

Hedging Mexico's Electricity Bets: The Case for Renewable Energy

by Daniel Farchy

Few investors would risk putting all of their money into a single asset based on a 30-year forecast, yet narrowly-interpreted least-cost energy planning has often done just that. In Mexico, regulatory policies have hindered adoption of renewable energy (RE) and other diversified power options that could reduce portfolio risk. Against this backdrop, this note illustrates the country's growing recognition of RE as a viable way to broaden investments in power generation and increase long-term security.

A Portfolio Approach

Policy makers have long accepted least-cost approaches to power-generation planning as the most effective way to ensure a country's well-balanced energy supply. But given today's broad range of options and future uncertainties, identifying long-term least cost is virtually impossible. Additional challenges to least-cost planning include price variability and distortions caused by hidden subsidies. Furthermore, the environmental and social costs associated with certain energy sources are often ignored.

In the financial sector, risk-averse investors have long applied the concept of modern portfolio theory, which shows how a basket of diverse assets can offer the maximum possible return for a given level of risk. When applied to the planning of utility-generation capacity, the portfolio approach dispels the widespread belief that adding fixed renewable energy (RE) capacity necessarily costs more. To the contrary, because RE sources have higher upfront costs but lower ongoing input costs, including a larger percentage of RE sources in a country's energy-production portfolio can reduce exposure to commodity-price-derived risk.

In Mexico, where state utilities are required to buy the cheapest electricity available for firm, instead of intermittent, supply of new power generation, RE options have traditionally taken a back seat. To meet



its increasing electricity demand, Mexico plans to use the combined-cycle gas turbine—a least-cost power source under today's economic conditions. But recent gas-price volatility has raised questions about this option as a future least-cost source. Evaluating a true least cost is hampered by hidden subsidies that distort prices and the failure to include associated environmental and social costs. Thus, a more inclusive economic definition of least cost is appropriate: one that recognizes the partial capacity value of intermittent RE sources, the value of RE options in a diversified portfolio for energy security, and internalization of environmental values.

This note explores the potential benefits of incorporating portfolio valuation and risk analysis into Mexico's least-cost planning for power generation and ways in which they are enhancing how RE is valued and hence used.

Regulatory Barriers

The Mexican government has the exclusive right to generate, transport, transform, distribute, and supply energy with the aim of providing a public service. While relaxation of regulations in 1992 exempted certain limited sectors (including self supply) from tight restrictions, the State retains a practical monopoly on the power sector;¹ energy utilities, facing tight bud-

ESMAP is a multi-donor trust fund managed by the World Bank Energy, Transport, and Water Department (ETW) that promotes the role of energy in poverty reduction and economic growth in an environmentally responsible manner. Its work applies to low-income, emerging and transition economies and contributes to the achievement of internationally agreed development goals.

¹ Sector policy is formulated by the Energy Secretariat (SENER), with executing authority in the hands of the Federal Power Commission (CFE) and Central Light and Power (LFC) (serving Mexico City).

getary constraints, have been unable to approve the commissioning of new RE capacity, given the high upfront costs. Over the past few years, the perceived risk of an uncertain market with a monopsony buyer has further limited the private sector's investment in RE generation supply.

Mexico's pricing system, which places a wedge between the price paid to private investors and that charged the end user, poses another regulatory challenge (Antonius et al. 2006). The prices faced by the consumer reflect the average cost of supply, covering a broad mix of generation plants (including many outdated, high-cost fuel-oil and coal-fired thermal plants). Because these costs are passed on to consumers, the price is high compared to that of electricity generation from newer plants. Payment to producers is based on the marginal or avoided cost, currently determined by the low-cost, high-efficiency, combined-cycle gas turbine plants. Consumers therefore pay prices at which it would be economically attractive to use RE options; however, a constitutional mandate prevents direct consumer-producer contact, so independent power producers (IPPs) cannot charge these prices.

Opening a Dialogue

In the late 1990s, Mexico engaged the World Bank's assistance to explore environmental issues. One resulting ESMAP study examined potential policy and investment options to help the country meet environmental standards, including air quality (Kojima and Bacon 2001). It became apparent that the environment was the channel through which the World Bank could engage Mexico on energy issues. At this time, the World Bank proposed an extensive ESMAP study to explore long-term options to promote RE in Mexico.



The resulting studies identified significant potential benefits to Mexico's electricity sector that could result from incorporating a higher proportion of RE sources into its production portfolio (Antonius et al. 2006). Two key benefits identified were:

Diversification. Mexico's current energy plans envisage diversification away from fuel oil at the expense of a new dependence on natural gas. In the longer term, hydrocarbon supplies are expected to diminish, pushing up the price the country must pay to satisfy its increasing energy demand. In the medium term, prices for natural gas have been the most volatile among energy commodities; overexposure to such price volatility could harm the electricity sector.² Diversification away from fossil fuels could mitigate the negative effects of future price rises and volatility, thereby increasing overall energy security. RE's marginal cost of production is less exposed to commodity-price fluctuations because of its low recurrent input costs.

Improved environment. Reducing greenhouse gas emissions would help Mexico meet its national targets for sustainable development.³ Replacing older fuel-oil and coal-fired power plants would also benefit public health by reducing harmful local pollution.

The studies also identified remaining institutional barriers, and recommended ways to move forward. These include improved valuation techniques for RE, including the application of portfolio theory to the planning of utility-generation capacity, and introduction of an incentive-based mechanism to spur market development.

In contrast to traditional command-and-control mechanisms, incentive-based policies are more flexible in responding to changing circumstances.

One proposed solution was to establish a special fund to foster development of an RE power sector. Such a fund could provide an output-based subsidy as a temporary solution to current price distortions. These subsidies could be provided through a competitive bidding process and phased out over a clearly established timeline, ensuring that only the most effi-

² This is true even with energy procured through IPP arrangements: The CFE's standard power purchase agreements (PPAs) place all input (gas) price-volatility risk on the CFE, constituting a significant contingent liability.

³ As set forth in the National Development Plan (2001–06).

cient RE producers received the funding. It would be vital to implement such a scheme in conjunction with a review of sector uncertainty and inefficient pricing arrangements. Promoting RE options without implementing structural reform would be more costly, as part of the resource used to create RE incentives would be used to offset economic distortions in the sector.

Winds of Change: A New Generation

Champions within the sector strongly agreed that RE was the way to move forward. There was also a growing realization that, as a member of the Organization for Economic Cooperation and Development (OECD), Mexico would continue to face increasing pressure to limit its greenhouse gas emissions. At the same time, the CFE recognized the growing overexposure to the natural gas market for electricity generation. By 2002–03, with gas prices spiking to US\$7–10 per million BTU, RE looked increasingly attractive as a diversification tool to hedge against volatility. Still, Mexico was wary of using its domestic resources to subsidize RE development. The question for the World Bank was how best to assist Mexico in developing its first demonstration wind-energy source.⁴

This issue was the driving force behind the creation of the GEF-funded Large-scale Renewable Energy Development Project, a US\$25 million, eight-year effort that addresses the need to kick-start Mexico's RE sector with a large investment in wind energy and provide the technical assistance to help modernize the country's electricity-sector institutions in order that they benefit more fully from the system value created by RE. The project includes a financial mechanism to stimulate organizational learning and cost reduction, as well as technical assistance activities to address analytical and policy barriers.

Financial mechanism. Based on best practices in RE promotion policies in the United Kingdom, Ireland, and California, the project developed a tariff price-support mechanism (to be capitalized by a US\$20.4 million grant included in the GEF project) to provide the winning bidder of a 101-MW wind farm an output-based incentive for the first five years of operation. To satisfy the CFE's narrowly-interpreted least-cost sourcing requirements, the World Bank provided the



output-based subsidy to lower the cost of wind energy to that of marginal generation resources in the CFE system.

Known as La Venta III, the wind farm, located in Oaxaca, will be financed by the private sector through commercial sources (with a long-term PPA and tariff support structure as key securities with which to obtain financing). The CFE will pay the IPP according to its willingness to pay, as determined by a bid reservation price derived from the system's long-run marginal avoided cost of energy and capacity contributions. The financial mechanism will then bridge the difference between the reservation price and the generation cost of the winning bidder. The end result will be the 101-MW La Venta III wind farm, with an estimated total investment cost of about US\$120 million.

Technical assistance. The project also supports a range of technical assistance activities. These include analysis and development of methods designed to enhance a broader valuation of RE resources;⁵ as well as development of modeling capabilities within the CFE for better integration of RE into the national grid system. Activities also include strengthening the energy ministry's capacity to serve as a one-stop shop for RE project developers and implementation of an

⁴ Large hydropower and geothermal sources, already substantially developed, were excluded.

⁵ Including the use of Capital Asset Pricing Models in valuing generation portfolio development, analysis of the system effects of intermittent RE sources, and RE-price benchmarking.

expanded menu of outreach and advisory services. In addition, required databases and plans will be developed to help the CFE and developers expand wind development in Oaxaca and nationally.

Conclusion

Removing subsidies to hydrocarbons, accounting for price variability, and reflecting the additional portfolio value of RE options are all likely to make grid-connected RE facilities competitive in Mexico.

Two recurring themes have emerged from ESMAP's RE program on what Mexico needs to move forward: i) a modernized regulatory system to level the playing field between RE sources and their hydrocarbon peers and ii) a fund (at least in the medium term) to foster the creation of an RE sector through a subsidy aimed at making RE capacity competitive with that of fossil fuels. The GEF project aims to create the necessary conditions to work toward the former and to launch the latter with the creation of the subsidy mechanism for the La Venta III wind farm.

Applying the portfolio approach to Mexico's power-generation planning was not the only factor contributing to the development of the wind-farm activity in the Large-scale Renewable Energy Development Project. Indeed, it probably played a minor role in influencing policy makers to move the project forward. But the idea of valuing RE as a way to broaden investments in power generation—which is gaining worldwide acceptance—cannot be underestimated.

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In Memoriam

This note is dedicated to the memory of Shimon Awerbuch, eminent financial and energy economist, whose untimely death in February 2007 represents an irreparable loss to the international development community. Shimon was a tireless leader in energy and utility regulation and the economics of innovation. For the past four years, he was Senior Research Fellow of Science and Technology Policy Research (SPRU) at the University of Sussex. Prior to joining SPRU, he was Senior Advisor for Energy Economics, Finance, and Technology at the International Energy Agency in Paris. His pioneering research on the portfolio aspects of energy diversity and security, including the value of renewable energy, contributed significantly to the development of this note.

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