



## THE BOTTOM LINE

Mexico's La Ventosa region has ample wind resources but is remote. The national electric utility would not build the lines needed to transmit La Ventosa's electricity to the grid without assurances that developers would follow through on their generating plans. But developers could not obtain needed financing in the absence of a guaranteed transmission network. To break the deadlock, the country conceived a planning process that yields a shared transmission network funded jointly by developers.

# Transmitting Renewable Energy to the Grid: The Case of Mexico

## Why is this case interesting?

**Mexico has world-class wind resources, but they are located far from the national grid**

Mexico's 2010 National Energy Strategy aims to promote sustainability and simultaneously increase energy access by increasing the share of renewable resources used to generate energy. The wind farms of La Ventosa, a windy area in the southeastern state of Oaxaca, are a key part of that strategy, which aims to raise the share of renewables in generation to 35 percent by 2024, up from 23.7 percent in 2008. In that year, Mexico's installed renewable capacity of 85 MW consisted of hydropower (92 percent), geothermal power (7.5 percent), and wind power (0.5 percent). La Ventosa is one of Mexico's prime wind sites with an estimated wind power potential of between 5,000 MW and 6,000 MW. Ongoing projects in the area are expected to generate a combined 1,967 MW.

The Mexican government provides energy through its vertically integrated electric utility, the Comisión Federal de Electricidad (CFE), but it has also been increasing its support for the development of renewable energy projects by promoting the participation of private entities, which have been allowed to generate power since 1992. In addition, the government is developing practical and sustainable approaches to connect La Ventosa's remotely located wind power generation to the transmission and distribution grid.



### Marcelino Madrigal

(mmadrigal@worldbank.org) is a senior energy specialist in the World Bank's Energy Practice.

With



### Rhonda Lenai Jordan

(rjordan@worldbank.org) is an energy specialist in the same practice.

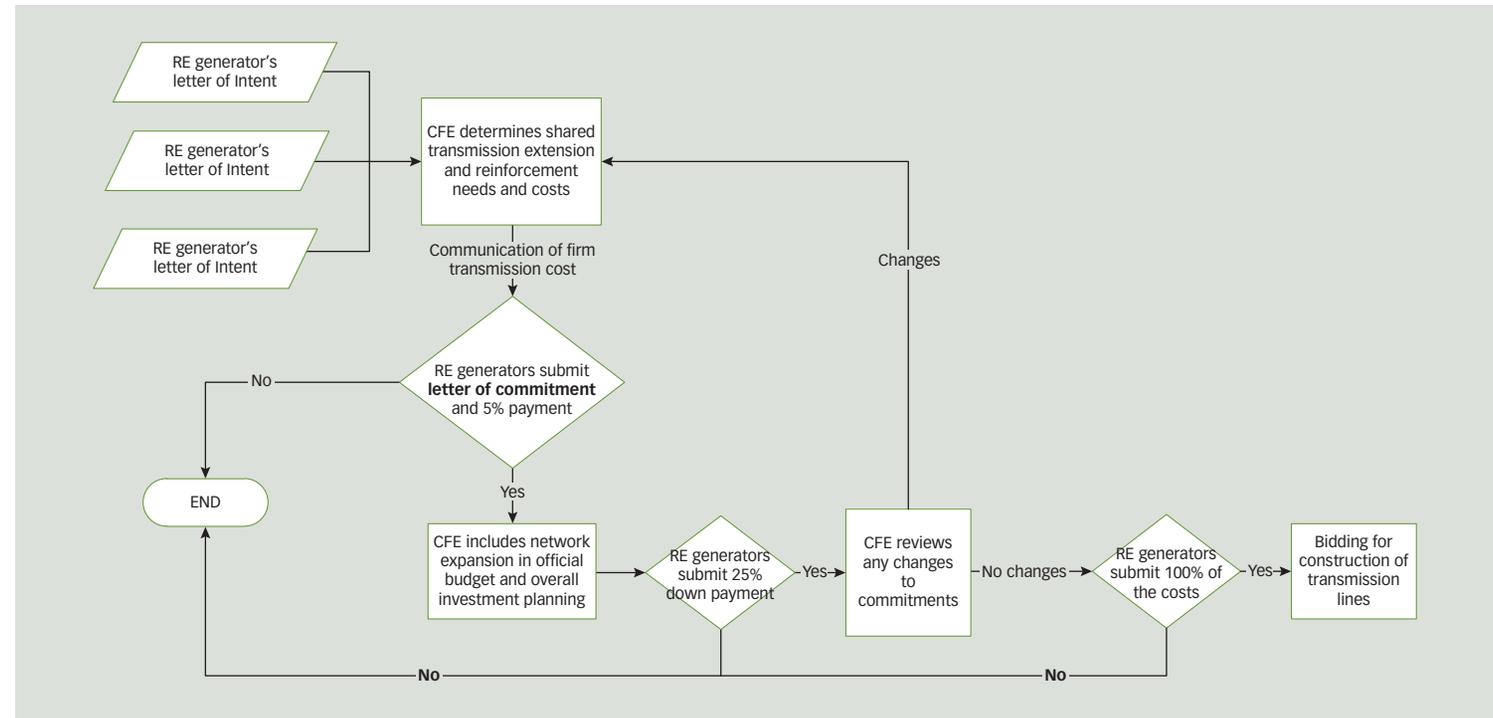
## What was the challenge?

**Neither the public grid nor private developers could move forward without commitments from the other**

Most of the projects in La Ventosa will be owned and operated by the private sector under a Mexican legal concept known as *self-supply*, whereby the government permits private energy projects to supply large industrial consumers at privately negotiated prices on the grounds that they do not constitute a public service. However, La Ventosa is located far from demand centers, and the existing high-voltage network is not equipped to capture and distribute the wind energy generated in the region—thus the need to expand the existing public transmission network to allow these private projects to operate.

Mexico follows a so-called deep connection policy, according to which generators are responsible for all transmission expansion costs. CFE owns and operates the entire transmission network in the country and currently has no legal responsibility to expand it on behalf of generators that are not providing a public service. This created a regulatory void in which neither renewable generators nor the CFE could move forward unless the other party guaranteed its commitment. Generators were not able to secure financing in the absence of a commitment from CFE that sufficient transmission infrastructure will be developed to accommodate the electricity they generate. But CFE required generators to commit to produce power before it would expand the transmission network.

Figure 1. The “open season” process for transmission planning in Mexico



Note: CFE = Comisión Federal de Electricidad, the Mexican electric utility; RE = renewable energy.

Source: Prepared by the World Bank with data from the CFE and CRE.

“This created a regulatory void in which neither renewable generators nor the CFE could move forward unless the other party guaranteed its commitment.”

### What was the solution?

#### The “open season” system facilitates coordination between the public grid and private developers

To achieve the country’s target for renewable energy generation, sites in La Ventosa would have to be developed, despite the regulatory void. To make this happen, Mexico devised what it called an “open season transmission planning process” that is invoked as often as needed by the Ministry of Energy and managed by the national energy regulator (Comisión Reguladora de Energía). The entire process, from start to finish, takes approximately six months (figure 1). The objectives of process are to:

- Identify the transmission investment needs of all the wind power projects in La Ventosa. During an initial submission period, interested renewable energy generators in the region express their interest in reaching a formal transmission service agreement with the utility. Generators present preliminary proposals in which they specify their location, size, expected date of commencement of operations, and other relevant technical information.
- Determine the least-cost transmission expansion strategy to serve the generators that expressed interest during the submission period. After the submission deadline is reached, project proposals are reviewed by CFE, which performs technical

“To achieve the country’s target for renewable energy generation, Mexico devised what it called an ‘open season transmission planning process.’”

- studies to determine the lowest-cost transmission network needed to meet their collective requirements.
- *Define the cost-sharing ratio (or transmission rights price) for wind developers.* Under Mexico’s deep-cost allocation policy, renewable energy developers are responsible for the costs of the enabling facilities, system extensions, and network upgrades needed to handle their supply. Once the necessary transmission network is defined, the price of the transmission services agreement is determined by dividing the total cost by the generation capacity of the generators to be served by the network. Although all costs are borne by the renewable energy developers, this coordinated planning process can greatly reduce the investment needs of individual projects. The open season process is an anticipatory one that considers the full set of sites up front and creates an optimized transmission plan, as opposed to a reactive approach in which transmission lines are built for each individual site in response to developer requests, which leads to suboptimal, more-expensive solutions.
  - *Ensure the commitment of developers.* As the open season moves forward, developers are required to gradually increase their financial commitment to bear transmission costs. Generators initially submit letters of commitment with a payment of 5 percent of the total costs. CFE includes the network expansion plan in the official budget and utility expansion plan. Generators subsequently make a 25 percent payment. If at any time during the process a developer backs out, CFE must reevaluate the expansion plan and communicate changes and associated costs with the remaining developers. If there are no changes, developers pay 100 percent of their allocated cost and the utility obtains bids to build the transmission infrastructure. After the infrastructure has been developed, renewable generators pay a network usage charge determined using a pricing methodology (the energy-based postage stamp method) whereby all users pay the same rate based on the annual megawatt-hours of consumption and generation, regardless of peak usage. Further detail on transmission cost allocation and network pricing can be found in Madrigal and Stoft (2011).

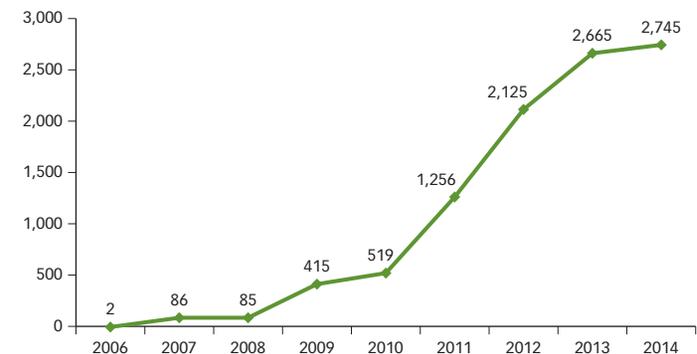
## What have we learned?

### Greater certainty and lower transmission costs unlocked major investment in wind energy

The open season process was a major breakthrough that made possible several agreements to build wind power generation projects in an area that previously had been closed to development because of the lack of transmission infrastructure. The open season process gave developers of renewable energy the certainty and predictability they needed concerning the development of transmission infrastructure, while also reducing the investment costs of that infrastructure by ensuring development of an optimized and shared network. Moreover, the system is transparent for all participants. It highlights the ability of CFE to modernize its role as a facilitator and creative problem solver, and encourages renewable energy developers and energy consumers to collaborate and follow through on their commitments for the benefit of all involved.

To date, the open-season process has been performed twice in the La Ventosa region, where 2,745 MW of wind power projects will begin operation by 2014 (figures 2 and 3), enabling Mexico to meet its goal of increasing the share of renewables in the nation’s energy mix.

Figure 2. Wind power capacity in operation in La Ventosa (MW)



Note: All projects are committed or under construction.

Source: CFE 2010.

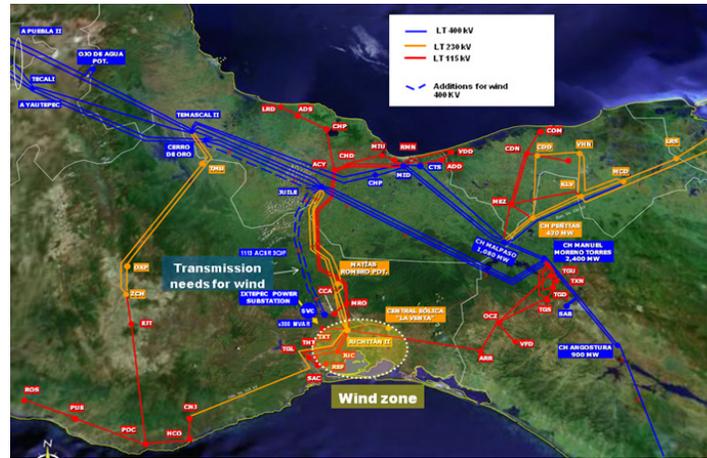
## MAKE FURTHER CONNECTIONS

Live Wire 2014/1. "Transmitting Renewable Energy to the Grid," by Marcelino Madrigal with Rhonda Lenai Jordan

Live Wire 2014/2. "Transmitting Renewable Energy to the Grid: The Case of Brazil," by Marcelino Madrigal with Rhonda Lenai Jordan

Live Wire 2014/4. "Transmitting Renewable Energy to the Grid: The Case of Texas," by Marcelino Madrigal with Rhonda Lenai Jordan

**Figure 3.** Existing transmission network and new transmission needs in La Ventosa



Source: Secretaría de Energía 2010.

Further detail on transmission planning for the scale-up of renewable energy can be found in Madrigal and Stoft (2011).

## References

- Madrigal, Marcelino, and Steven Stoft. 2011. "Transmission Expansion for Renewable Energy Scale-Up: Emerging Lessons and Recommendations." SEGEN Paper 26, World Bank, Washington, DC. June.
- CFE (Comisión Federal de Electricidad). 2010. "Programa de Obras e Inversiones del Sector Eléctrico 2010–2024." Mexico, D.F. [http://www.semarnat.gob.mx/temas/..ot/pre\\_sector\\_electrico\\_2010\\_2024.pdf](http://www.semarnat.gob.mx/temas/..ot/pre_sector_electrico_2010_2024.pdf).
- Secretaría de Energía. 2010. "Estrategia Nacional de Energía ratificada por el H. Congreso de la Unión." Mexico, D.F. September 8. <http://www.energia.gob.mx/res/1646/EstrategiaNacionaldeEnergiaRatificadaaporelHCongresodelaUnion.pdf>.

*The peer reviewers for this note were: Silvia Martínez Romero (senior renewable energy specialist, ESMAP) and Waleed Saleh Alsuraih (senior energy specialist, MENA). The authors acknowledge contributions from Francisco Barnes de Castro and personnel from the Comisión Reguladora de Energía, Mexico. This note is based on original work by Marcelino Madrigal and Steven Stoft.*