcome the slightly higher initial costs, such as registering as a Clean Development Mechanism did

for Mexico.

With regards to whether a country should buy wind turbines from abroad or foster the capacity to build wind turbines domestically, the existing differences in size and capacity between Mexico and each Central American country increases the net cost in the latter. While it is a strategic choice to implement wind power, the markets are simply not as large and the existing technological capacities within Central American countries (with the exception of Costa Rica) are considerably less. An ambitious option is for a country to develop a wind turbine export industry (in addition to domestic use), but this would require a rapid advancement in technical knowledge and foreign investment, which would be beneficial but result in high risk. Central America may want to consider other options that may be more viable, and focus on gleaning the maximum benefits possible. The option with least domestic benefits is to import turbines from Mexico (if Mexico continues to grow their industry). An option through which more benefits could be gained is to specialize in producing a specific part of the turbines, such as the blades or towers that have high transport costs, while importing the rest. With any of those options, the implementation of wind power would still require knowledge people to assess, construct, operate, and maintain wind farms, leading to social, economic, and environmental benefits.

ⁱ Global Wind Energy Council and Greenpeace, *Global Wind Energy Outlook 2006*, 2006.

ⁱⁱ International Energy Agency, "Chapter 21 Mexico," *IEA Wind Energy Annual Report 2006*, 2006.

ⁱⁱⁱ As stated in the 2005 Renewable Energy Utilization Law. Source: *Global Wind Energy Outlook 2006*, Global Wind Energy Council and Greenpeace, 2006. *Ibid* Global Wind Energy Council, et al.

^{iv} Huacuz, Jorge M., "Renewable Energy in Mexico: Current Status and Future Prospects," No date.

^v International Energy Agency.

^{vi} Global Environment Facility, "Catalyzing Technology Transfer," GEF Global Action on Climate Change, 2006.

^{vii} International Energy Agency.

^{viii} World Energy Outlook, OECD/IEA, 2008, <http://www.iea.org/textbase/pm/?mode=weo&id=3193&action=detail>.

^{ix} International Energy Agency.

^x Recreated from International Energy Agency.

^{xi} International Energy Agency.

^{xii} Global Wind Energy Council, *Global Wind 2006 Report*.

^{xiii} International Energy Agency.

^{xiv} *Ibid*.

^{xv} *Ibid*.

^{xvi} Commission Federal de Electricidad, <http://www.cfe.gob.mx/es/LaEmpresa/generacionelectricidad/>.