Colorado

Office of Economic Development and International Trade

Renewable Energy in Mexico

Short and medium-term business opportunities

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1. Introduction

Renewable energy continues acquiring great relevance in Mexico, as the result not only of skyrocketing hydrocarbon prices, but also as a natural result of the particularly strong existing potential in the country for wind, solar, mini-hydro and bio-mass projects. Mexico needs to diversify its energy portfolio, reduce environmental impacts and promote sustainable sources of energy as well as meet its commitments under the Kyoto protocol that call for expanding renewable energy generation.

Mexico's oil and gas reserves continue declining and the most important oil field, Cantarell, is at near exhaustion. Proven reserves are at a historic 9-year low and Mexico is increasingly dependant on imported natural gas. These facts are key drivers for redefining Mexico's energy policy, to include renewable energy project development among the sector's priorities.

The structural deficiencies of Mexico's energy sector are overwhelming and deny any sustainability to current emphasis and practices. The severe crisis that will ensue if things are left unchanged has instigated an on-going debate among sector experts and political leaders which, with the inclusion of renewable energy into the discussion, will result in legislation mandating specific actions to promote broader and expedited renewable energy use and project development.

Some government entity, most likely the "Commission for Energy Regulation" (CRE) (equivalent to the FERC in the U.S.), will have a mandate to promote the use of renewable energy. Defined guidelines for faster development of renewable energy projects under the Kyoto Protocol's Clean Development Mechanism (CDM) are also expected over the coming months.

These are very significant changes which, combined with favorable environmental conditions, create significant opportunity for short-term renewable energy projects to be developed in Mexico.

The Mexican government will develop significant wind power generation in Mexico's southwest region and will also increase geo-thermal power capacity. in the government is also developing incentives for promoting private and local government controlled clean energy projects.

In 2006, of the total power generation consisting of 56.4 thousand megawatts (MW), 22% was generated using renewable sources (including hydroelectric, which represents 19% of the total). Wind power represented 0.004% of the total generation capacity, geothermal 2% and other types of renewables 1%. By 2012 the Mexican government plans to increase power generation capacity by 9 GW and the proportion of renewable generation to 25%. The government's plan calls for incorporating 588 MW of new wind power, 158 MW in geothermic generation, 1,504 MW in hydro and 1,996 MW are expected to be invested by private companies in various types of renewable generation, including wind power, biogas, solar, hydro and bio-fuel based generation.

In addition to the projects sponsored or promoted by the Federal Government, local governments are also driving investments into renewable energies. Monterrey, the county's second largest city, developed Mexico's first biogas recovery project in the "Simeprode"

landfill. The project received funding from the World Bank and has proved the viability of using this technology in Mexico. Several municipalities are undertaking similar bio-gas recovery and power generation projects. Other renewable energy projects are found in rural areas isolated from the grid; self-supply projects utilizing photovoltaic cells are producing sufficient power to satisfy basic needs such as pumping water, basic illumination and refrigeration systems.

This report describes current trends and prospects for Colorado companies interested in exploring business opportunities related to the renewable energy sector in Mexico. Information presented in this document includes insight into Mexico's particular conditions which allow for several renewable energy projects to be economically and technically viable.

It also refers to specific investments taking place and the development of new areas - especially bio-fuels - which are becoming increasingly competitive due to fossil fuel prices.

This report aims to introduce Colorado companies and organizations to the trends shaping Mexico's renewable energy sector developments, which can translate into short-term business opportunities ranging from technology transfer, to equipment sales and project development opportunities.

Mexico is an importer of "clean energy" equipment and technologies, as production of these types of equipment has been limited to PV panels. In recent weeks several international companies have expressed interest in investing in the development of renewable energy generation projects as well as for producing clean energy technologies locally. The German company Qcells announced a US$3.5 billion investment in Baja California Mexico, which is expected to create a cluster for solar power technology production in that area.

2. Recent Developments:

The current administration, through the Secretariat of Energy (SENER), has sought to develop and promote renewable energy. During the previous administration, President Calderón acted as Secretary of Energy and he issued the tender for the construction of Mexico's first wind power project, developed in the State of Oaxaca. Elected President in December 2006, Calderón has since dedicated efforts towards the creation of energy policies, developing related financial mechanisms, and strengthening the regulatory framework to improve opportunities for investment in renewable energy projects.

President Calderón inaugurated the "La Venta II" wind power project in March 2007. The project included a US$100 million investment for 83MW of wind power generation. The venture was developed as a public works project by the Spanish companies Gamesa and Iberdrola.

To further develop wind power potential in Mexico's southeast region, the government issued a tender for the "La Venta III" project, this time under an Independent Power Producer scheme that grants a "take or pay" power purchasing agreement for 20 years, while investment for the construction of the project comes from the private sector. The tender was cancelled due to political issues and is planned to be re-bid in mid-2008. The project calls for the construction of a 101 MW wind farm with an estimated cost of US$150 million. The project will receive support from the Global Environment Facility (GEF).

In terms of rural electrification, the "Integrated Energy Services Project for Small Rural Communities" is being implemented with the coordination of the Ministry of Energy, and joint participation by the Commission for the Development of Indigenous People and the World Bank. This program will bring electricity to 50,000 rural households in areas in the states of Chiapas, Guerrero, Oaxaca and Veracruz that are isolated from the national electric grid.

Seeking to incentivize investments in clean energy, the Commission for Energy Regulation (CRE) issued a contract called the Interconnection Contract for Intermittent Sources with Credited Capacity to allow calculating and crediting the capacity that clean energy projects provide to the electric grid. It is estimated that, with this incentive, over 700 MW in generation permits will be granted to private investors.

More recently, President Calderón presented a proposal for reforming Mexico's energy sector to the House of Representatives. The main topics of the reform seek to give more freedom to Mexico's oil and gas company, PEMEX, to partner with private companies for performing exploration and extraction activities and to change PEMEX's current fiscal regime to allow the company to make the necessary investments for modernizing and improving its production indexes. The proposed reforms were controversial as opposition parties considered the move an attempt to privatize PEMEX. The political parties agreed to discuss the proposal and the various options for a period of 70 days prior to proceeding with a vote either for this or an alternative reform. The result has been a national debate defining the future of Mexico's energy sector. This debate is expected to conclude by the end of July 2008.

The core of the matter is defining whether increased private participation in the form of work provided by private contractors to Mexico's government controlled oil and gas monopoly, PEMEX, violates the Mexican constitution, which states that the energy sector is an activity reserved for the State.

An inflexible, pseudo-nationalistic view has prevailed over all aspects of Mexico's energy sector, specifically oil and gas, but also permeating into power generation, with different results in each case. The oil and gas sector is facing a severe crisis while the power generation sector meets world-class standards and has opened opportunities to private developers, investors and operators.

The context is important for understanding why development of the sector is decades behind to other comparable economies.

The oil and gas sector in particular has reached a stage of dramatic and unsustainable contradictions as the country is having difficulties both on the upstream side, and in downstream operations. Upstream, its major reservoirs of the Cantarell field are being depleted without replacement by proven reserves and downstream the country has become a significant importer of petrochemicals and gasoline, with demand growing at a faster pace than GDP.[1] This is a clear sign of the lack of adequate investment plaguing the sector. The present administration has proposed legislation for the modernization of the sector through, among other measures, increased contracting of private company suppliers.

[1] Cantarell's production has declined by 900 KBPD from 2004 levels and overall production has only been replaced by 400 KBPD from Ku-Maloob-Zap. Mexico is importing 500 KBPD of Gasoline @ US$1.20 per liter which is sold @ US$0.72 implying a daily subsidy of US$36 million or US$13.1 billion per year.

Opening the debate on PEMEX has given one of the small Mexican political parties running under a "green" platform (Partido Verde Ecologista de Mexico) the opportunity to present their vision of a correct approach to the topic of PEMEX modernization, while also emphasizing critical elements that should also be considered in reference to the overall revamping of the energy sector.

Senate members of this party argue that fossil fuels are the quintessential non-renewable energy source and that the country should focus on promoting the use of renewable energy, and especially technologies that do not contribute to the greenhouse gas effect. As a condition for participating in the PEMEX debate, the "green" party introduced legislation to expand the reach of Mexico's CRE, to include as one of its mandates the obligation to develop promotion plans to foster the increased utilization of non-polluting renewable energy. This development, on April 28, 2008, which has received little attention within the over-politicized PEMEX debate, represents a very significant milestone for the renewable energy industry in Mexico.

The proposal calls for the promotion of renewable energy and funding for research conducive to the development of energy alternatives in Mexico.

Another call by this party is to precisely define methodology for enacting Clean Development Mechanism (CDM) projects derived from the Kyoto protocol, to promote projects to reduce Co^2 and other greenhouse gas emissions. This would be a second factor fostering a more accelerated introduction of renewable energy projects in Mexico. An important element is that viable CDM projects attract international investment, as there is an active trading environment for CO^2 points used especially by European and Canadian companies to comply with their reduction obligations.

The debate called for presentations on the topic during 70 days by leading politicians, interested individuals and a experts including Dr. Mario Molina, Nobel prize laureate on environmental chemistry.

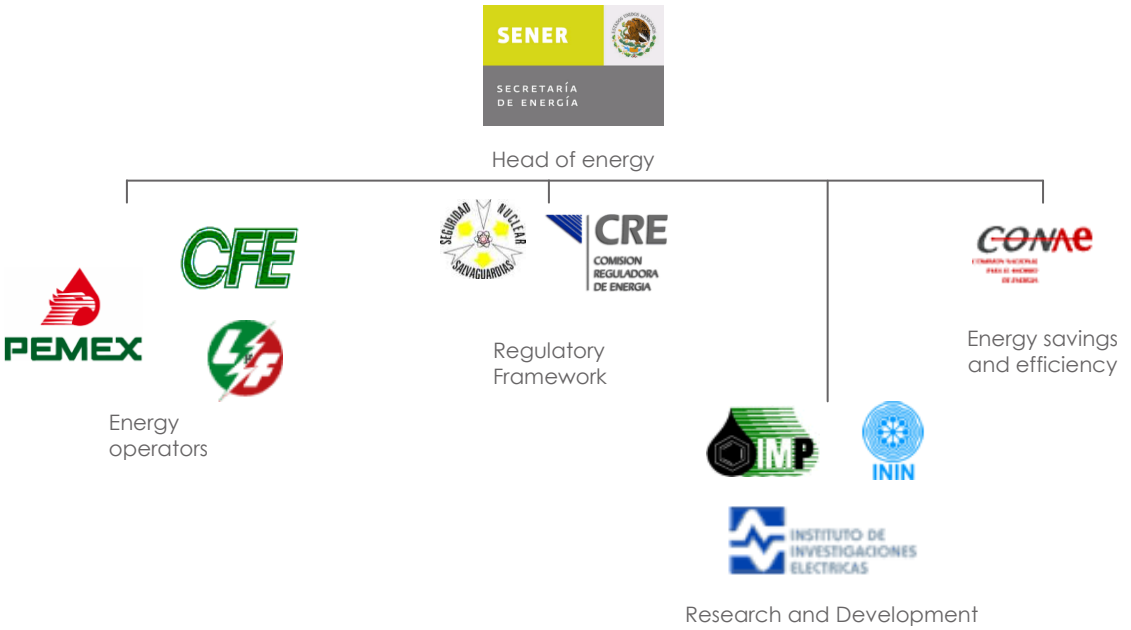
During his presentation, Dr. Molina emphasized the urgent need for Mexico to become more efficient in its energy use in all segments including power generation, transportation, residential, and industrial, and was emphatic that global warming is probably a more important topic than the decline of Mexico's oil reserves. His presentation underlined that the "atmosphere will be depleted before fossil fuels."

It is important to note that the President of Mexico was Secretary of Energy during the previous administration, and as such developed a series of policies for the promotion of renewable energy in Mexico in combination with bi-lateral and multi-lateral organizations including the World Bank. This indicates that the current administration is knowledgeable and sensitive towards the importance of renewable energy.

All the above-mentioned developments are important as they confirm Mexico's interest in fostering the development of the clean energy sector and indicate that in the coming years conditions will be set to attract investment not only from the federal and local governments, but also from private players, representing important opportunities for Colorado companies in Mexico.

3. General Energy Sector Overview

The federal government plays a dominant role in Mexico in both the oil and gas and power generation sectors. The government develops policies for the sectors through the Secretariat of Energy (SENER) and controls and operates the segments through three monopolistic players: PEMEX for oil and gas and CFE (Federal Electricity Commission) and LYFC (centralized light and power utility) for power generation/ distribution.



CFE is Mexico's leading power sector player; it is a government controlled power utility servicing all of Mexico except the central region which is served by LYFC, which is itself a client of CFE and has limited generation. CFE's generation capacity is 49.86 GW of which 11.4 MW are owned by private companies which have built dedicated capacity for CFE.

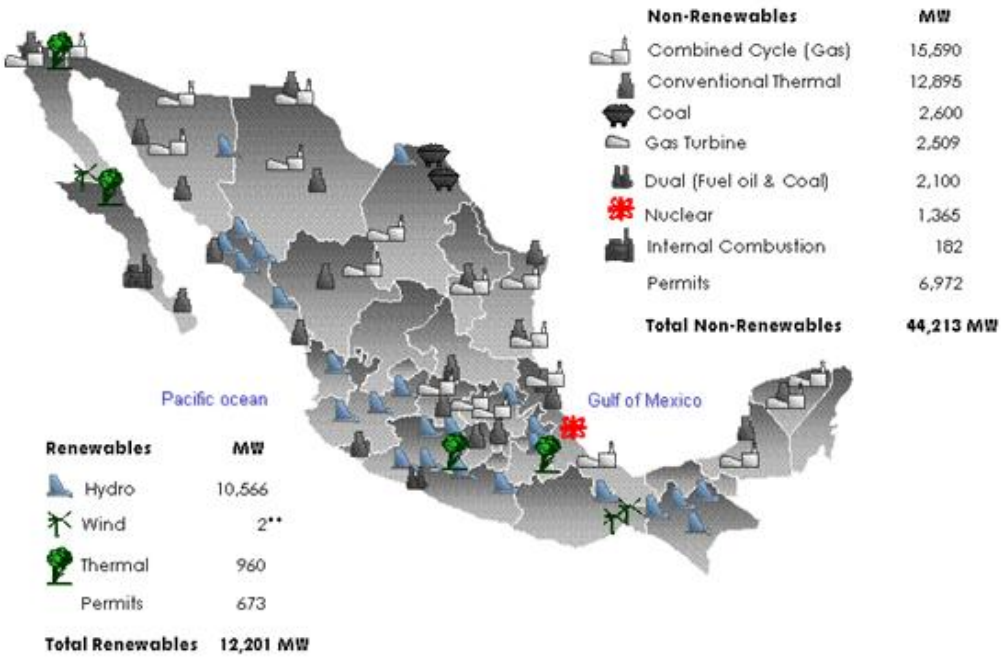
CFE is also the largest power distributor in Mexico, owning, maintaining and operating the national power grid comprised of 48,566 km of transmission lines.

CFE receives power from 177 plants consisting of the most common generating technologies including combined cycle, coal, hydro and nuclear, as well as renewable energy from sources such as hydro, geo-thermal and wind power.

CFE operates with slightly under 100,000 employees and provides power directly to 93.5 million Mexicans.

National maps describing regional power infrastructure in Mexico can be accessed at: http://www.cfe.gob.mx/en.

Generation Capacity 2006 by Type



Source: National Infrastructure Program.
Permits: Includes self-supply and cogeneration.
*** Only shown La Venta I, La Venta II and a pilot project in Baja California were incorporated in 2007*

Control over the power sector is tight, requiring government authorization by private investors for the construction and operation of power generation plants in excess of 0.5 MW of capacity. Significant opening to the private sector took place with the modernization of the public power service laws in the early nineties. Specifically it allowed for construction of power plants for cogeneration, self supply and export, and allowed electricity imports. Another important reform in the sector has been the role of IPPs (Independent Power Producers), which allows the government utility (CFE) to issue bids for take or pay contracts to private sector developers and operators.

Mexico historically has generated and used energy inefficiently, creating significant environmental impacts. To address this issue and increase awareness of the need to reverse existing trends, the government undertook several policies including establishing CONAE, the National Commission for Energy Savings, in 1989. CONAE has successfully developed significant energy efficiency programs over the past decade. The government has also introduced over 18 federal regulations mandating levels of energy efficiency on certain equipment and applications and currently has three additional regulations under a final review process.

Mexico currently produces 78% of its energy from non-renewable sources, 23% from hydroelectric, geothermal and nuclear plants and only 1.004% of its power from other types of renewable sources, namely biomass, solar and wind. The current administration's goal is to increase its renewable energy to 8% of total power generation by 2012. Reaching 8% by 2012 will meet Mexico's commitment to the Kyoto protocol and result in the acceleration of related projects in the very short term.

4. Incentives

At present, incentives for renewable energy projects are limited. The most important existing incentive is a one time deduction of 100% of the investment to install equipment for renewable energy projects, as indicated in Article 40, Section XII, of the federal income tax law.

The Interconnection Contract for Intermittent Sources with Credited Capacity, issued by the CRE is also an important incentive that is beginning to generate interest for the installation of small scale clean energy devices. This contract allows customers to credit the value of their power generation sent to the grid to their electric bills. While the results are still to be seen as the specific rules and tariffs have not yet been defined, the Mexican government estimates that over 700 MW in generation permits will be granted in the coming five years.

Another form of incentives comes from the Energy Savings Trust (FIDE for its acronym in Spanish), which is an independent organization formed in 1990 under the auspices of the CFE, the government and the private sector. More specifically, a group of chambers including CANAME (National Chamber of Electric Equipment Manufacturers), CMIC (Mexican Chamber for the Construction Industry), CANACINTRA (National Chamber for the Manufacturing Industry) and CNEC (National Chamber of Consulting Companies),have joined to promote more efficient energy use, green house gas emissions mitigation and overall energy savings.

During the first quarter of 2008, the FIDE's programs succeeded in generating energy savings estimated at 1,949.6 GWh of consumption and 89.2 MW of demand. This is equivalent to 3.4 BDD of oil and reducing green house gas emissions by 1.3 billion tons. Historic results reached 14,217.7 GWh of consumption and 1,604 MW of demand saving, which exclude Daylight Savings Time (DST) savings.

The main activities of the organization include:

- Project development
- Financial support to energy users under programs including:
    - Energy audits
    - Energy savings evaluations for small enterprises, commercial buildings and residential developments
    - Purchase of high efficiency equipment for new facilities and replacement of old, inefficient equipment.
    - Air conditioning replacement programs with World Bank funding

Over the past year the organization has developed 36 projects: 11 within industry, six in the commercial and services sector, six in municipalities and 19 with small enterprises.

FIDE has financed 3,885 energy savings projects, specifically to reduce power consumption with the introduction of more efficient practices and equipment.

Mexico has incorporated fully the use of LEAP (Long-Term Energy Alternative Planning) programs for the development of its energy policy or related investment plans.

The German government, through GTZ, has provided funding for exploring additional LEAP planning in Mexico for a more expedient introduction of renewable energy. This development has required the participation of local research organizations involved in energy research, which include the government funded IIE (Instituto de Investigaciones Electricas), Electric

Power Research Institute, which is a leading organization involved in power generation from renewable energy in Mexico.

Some of the institutions in Mexico that have developed Energy – Environment modeling include:

- Secretariat of Energy (Secretaria de Energia)
- Petroleos Mexicanos (PEMEX)
- Federal Electricity Commission (CFE)
- Las Americas University
- Mexican Petroleum Institute (IMP)
- Electric Research Institute (IIE)
- Nuclear Research Institute (ININ)
- National Autonomous University (UNAM)
    - Engineering Institute
    - University's Energy Program
    - Energy Research Center

5. Investments into the Power Sector

The Mexican government investment goals in electric power for 2012 are:

- Maintain the reliability of the electrical energy supply, implementa plan to maintain a reserve margin of 23 to 25 percent.
- Increase effective generation capacity to 9 thousand megawatts.[2]
- Strive for renewable sources to represent 25 percent of the effective generation capacity.
- Put into operation more than 14 thousand kilometers of circuit lines at varying tension levels.
- Increase electricity service coverage to 97.5 percent of the population.
- Place Mexico in the top 40 percent of countries with the best evaluations according to the Quality of Electricity Supply Index of the World Economic Forum.

It is important to mention that investment in the sector has experienced growing participation of private companies under the IPP (Independent Power Producer) figure which now represents slightly less than 19% of total power generation capacity.

To provide some pricing references on power rates in Mexico, the most competitive contract signed by CFE for power from a private producer under the IPP scheme was for power from the combined cycle Monterrey III plant, which pays US$ 0.30 / Kwh (at US$ 6.25 MBTU).

The analysis and evaluation of the economic viability of privately sponsored power generation projects is different in each of the eight tariff regions of the country. The prices in the region and particular conditions and requirements by users define the viability of self-generation as an alternative for purchasing power from the utility. This is important because the projects must stand on their own numbers as they do not receive subsidies, with the exception of a tax credit in the form of immediate depreciation.

[2] It considers the phasing-out of electricity plants that currently provide 3 thousand megawatts.

The power utility CFE provides information in its web page regarding its generation costs at specific transmission nodes throughout the country. The information is very detailed and allows for developing an initial evaluation of costs from alternative power supply options, especially between purchasing from the grid or developing a self-supply project.

The regions are presented in the following table.

Electric power tariff region divisions in Mexico
Baja California
Baja California Sur
Northwest region
North region
Northeast region
South region
Central region
Yucatan peninsula region

Source: CFE, 2008 tariff regions.

In addition to regions, power prices are also segmented by type of use, voltage, hour and time of year; the division provides special pricing for agricultural irrigation and for public services, which include the operation of water and waste water systems, as well as pumping sewage into treatment reservoirs, to mention a few examples. The main tariff division is presented in the following table:

Tariff type	Number of tariffs
Residential	8
Public services	3
Agricultural irrigation	4
General Services	21

Source: Hanhausen & Domenech Consultores (HDC) with information from CFE.

The CFE controls the national power dispatch center (CENACE, National Energy Control Center) and the national distribution grid, supplying power to consumers at different voltages. The following table presents voltages which are also a division of tariffs.

Tariff by voltage definition	Voltage
Low	< 1000 volts
Medium	1-35 Kv
High	35-220 Kv
High transmisión	> 220 Kv

Source: Hanhausen & Domenech Consultores (HDC) with information from CFE.

Users are penalized if they do not meet the power factor, and if they reach a factor of < 0.9 they will be penalized with a charge of 120% of the tariff rate. If the users maintain a power factor of > 0.90 they receive a rebate of 2.5% of the tariff.

The price for power includes a fixed charge and a variable charge resulting from actual power consumption. The specific costs would depend on type of use, region, tension, load factor and consumption. Few medium size companies seek for sophisticated supply alternatives to the grid, which is charging very high prices during peak demand hours. There are a large number of projects using diesel engines operated by industry for peak shaving. This might become a

significant environmental issue because of the potential environmental impact especially in critical air-quality areas like Mexico City.

At present there are no specific rules for returning power to the grid on an inverter type operation resulting from micro generation but it is expected that these rules will be issued before the end of 2008.

The climate change phenomenon is becoming increasingly significant and consequences are occurring much faster than anticipated by scientific forecasts. Mexico participated in the initial conferences sponsored by the German government in April 2008 for the establishment of IRENA (International Renewable Energy Agency), whose purpose is to extend the use of renewable energy in the world. The founding conference for this organization will be held in the autumn of 2008.

The IEA (International Energy Agency) had estimated that oil prices could reach US$77 per barrel - at real 2005 prices- by 2020 under an unlikely aggressive price increase scenario. This forecast, made in 2005, was the least optimistic, and, while over the past months natural gas prices appear to have decoupled from the their historically direct price correlation with oil, the full impact of the current pricing shock could impact the natural gas dependant portion of the power generation sector. These unforeseeable events described by some as speculation and by others as true parametric demand shifts, have demonstrated that oil & gas prices have become unpredictable and subject to significant speculation.

Oil prices have basically doubled over the past year, crossing the US$100 per barrel level for the first time in 2008 and with most current estimates increasing the likelihood of reaching the US$200 dollar per barrel mark within 18 months. This pricing environment has already created significant economic impact in the transport sector dependent upon fossil fuels and impacted other sectors through the distortion of relative prices, especially of corn and other crops capable of serving as an input for the production of biofuels.

It is also estimated that world temperatures have risen by 1.8 to 4 degrees Celsius at the end of the 21st century, emphasizing the urgent need to mitigate the green house gas effect caused by burning fossil fuels.

World energy needs are expected to double by 2050, which leads to demand for researching new energy alternatives, especially renewables with minimal environmental impact.

It is unlikely but possible that CFE's capacity expansion plans could change in the near future if current price and environmental deterioration persist. Under the considered technologies, wind and solar power show greater opportunity. However, a new consideration of the nuclear alternative has also been mentioned.

6. Renewable Energy Potential vs. Actual Use in Mexico

Several recent studies on renewable energy potential in Mexico confirm that the country has very high potential for photovoltaic and wind power generation, among others, but that actual exploitation of the potential is below 1%.

Similar potential for geo-thermal, mini-hydro, biomass and renewable power in general has been set aside while the focus has been on combined cycle generation using imported natural

gas. These decisions meet stated sector policy objectives of the Mexican government which have consisted of developing long term capacity expansion programs based on maximizing economic value. The sector has, over the past decade, introduced some other factors besides cost which have included the following:

- Energy efficiency regulations
- Introduction of daylight savings time
- Fuel substitution in favor of less polluting natural gas

These steps were substantial in moving towards a more sustainable operation of the power generation sector, but they fall short of addressing the types of actions and projects required in the post-Kyoto environment. There has been no specific requirement to introduce renewable resources until Mexico's recent commitment to the CDM (Clean Development Mechanisms) and the Kyoto protocol.

Government policies now mention the need to increase the participation of renewable power, setting a commitment under the Kyoto protocol, which will likely spur a more decisive development of renewable energy projects over the coming years.

There is significant criticism in Mexico by leading experts on environmental matters, who question why there are no final plans for increasing the nuclear generation capacity in Mexico considering that the electric power requirements will double by the year 2050 and Mexico has had to contract long term CNG supply agreements for imported gas that will be required to operate new power plants already under construction.

There are changes in the law to increase renewable energy use to represent 9% of generation, excluding hydro-electric plants.

The government has a US$60 million annual research budget for the power sector with 7% going towards non-power generation applications.

7. Solar Power

Mexico has some of the highest potential for solar power use in the world with average isolation potential of 0.6 Kwh / sf.

Approximately 38% of the national territory has potential for 2 KJ/square centimeters per day, with 57% of the territory at a range of 1.6 to 2, which represents very significant levels of isolation.

In Mexico, solar power has been used for thermo solar applications for water heating and photovoltaic applications for the provision of electric power at isolated sites and settlements. Current solar power generation represents approximately 12,000 MWh/year but is expected to at least double its size in the next five years.

For example, PEMEX was awarded the 2007 national prize for solar power applications for the use of photovoltaic panels to power monitoring systems for its off-shore oil & gas production platforms in the area of Tampico.

A recently proposed construction code regulation in Mexico City requires that all new construction of over three stories use solar panels for heating at least 30% of the heated water used by those buildings.

The urban development office for Mexico City is also working on developing a long list of requirements to make future buildings energy efficient and environmentally friendly for LEED certification.

Some of the applications of solar energy in Mexico are presented in the following table.

Solar power panels	Application
Photovoltaic	Refrigeration/ lighting at isolated rural communities
	Water pumping at isolated communities
Photovoltaic specialty	Off-shore platform power systems
Thermal	Water heating

Source: Electric Sector Perspective, 2007 SENER

Because of the high levels of isolation, solar power use for water heating is done through a thermal application and not through photovoltaics .

The Mexican Ministry of Energy, through its research institutions, has estimated solar power costs as indicated in the following table:

Generation type	Cost in US$
Photovoltaic	
1 Kw capacity	3,500 to 7,000
Kilowatt / hour	0.25 to 0.50

Source: Metropolitan Autonomous University, vision of renewable energies towards 2030.

Power service coverage in Mexico is uneven, reaching levels of 97.09% in certain regions and coverage of slightly under 90% in other rural mountainous areas. Because of the existence of a large number of small communities in areas with very limited access, there are several programs destined to provide photovoltaic power to these communities for sustaining water pumping, refrigeration and basic lighting and communications.

The electrification of isolated rural areas still presents significant opportunities for introducing photovoltaic systems or other self-sufficient power generation systems, particularly in the states of Chiapas, Guerrero and Oaxaca in the southern pacific region of Mexico and the state of Veracruz in the gulf area.

There are other initiatives involving the use of photovoltaic systems, the most important of which include the installation of photovoltaic cells in public schools for self-consumption and for connecting those to the grid in exchange for a reduced power rate or credit based on generation capacity. This initiative is in early stages and the first pilot projects are in installation stage in the State of Mexico. The entity responsible for the project is the Secretariat of Education.

Another example of development in the solar sector is the installation of photovoltaic panels in houses developed by the Mexican construction company URBI. In 26 years of business URBI has developed over 264,000 houses and is the leading housing developer in northern Mexico.

This group recently launched a program called “Green House” and is installing energy-saving technologies that, combined with the use of photovoltaic panels, seek to differentiate their developments from those of competitors. URBI is working on an agreement to provide the power produced by its houses to CFE and in exchange obtain an exemption or a reduced tariff for homeowners.

Mexico is developing its first large-scale solar power project in Agua Prieta, Sonora, The Agua Prieta II project, currently under development, will be an integrated solar-combined cycle system power plant (ISCCS) that will combine 31 MW of solar power generation with a 480 MW thermal power plant. The project received a US$49.35 million grant from the World Bank’s GEF (Global Environment Facility) for the construction of a 31 MW solar field. The solar collector field consists of a large field of single-axis tracking parabolic trough solar collectors. This will be the first project of this nature in Mexico and Latin America and it is expected to be replicated by demonstrating its financial feasibility in addition to its contribution to CO2 emission reductions.

8. Wind Power

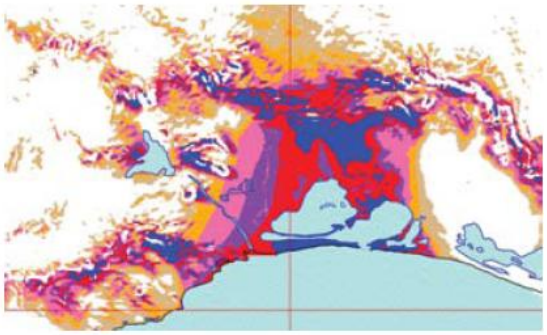
Mexico has several well-defined geographical areas presenting some of the highest wind power generation potential in the world. One of the best known areas is the Tehuantepec isthmus in the state of Oaxaca in southern Mexico, which hosts two wind power projects in operation (La Venta I and II) and where several projects are considered for the near future.

Wind Energy Potential in Oaxaca

Wind Power Classification

Wind Power Class		Resource Potential	Wind Power Density at 50m (W/m²)	Wind Speed* at 50 m (m/s)
	1	Poor	0-200	0-5.3
	2	Marginal	200-300	5.3-6.1
	3	Moderate	300-400	6.1-6.7
	4	Good	400-500	6.7-7.3
	5	Excellent	500-600	7.3-7.7
	6		600-800	7.7-8.5
	7		>800	>8.5

*Wind speeds are based on a Weibull k value of 1.8



Source: Wind Energy Resource Atlas of Oaxaca, National Renewable Energy Laboratory (NREL), 2003.

Other areas offering significant potential include Baja California, where a 300 MW plant is under construction to generate power for export into the U.S., and the Yucatan peninsula with estimated potential of 352 MW. This last area includes the sites of the Mayan Riviera including Cancun with estimated potential of 157 MW.

The estimate for wind power generation in Mexico is that it could potentially support 40,000 MW of capacity. The capacity could allow for the eventual substitution of several thermo-electric plants. As an example, in the state of Baja California, specific site potential has been defined at 274 MW at San Pedro Martir and La Rumorosa.

Generation type	Cost in US$
Wind power	
1 Kw capacity	1400
Kilowatt / hour	0.043

Source: Metropolitan Autonomous University, vision of renewable energies towards 2030.

Wind power potential is also found at other locations in Mexico. The most detailed studies on potential have been produced for the areas previously indicated, especially the Tehuantepec area, which will host a long list of wind power projects.

The expected construction of wind power capacity in the area reaches 1,479 MW which is the combined capacity of seven well-defined projects presented in the following table:

Project name	Capacity in MW
Desarrollos Wind poweros Mexicanos	226
Eoliatec del Pacifico	159
Eoliatec del Istmo	141
Fuerza Wind powera del Istmo 2nd, stage	49
Gamesa Energia	285
Preneal Mexico	393
Union Fenosa Generacion Mexico	226
Total	1,479

Source: Construction and Investment program for the power sector (2008-2017)

The previous table contains information on private sector projects. In addition, the state utility CFE has plans for seven wind power projects, named La Venta I through La Venta VII. The first two projects are already in operation and are gaining increasing interest because of the significant technological progress in the length of the turbine blades which now have a 120 meter circumference and significantly increased power output.

The La Venta I and II projects, were the first wind power projects to be connected to the grid in Latin America. Both projects combine 105 air-generation turbines for a capacity of 85 MW.

CFE has another pilot project in northwestern Mexico at Guerrero Negro at the Viscaino bay in Baja California. It is a pilot station with a single generation turbine and an output of 0.6 MW. Potential in the area is significant and will eventually result in a large wind power project being developed at the site.

A large number of wind power projects are moving forward in the Oaxaca area, but there have been some delays as the significant generation increase in the area has created a bottle neck of transmission lines for distributing power to other areas.

The construction of a new 400 Kv line will eliminate distribution bottlenecks in the area. This project is expected to be tendered in late 2008.

9. Mini-hydro

The government evaluation of renewable energy generation also defined the potential for mini-hydroelectric plants. These plants are defined as those with capacity of < 5 MW. The national potential for these plants is estimated at 3,250 MW.

An example of one area with significant potential for mini-hydro generation is the Papaloapan basin. The National Commission for Energy Savings (CONAE) has developed studies of the potential of the Rio Blanco River in the state of Veracruz along Mexico's gulf coast. This organization has, for many years, developed training programs to educate local communities about the benefits of developing mini-hydro projects.

The production of the mini-hydro plants is related to the type of technology used in the turbines, so there is expectation that technology improvements on micro-turbines will make these projects increasingly attractive.

10. Bio-Energy Projects

The largest use of biomass for power generation in Mexico is from sugarcane bagasse, which is used as fuel for generating power at sugar mills. The use of bagasse produces an equivalent of 92 PJ (penta joules) per year.

The CRE has granted several permits for power generation using biomass. Some examples are presented in the following table:

Recent generation permits using biomass

Biomass type	Generating capacity in MW
Biogas	19
Bagasse	70
Bagasse/ fuel oil	224

Source: Energy Regulatory Comission (CRE)

There is an additional type of project based on the use of methane and other gases that are extracted from municipal landfills. One recent project in this area is called Energia de Nuevo Leon, which utilizes gas extracted from the landfill in the city of Monterrey. The production capacity of the project reaches 7.4 Mw and it is a significant showcase project in Mexico as it is the first of this type to be developed.

The World Bank is carefully monitoring regulatory changes in Mexico for the promotion of biogas projects at landfills. It is estimated that there is potential to replicate this type of generation in most of the larger and medium-size cities in Mexico. Landfills, especially in Mexico City and the State of Mexico, have begun analyzing technologies and are expected to replicate the Monterrey project in the near future.

The biomass energy project potential in Mexico is estimated at between 2.635 and 3771 PJ per year.

There are also some important biofuel initiatives taking place in Mexico. The sugar industry generates 45 million liters of ethanol per year.

In 2009 a pair of biofuel refineries will start operations in the state of Sinaloa and will produce fuels from various agricultural products. In the state of Nuevo Leon, the company Grupo Energéticos is developing a biodiesel produced from animal waste resulting from beef processing operations.

The U.S.' Twenty in Ten initiative has spurred immense interest and technological exploration for the production of biofuels. The use of non-food crops has received significant attention and attracted a long list of U.S. and European investors to develop Jatropha projects in Mexico.

There is widespread interest in taking advantage of specific agricultural conditions in Mexico for growing Jatropha Curcas. There are at least four U.S. and European groups securing land to assure the supply of the seeds to be processed for the production of biofuels. One of these groups recently announced the purchase of 5,000 acres in the Yucatan area that will be used for planting Jatropha. The Secretary of Agriculture for the state of Michoacán has also recently announced similar plans to grow Jatropha in Michoacán and the same is happening in Chiapas. The investments include the initial planting of the Jatropha plant and the construction of seed pressing plants and refineries. All this is planned to take place over the next few years in Mexico.

Research on the planting of Jatropha is widespread in Mexico, with significant research conducted by the National Polytechnic Institute (IPN). There are several Jatropha research centers in Morelos, Sinaloa, Yucatan and various other states.

The Mexican government through the Secretariat of Energy (SE) passed legislation on February 1st, 2008, for the promotion of biofuels and specifically indicated that support should be provided to those varieties resulting from crops not used for foods. The policy is to introduce programs supporting biofuel without causing any potential risk, including price increases, to the food supply in Mexico.

This law calls for the establishment of a special federal commission which will be responsible for developing specific support programs. Details on the working of this commission and its decisions on potential support programs will be defined in the coming months.

11. Geo-thermal

Mexico is the world's third largest user of power resulting from geo-thermal plants. It is currently generating 960 MW and is also a significant developer of research and technology for this type of generation.

The International Geothermal Association has produced a long list of abstracts describing Mexico's generation potential, capabilities and experience in the development of these projects.

There are several additional geothermal plants planned by the CFE. The following table presents the plants that are on the engineering development and other preparatory stages. These plants include the following:

Plant name	Capacity in MW
Cerro Prieto V	100
Cerritos Colorados I	26.9

Cerritos Colorados II	26.9
Los Humeros II	25
Los Humeros III	55

Source: Federal Electricity Comission (CFE)

The Secretariat of Energy has estimated costs for these type of projects as follows:

Generation type	Cost in US$
Geo-thermal	
1 Kw capacity	1200 to 5000
Kilowatt / hour	0.025

Source: Secretariat of Energy (SENER)

There are additional applications for geothermal in addition to power generation, such as drying materials like lumber and agricultural applications.

12. Business Trends and Opportunities

Mexico is no exception to the dramatic flux taking place globally in respect to fuel use, severe cost impacts and the urgent need to find alternatives and reduce environmental degradation. The renewable energy and biofuels sector in Mexico is gaining momentum. Recent investments indicate Mexico will become a very active player in the industry especially given the potential the country has for the use of renewable energy sources.

The International Energy Organization estimated world investments in renewable energy at US$ 45 trillion over the next couple of decades. In Mexico, aside from its share of these investment estimates, construction of manufacturing plants, project development and biofuel crops processing, could define investment at an estimated US$ 1 billion per year over the next ten years. This value does not include energy efficiency or energy sector modernization projects.

As examples of recent investments, the German firm Q-cells, which is the largest independent and second largest producer of PV modules, just announced a US$ 3.5 billion dollar investment program in the area of Mexicali in Mexico's state of Baja California for the production of solar panels for export. This will include exports into the U.S.

The plant will be established inside what is called the Silicon Border Science Park, which plans to develop as a research and manufacturing cluster for the renewable energy sector. The area will require technical collaboration.

Announced investment for planting, processing and refining Jatropha oil into biofuels will reach an estimated US$ 500 million over the next three years. The projects that have been announced come from about 20% of the groups that are actually currently developing contracts to secure land for planting.

There are significant research challenges related to the use of Jatropha as a biodiesel as the oils will require special mitigation treatment to protect the motors that will use the fuels. There will be research requirements for the correct refining of the oils. Germany is leading the race in technological development for Jatropha processing, which is also becoming common in African countries because of particular growing conditions.

Opportunities

The pricing environment of fossil fuels has created a very attractive environment to sell equipment and services in the following areas:

- Energy efficiency programs to reduce energy use and cost per unit
- Evaluation of alternatives to replace fossil fuel consumption
- Development and participation in projects which can access and obtain CDM (Clean Development Mechanism) funding
- Co2 mitigation (aside from reforestation)

The pace of development of renewable energy projects will dramatically accelerate in Mexico over the coming months as they will be impacted by the following:

1.- Recent legislation introduced for expanding the mandate of Mexico's CRE to become responsible for defining promotion policies for the aggressive incorporation of renewable energy projects.

2.- The recent biofuels law, which calls for the formation of a national commission (being formed) responsible for defining specific programs to promote biofuel production and use in Mexico.

3.- The issuance of specific rules to qualify projects under the CDM (Clean Development Mechanism) to be sponsored as Mexican projects under the Kyoto protocol and receive international funding for carbon emission credits.

4.- Continued policy providing immediate tax depreciation on renewable energy projects.

5.- Local regulations, including Mexico City's requirement to use solar power for heating at least 30% of water in all new construction developments over three stories.

6.- Significant pricing pressure making alternatives potentially cost-effective vis-à-vis fossil fuels and grid power usage.

7.- Firm government commitment to increase the participation of renewable energy projects (not counting hydro-power) in the composition of the national power generation mix.

8.- Increased awareness of dramatic global warming impacts which Mexico has recently experienced.

As funding for research and patent development in Mexico is very small when compared to other OECD countries, the country will be a net importer of technology, know-how and equipment related to renewable energy.

The country's advantages for the promotion of the industry include manufacturing and trade-agreement advantages, and natural conditions that make solar and wind power particularly viable, as well as the planting of specific crops including sugar cane based ethanol and bio-diesel resulting from Jatropha for biofuel production.

It is expected that the renewable energy sector will experience growth at five times the pace of GDP growth in Mexico over the next five years. This estimation could increase as result of cluster investment attraction of PV manufacturing in Baja California and potential exponential growth of biofuel exports because of the U.S.' Twenty in Ten initiative.

Mexico will be particularly attractive for investments in wind and solar projects as those technologies have been increasingly used in projects sponsored by the government and promoted for private investors.

There is at present some exporting from of Mexico of locally manufactured solar panels under HS 854140001. Company's exporting panels manufactured in the country include:

-Andrew Manufacturas
-Clarostat de Mexico
-Dialight de Mexico
-Kyocera Mexicana
-Sanyo Energy
-United Solar Systems de Mexico

The country is an importer of wind power turbine equipment under HS 85023199:

Some companies importing this equipment include, among others:

-Bioenergia de Nuevo Leon
-Energia Renovable de Mexico
-Energias Alternas
-Air temp de Mexico

13. Promotion approach

There are many options for the promotion of Colorado's special expertise in renewable energies in Mexico. The first steps should include:

1.- Define specific leadership areas and showcase projects including:

- Engineering capacity for feasibility evaluation, engineering design and implementation of renewable energy projects
- Technology transfer agreements and or specific research skills
- Renewable energy project evaluation, development, financing and operation
- Other specific capacities

2.- Develop initial introductions in Mexico with:

- National Commission on Energy Savings (CONAE)
- Electric Power Research Institute (IIE)

- Energy Regulatory Commission (CRE) after mandate is expanded to include renewable energy promotion

- National Bio-fuels Commission (after formation)

- Participation in trade events sponsored by local renewable energy associations.

The Enviro-pro trade show in October in Mexico City has an important energy and renewable energy component and is considered the leading event in Mexico to gain exposure for products and technologies related to power generation.

CONAE is the leading active and committed advocate of energy savings and alternative energy project development including mini-hydro generation.

IIE is a research institute funded by the government which has been involved in all types of power generation research. IIE has been an active participant in PV generation projects for rural communities and is the leading authority on photovoltaic project development in Mexico. The institute is highly knowledgeable of technology needs which could result in technologies or equipment to be imported to Mexico.

Below is a list of leading associations and the events they organize:

National Association of Solar Energy
Address: Av. Cuauhtémoc No. 1475- 4th Floor Col. Santa Cruz Atoyac. 03310 México DF Phone / Fax: (52 55) 5601 8763 www.anes.org
Description: The National Association of Solar Energy (ANES) is Mexican non-profit trade association dedicated to the promotion and debate on solar and renewable energy use in Mexico.
Events: • National Solar Energy Week 20 to 24 of October 2008 in Merida • Co-sponsor of the 2nd International Conference on Energy Sustainability; 10 to 14 of August, 2008, The Hyatt Regency, Jacksonville, Florida

Mexican Association of Wind power Energy
Address: Jaime Balmes No. 11. L-13OF Col. Los Morales Polanco 1510 México, D.F. Phone: +(52 55) 5395 9559 Ing. Cesar Xavier Fuentes Trujillo Manager gerencia@amdee.org www.amdee.org
Description: The Mexican Association of Wind power Energy (AMDEE) was established in 2005 to represent and further the interests of wind power power developers in Mexico. The company groups developers, equipment suppliers and all parties interested and involvedin the expansion of wind power power generation in Mexico.
Events:

• Border Energy Forum October 23-24, 2008, Monterrey • Windpower 2008 Conference & Exhibition, 1 to 4 de June, Houston, TX

Bio-energy Mexican Network
Address: Antigua Carretera a Pátzcuaro No. 8701 Col. Ex-Hacienda de San José de la Huerta 58190 Morelia, Michoacán Phone: +(52 443) 322 2777 ext. 42617 rembio@oikos.unam.mx www.rembio.org
Description: Bioenergy Mexican Net (REMBIO) is a non governmental organization, working to promote sustainable practices based on an efficient use of biomass energy. Among their members there are individuals, companies and institutions; it is also subscribed to the National Association of Solar Energy and other international associations.
Events: • Forum to further Bioenergy June3-4, 2008, UIA, Mexico City • International Symposium on Solar Hydrogen and Biofuels 18 to 21 of August 2008, Cancun • Enviro Pro México October 14-16, 2008, WTC, Mexico City

The Colorado Office of Economic Development and International Trade, through its trade office in Mexico can assist individual companies in learning about specific potential project opportunities, local partners and defining a product-specific entry or expansion strategy into the Mexican market. For more information please contact:

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AMEE- Mexican Association for the Energy Economy
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CONAE- National Energy Savings Commission

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Acronyms:

CANAME	Cámara Nacional de Manufacturas Eléctricas (National Chamber of Electric Equipment Manufacturers)
CFE	Comisión Federal de Electricidad (Federal Electricity Comission)
CDM	Clean Development Mechanism
CRE	Comisión Reguladora de Energía (Energy Regulatory Comission)
FIDE	Fideicomiso para el Ahorro de Energía (Energy Savings Trust)
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GTZ	Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation)
GW	Giga Watts
GWh	Giga Watts/ hour
IIE	Instituto de Investigaciones Electricas (Electric Research Institute)
IPN	Instituto Polotécnico Nacional (National Polytechnic Institute)
LYFC	Luz y Fuerza del Centro (Central Light and Power Utility).
O&G	Oil and Gas
MW	Mega Watts
PEMEX	Petroleos Mexicanos (Mexico's Government Owned Oil Company).
SEMARNAT	Secretaría del Medio Ambiente y Recursos Naturales (Secretariat of the Environment and Natural Resources)
SENER	Secretaría de Energía (Secretariat of Energy)
WB	World Bank