

Green Energy Market in Mexico: Background and Proposal

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SUMMARY

Mexico's enormous opportunities for making use of renewable energy are limited by the relatively high costs involved and the government's budgetary restrictions. International experience demonstrates, however, that it is possible to establish mechanisms that, if advanced by the government as public policy and without implying subsidies that would create new burdens on national public funds, could serve to make use of renewable energy. This document establishes and describes the opportunities and benefits that better use of renewable energy would bring for Mexico, and based on international experience, proposes elements of what could be a Green Energy program in Mexico.

I. INTRODUCTION

Renewable energy (RE), understood as forms of energy with practically unlimited sources (such as the sun) and through which different technologies can be transformed into the energy services required by human activities (lighting, heat, cooling, motive force), has been used by humanity in numerous ways throughout history. Nevertheless, at the present time, when energy use is much more intensive than at any other point in time, RE is used only marginally, and only a couple of decades ago, did a process begin to place these energy resources to better use through the development of new technologies.

Over the last twenty years, in a process associated with environmental concerns, supported by public policies in developed countries and encouraged by business initiatives, renewable energy has once again returned to a position of great importance within the global energy agenda.

In Mexico, where we have abundant renewable energy resources and clear opportunities for taking advantage of them, progress has been slow, especially since national economic conditions have led, in many ways, to a search for more short-term, inexpensive options. As a result, alternatives such as those represented by renewable energy have been discarded, since they cannot compete in terms of prices with conventional systems. Nevertheless, because of the world's technological development and concerns regarding the negative aspects (both environmental and economic) of excessive dependence on fossil fuels, strategies for developing RE are being analyzed in order to take advantage of market forces, without falling into subsidy-based policies, to promote fully developing the opportunities Mexico has in this area.

This document presents one of the proposals being considered within the federal government for promoting renewable energy. The document begins by establishing the factors that point to the need for these actions, refers to what can be learned from

international experience, demonstrates evidence that substantiates the proposal, and ends by describing its principal elements.

II. FACTORS ESTABLISHING BASIS FOR PROPOSAL

The necessity of and opportunity for promoting projects that generate electricity from renewable energy forms in Mexico is based on a combination of benefits and advantages that together clearly identify the realm of opportunity for this type of project and the need for establishing public policy strategies for making good use of these resources. Below, these factors are listed and explained.

Immense, usable potential. Mexico has considerable potential for generating energy based on forms of renewable energy, both because of its large territory (two million square kilometers) and its geographic location between latitudes 14° and 33° in the northern hemisphere, characterized by great amounts of sunshine. To the west and to the east, the country is bordered by coastlines formed by the Pacific Ocean and the Gulf of Mexico, producing rainfall during nearly the entire year, and it also has a number of geographic areas with high wind potential. The following are estimates according to type of energy:

- *Solar.* Nearly three-fourths of national territory can be considered arid or semi-arid with an average solar irradiation of more than 5.5 kilowatts per hour for each square meter.¹
- *Wind.* It is estimated that the wind potential technically usable in Mexico is as high as 5,000 megawatts (MW, equal to one million watts), which is equivalent to 14% of the current total installed capacity for electricity generation.
- *Small hydraulic.* National small hydraulic potential, specifically of small hydroelectric power stations of less than 5 MW, is above 3,200 MW, according to studies conducted by Conae and the Federal Electricity Commission (*Comisión Federal de Electricidad—CFE*).
- *Biomass.* In the agroindustrial sector, specifically in the sugar cane industry, a potential for electricity generation has been established, using sugar cane waste pulp, for producing more than 3,000 GWh a year.

Need for energy diversification. Current electricity generation in Mexico depends more than 70% on fossil fuels. It is therefore necessary to diversify primary sources of energy for electricity generation.

High environmental impacts of current electricity generation and growing environmental awareness in the population. The relatively high level of emissions of polluting gases and the large amounts of water needed in electricity generation based on fossil fuels, together with increasing public awareness as to the resulting impacts on the

¹ This means that using the technology currently available on the market, all the electricity necessary for operating a 15 square foot (two-door) refrigerator could be produced from one square meter.

environment, have created public expectations for energy forms having less impacts of this nature.

Advances in technology associated with using renewable energy. The costs of technologies for converting renewable energy into electricity are already at a level that allows for competing with conventional systems in growing market niches. Two technologies are worth highlighting in particular: wind power, and direct conversion of solar energy to electricity.

- *Wind.* The technology associated with the generation of electricity from wind experienced a 25% drop in costs from 1992 to 1997. Currently, average costs of electricity generated from wind are between four and eight cents of a dollar per kWh generated. This is very close to the three cents of a dollar per kWh currently required by conventional generation through combined cycle systems fed by natural gas.
- *Photovoltaic.* The unit cost of technology related to the generation of electricity by photovoltaic processes has changed significantly, decreasing by more than 50 times since 1973, from 200 to 4 dollars per watt.

Need for rural electrification. Currently, more than five million Mexicans living in areas removed from the electricity network are without this service, which is fundamental to having access not only to electricity but also to potable water and education. It is precisely in communities that are far removed from the network where it is often less expensive to obtain electricity from systems that make use of renewable energy forms, than to expand the electricity network.

Need for distributed generation. Distributed generation, understood as small-scale electricity generation at the installations of final consumers in the electricity network, strengthens the regulation of the electricity network, and therefore the quality of services and level of income generated by those services. Thus, small-scale production and self-supplying through renewable energy can support an improved operation of the electricity system.

Capacity for producing equipment in Mexico. Mexico has the industrial capacity for producing a significant proportion of the elements (materials, equipment and systems) needed for generating electricity from renewable energy. As a result, taking advantage of energy opportunities also leads to the development of specialized national industry that could be in a position to export to other countries in the American continent.

National capacity in research and development. In Mexico there are a number of research and development centers that are established and operating, and some of them have been in existence for more than 20 years. These centers have the highest levels of technological knowledge, and are carrying out projects for making use of renewable energy. At the same time, these centers have professional staffs, although relatively small in relation to the great potential that exists, that can serve as the basis for expanding this type of capacity.

Possible engine for regional development. Renewable energy is implicitly local in nature: the potential of wind, rivers and solar radiation depends on their location, and making use of these energy forms can lead to the development of the regions where these resources are found. In this sense, the wind in Oaxaca, biomass in Durango and small hydraulic plants in Puebla are combinations that reflect possibilities for regional development.

III. BEST INTERNATIONAL PRACTICES IN RENEWABLE ENERGY

Defining the most appropriate path for promoting the development of RE in Mexico has been a topic of discussion for many years, however, to date there is no clear consensus for any particular direction. Beginning more than four years ago, however, Conae, together with the National Association of Solar Energy (*Asociación Nacional de Energía Solar*—ANES) and other public and private organizations have encouraged specialized, public discussion on this important topic, using international experience as a reference.

In particular, in May 2001, Conae, the Institute of Electricity Research (*Instituto de Investigaciones Eléctricas*) and the International Energy Agency organized a high-level conference in Cocoyoc, Mexico entitled “Best practices in renewable energy: sharing experience for developing markets.” The objective of this international conference was to facilitate dialogue among national and international actors with regard to future perspectives and opportunities for developing renewable energy in Mexico. Participating in the event were recognized national and international experts on these topics, representatives from public and private Mexican organizations (Sener, CFE, CRE, SE, ANES, CANAME) and from international, national and multilateral entities (UNDP, GEF-WB, USAID, GTZ).

At the conference, there was an extensive review of the status of technology, markets and public policies related to renewable energy. A key conclusion was that in order to expand the use of RE, emphasis should be placed at this time on the search for market mechanisms for these energy forms since, at least for small hydraulic, biomass and wind projects, there is a high level of technological development and availability. This places the development of technology as a secondary priority, if what is desired is to make use of RE.

This conclusion is fundamental, since one of the central points of discussion in the context of meetings organized by Conae had been with regard to the priorities of Mexico’s public policies for developing RE forms. Two clear positions had emerged: one that considers concentrating efforts in technology development as the focus, and one that defends the idea that this development will come in association with greater demand for renewable energy, as the result of policies for promoting this form of energy.

Also, the following were established as fundamental elements of policies for fully developing the renewable energy opportunities in Mexico:

- **A specific legal framework.** A specific legal framework that gives investors a sense of security, and that makes it possible for projects to obtain conventional financing.

- **A special incentive system.** In order for renewable energy to be expanded in the market, it is necessary that a special incentive system be established, based on the logic of “investments for learning,” as demonstrated by international experience.

At the same time, as a recommendation from a tactical point of view for those interested in facilitating the process of developing RE markets, it was established that the best option is to first identify the price, which will create interest in the private sector for making investments, thus placing less emphasis on justifying it through an appraisal of external factors. This recommendation is also important since in Conae, it was thought that an evaluation of external factors was of utmost importance, as a key element in the definition of policies.

Finally, it was established that there are other elements, in addition to those mentioned above, that have been shown to be valuable in the experience of the countries that have most extensively developed their RE potential. These elements are:

- **Certainty in terms of the time periods in which financing is provided.** It is thought that time periods of between 10 and 15 years would be appropriate.
- **Differentiated incentives for performance.** It is recommended that incentives be based on performance (energy produced) more than on investment (installed capacity), and that such incentives not be uniform, but rather according to the type of renewable energy and transformation technology.
- **Technical standards.** It is considered necessary that the quality of equipment and systems be assured, specifically through precise technical specifications.

IV. THE CONCEPT OF “GREEN ENERGY” IN INTERNATIONAL EXPERIENCE

The development of renewable energy around the world is not only a consequence of the fact that it is now more cost-competitive in many market niches. Growing environmental concern has also provided an impetus. Given that public policies for supporting and promoting renewable energy have been based on its contribution to reducing dependency on petroleum, as occurred during the 1970s, we can say that the more recent policies emerged to some degree from environmental concerns. This, in particular, reflects the growing public awareness as to the quality of the environment in which we live, and also a clear perception that using RE should be used to a greater degree, instead of other energy options that are less environment-friendly.

Based on this logic, one of the strategies that has been gradually advanced for increasing electricity generation from RE sources is to establish a “Green Energy” market, differentiating electricity from renewable energy from electricity from conventional sources. Establishing this market takes advantage of the environmental interest of major sectors of the population, who are willing to pay more for electricity, if they know it will contribute toward taking better care of the local and world environment.

At the present time, particularly in the US electricity market, there are three different forms this strategy has taken:

- **Green Electricity.** This alternative is the one that corresponds to deregulated markets, characterized by competition, and the product is offered by actors other than the electric company controlling the distribution in a geographic area.
- **Green Price.** This is the option offered by regulated electric companies, those operating as vertically integrated monopolies. In the United States, this alternative is offered by more than 80 companies.²
- **Certificates of Renewable Energy.** These are renewable energy options that may be offered by anyone in any market, without geographic limitations. Specifically, they pay for a set of attributes associated with RE electricity generation (and therefore provide recognition to those buying them). These certificates can be commercialized where demand exists, since are not subjected to limitations from electricity legislation.

These mechanisms have demonstrated their usefulness in the United States, since there is a demand for them from a growing number of electricity consumers, especially in residential areas, in industry, and especially in federal and state governments. These consumers pay a higher price that is approximately 7.5% above the average price for conventional electricity.³

V. A LOOK AT INTEREST IN “GREEN ENERGY” IN MEXICO

As previously stated, one of the barriers in Mexico to making full use of renewable energy is the fact that one of the central elements of energy policy has been to guarantee a supply of electricity at the lowest cost possible. This policy, characterized by a clear sense of short-term economic efficiency, makes more sense when one acknowledges that the price paid by a highly significant portion of electricity consumers is subsidized, representing an enormous strain on public finances. Since to date, renewable energy has not been the most economic option, it has not been considered as an alternative in the major electricity supply projects.

In line with this logic, and with the aim of seeking alternatives for promoting RE in Mexico without provoking a new burden on national public funds, Conae has been analyzing the possibility of using Green Energy type mechanisms to expand the demand for RE in the country. As part of this process, Conae conducted a survey on Green Energy at the beginning of 2002 with the major industrial users of electricity in Mexico. Assistance was provided by the Commission for Environmental Cooperation (CEC), a trilateral entity established by the signing of the North American Free Trade Agreement (NAFTA).

² Hamrin, Jan. 2001. *Comercialización de Electricidad Verde en los Estados Unidos*. Presentation at POWERMEX event, Mexico.

³ Hamrin, Jan. 2001. op. cit.

The CEC-sponsored survey was carried out by Gallup-Mexico with 100 of the largest electricity consumers, with the objective of measuring their willingness to buy electricity produced by renewable energy sources and with a possibly higher price. High-level executives were interviewed with regard to concepts related to an understanding of the process of electricity generation, its environmental impact, the participation of renewable energy, and the society's perspectives in general and the perspectives of the companies' clients as to the role of renewable energy in caring for the environment.

It is important to point out that the companies consulted, from different industrial branches and different parts of the country, experience varying impacts in electricity costs in relation to their total costs. In particular, it is noteworthy that in more than 40% of these companies, electricity represents 10% or more of their variable costs.

A significant number of conclusions can be made from this survey. First of all, there is a clear awareness of the negative environmental impact from current processes of generating electricity. This was demonstrated by the fact that 88% of those interviewed believe there is a need to reduce the environmental impact from electricity generation, and 33% believe they contribute toward environmental deterioration through their electricity consumption.

A particularly interesting aspect for Conae was the companies' perspective as to societal attitudes toward the environment. This was of special interest because Conae believes that some type of green certificate attributed to the products and services placed on the market by these companies could add extra value in the eyes of consumers who, in international markets, are particularly sensitive to this type of characteristic. It was therefore significant that 35% of those interviewed believe the public sees a need to reduce environmental impact, while 52% believe their clients see a need to reduce the impact resulting from the generation of electricity, and finally, a high percentage of 70% think the public is sensitive to what their companies do in the interest of the environment.

Finally, the most important and significant aspect consists of the opinions expressed regarding the possibility of buying renewable energy as a differentiated product. 94% are willing to buy electricity generated by renewable energy; 54% are willing, even if the costs are higher; and 30% are willing to pay 10% or more above the price for electricity from conventional sources.

In conclusion, the survey sponsored by the CEC revealed clear evidence that there is indeed a demand for Green Energy in Mexico, even if it is latent.

VI. CONAE'S PROPOSAL

Taking into account what has been established here and after a process of integrating concepts, experiences and proposals, Conae has presented a proposal for a Green Energy market to authorities and specialists in the area of energy. As explained here, this proposal is based on the interest expressed by broad sectors of consumers in Mexico and in developed countries for products and services with low environmental impact.

In particular, Conae proposes that the most significant demand for Green Energy would come from companies that are physically located in Mexico, but directed at those environmentally sensitive markets—in other words, companies that export to markets in the United States and Europe—as well as focused on sectors of the Mexican population with the same kind of environmental attitude.

At the same time, the proposal is for a transitional program that would serve to give impulse to a market in which economic actors currently not in our country would become integrated. It is worth mentioning, therefore, that the scope of what Conae is proposing is determined by an estimated critical mass of projects that would be large enough for investments to be made not only in generating plants, but also in industrial production of the different elements for the systems and their assembly. And this could be the basis for industrial development oriented toward export markets. Based on opinions gathered from various potential investors, it is estimated that a demand of 500 MW could be enough to stimulate these investments in the manufacturing industry.

To be used as a reference, it is worthwhile to make some estimates to facilitate outlining the scope of the demand for a program of this type. Identified below are a number of universes of possible purchasers of Green Energy, made up of large consumers, on the one hand, of which there are more than 530, and on the other hand, all consumers, of whom there are more than 24 million (Table 1)

Table 1. Number of consumers, products and sales for different groups of consumers (Year 2000)

<i>Electricity Rate Groupings</i>	<i>No. of Consumers</i>	<i>Products (Thousands of pesos)</i>	<i>Sales (MWh)</i>
HM	23,856	24,310,850	41,424,941
HS	260	3,648,655	7,105,626
HS-L	225	7,760,485	17,184,948
HS+(HS-L)	485	11,409,140	24,290,574
HT	22	758,727	1,710,014
HT-L	26	5,316,719	14,310,338
HT+(HT-L)	48	6,075,446	16,020,352
Subtotal	533	17,484,586	40,310,926
Total	24,389	41,795,436	81,735,867
All consumers	23,881,053	93,536,836	155,348,661

Source: CFE, Statistics by state.

If the program has a potential for 1,500 MW⁴ and if this capacity comes only from plants operating from wind power, with these plants functioning 4,000 hours a year (46% of plant factor), the maximum generation within the special system would be 6 billion kWh (GWh) a year. Therefore, the maximum potential proposed for the program, in terms of energy, represents just over a third (37%) of consumption by larger consumers, and 3.9% by all electricity consumers in the year 2000 (Table 2).

⁴ Equivalent to less than 5% of the entire installed capacity in Mexico at the end of 2000.

Table 2. Percentages according to generation by different installed capacities in the program (according to figures from the year 2000)

		Installed capacity (MW)			
<i>Electricity Rate Groupings</i>	<i>Consumption (GWh)</i>	<i>100</i>	<i>300</i>	<i>700</i>	<i>1500</i>
Only HT	16,020	2.50	7.49	17.48	37.45
HT+HS	40,310	0.99	2.98	6.95	14.88
HT+HS+HM	81,735	0.49	1.47	3.43	7.34
ALL	155,349	0.26	0.77	1.80	3.86

In economic terms, if every kWh purchased as Green Energy implies an additional payment of ten cents of a peso (0.1 \$/kWh)⁵ with respect to others outside a “Green Rate,”⁶ the increase in the amount billed would be (if these were, respectively, the only purchasers of Green Energy): 10.0% for the 48 largest consumers, 3.5% for the 533 largest consumers, 1.5% if for all consumers with a demand of more than 100 kW, and just over 0.5% if all consumers would pay those extra ten cents per kWh (Table 3).

Table 3. Percent of increase in the amount billed per installed capacity in the program, according to the universe of consumers, for every 0.1 \$/kWh

		Installed capacity (MW)			
<i>Consumers</i>	<i>No. of Consumers</i>	<i>100</i>	<i>300</i>	<i>700</i>	<i>1,500</i>
HT	48	0.66	1.98	4.61	9.88
HT + HS	533	0.23	0.69	1.60	3.43
HT+HS+HM	24,389	0.10	0.29	0.67	1.44
ALL	23,881,053	0.04	0.13	0.30	0.64

Based on the above, a possible scenario for a Green Energy market would be that all consumers with a demand of more than 100 kW (rates HT+HS+HM) buy 10% of their electricity as Green Energy, paying ten cents of a peso more in their amount billed for each “green” kWh. In another scenario, without a Green Energy market and figuring the sharing of the cost among all consumers, there would be an increase in the amount billed of an average of less than 1%.

With these elements, Conae’s proposal brings the following components together:

- **Special system in the Public Service Law on Electricity.** This special system is what would offer a sense of legal certainty to investors, and would permit the existence of a set of special contracts and rates, especially those established between generators and the Federal Electricity Commission (*Comisión Federal de Electricidad—CFE*), and between the CFE and final consumers. As well, the special system would have limited

⁵ Equivalent to 17% of the average price paid by all electricity consumers in the year 2000.

⁶ It is estimated that the minimum amount to be paid per kWh would be precisely 0.1 \$/kWh.

potential in terms of time and established generating capacity, in addition to the entry rules for generator candidates.

- **Annual bidding process for the purchase of Green Energy.** Taking into account the goals established within the Special System, and as a way of establishing a critical mass of projects and of maximum purchasing prices, a bidding process would be held every year for CFE to commit to the long-term purchase of Green Energy, and in which the main parameter would be the unit price for electricity. Specifically, it is proposed that the Special System could begin to operate in 2003, with a bidding process for 100 MW, and then doubling the new capacity each year until reaching a total of 1,500 MW in the year 2006.
- **Long-term, fixed-price purchase contracts for energy produced.** This type of contract would be signed between the generator(s) winning the annual bidding process and the electric company, and would basically establish the purchase price (fixed), the time period for the contract, and the commitment to purchase all the electricity generated.
- **Green rate.** This would be a special rate offered by CFE to its consumers for the non-subsidized purchase of Green Energy.
- **Green Energy certification system.** To guarantee the electricity's "green" quality, it would be necessary to have an internationally accredited system for bringing transparency to the origin and destination of electricity generated by renewable energy.

From the author's perspective, the proposal provides a combination of clear benefits to each of the actors involved in the Green Energy scheme:

- **For the generator.** In particular, the certainty that investment would be recuperated, through long-term, fixed-price contracts, and that energy produced would not be subject to sale (in other words, what is produced would be purchased). Also, and as a complement to the Special System, other benefits would be fiscal incentives of an environmental nature, accelerated depreciation, and guaranteed land use permits (from state-level authorities).
- **For the final consumer.** While purchasing Green Energy may signify a higher cost for an input such as electricity, the possession of a certificate that demonstrates a company's commitment to the environment may contribute toward the marketing of its products and services, providing the buyer with added value to offer to current and future clients.
- **For the electric company.** A Green Energy market would bring a number of benefits for the electric company, especially the possibility of greater energy diversification, the guarantee of a supply at a fixed price, the possibility of having access to new sources of electricity generation in the short term, and in the case of wind energy in southern Mexico, a complement to hydraulic generation.

VII. CONCLUSIONS

Mexico has marvelous opportunities for making use of renewable energy, and it is necessary to identify the best public policies for promoting it. International experience demonstrates that it is possible to establish “green energy” markets in which final consumers cover the costs. In Mexico, a survey among the largest electricity consumers identified their interest to purchase electricity at a higher price if it is generated in plants operating with renewable energy.

For this reason, Conae proposes a scheme based on international experience which would give an “initial impulse” to a new stage in the energy sector, in which forms of renewable energy would play a broader role. This scheme, which would include the establishment by Law of a special system, is currently being analyzed, and during 2002 Conae will seek general consensus for its proposal, and particularly for its transformation into public policy.