CLIMATE CHANGE IN MEXICO

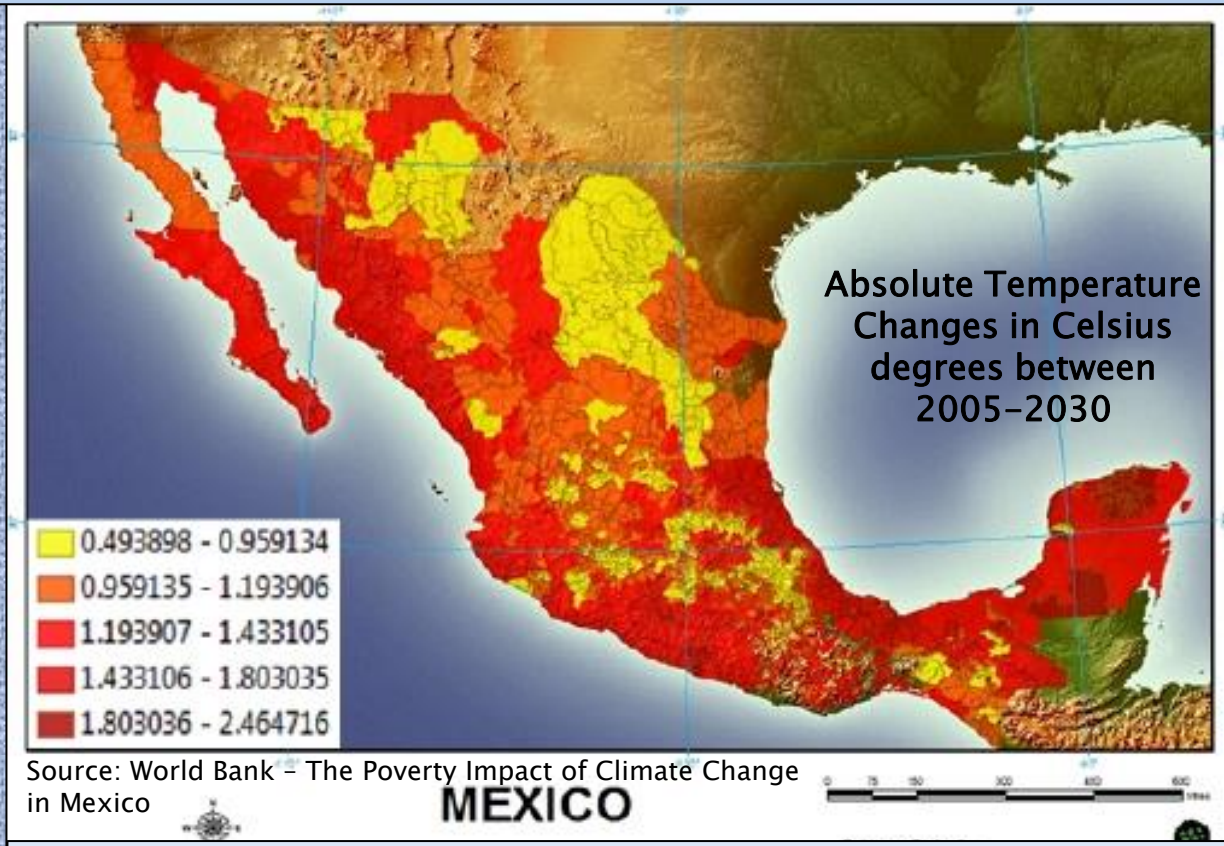
The flooding and landslides from Hurricanes Manuel and Ingrid damaged over 20,000 homes, left approximately 190 people dead, and caused over US$5 billion in damages.

Under current trends, experts predict an increase in average temperatures in Mexico of 2-4°C by 2080, mainly in the northern regions. (SEMARNAT)

June, 2014

TEMPERATURE RISES IN MEXICO

Mexico is highly vulnerable to climate change and is already suffering from longer and hotter periods, more droughts, more intense rains and hurricanes, frequent floods and landslides, rising sea level, and a loss of biodiversity. (Mexico possesses 12% of the world's biodiversity.)



Source: World Bank – The Poverty Impact of Climate Change in Mexico

A 2013 report from the World Bank predicts that annual temperatures in Mexico are expected to rise between 0.29 and 2.46°C by 2030-2039, compared to the historical average (1950-2000), depending on the region, and that almost the entire country will be experiencing drier conditions.

The rising temperatures and their impacts could result in almost 3 million more Mexicans living in poverty by 2030.

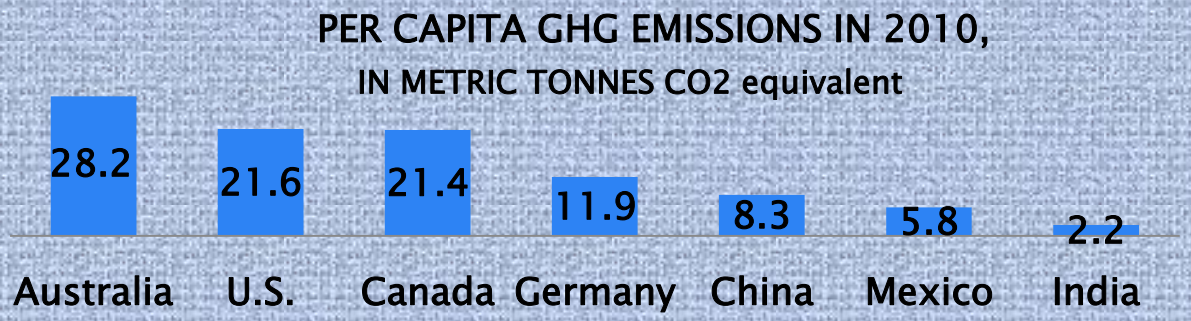
POTENTIAL EFFECTS OF CLIMATE CHANGE IN MEXICO

- A greater number of severe weather and associated precipitation events such as flooding, erosion, landslides, silting and overflowing rivers; more drought and desertification in the northern regions
- Changing precipitation patterns, in general resulting in a significant decline in precipitation;
- Diminished crop yield and less land for growing crops due to temperature and rainfall changes;
- A reduction in the availability of fresh water, both in quantity and quality; less available water for generating electricity;
- Sea level rise effecting many coastlines, especially in the Gulf of Mexico and the Caribbean;
- Biodiversity loss as a result of habitat transformation on a scale beyond its capacity to adapt;
- Impacts on health, energy, employment, transportation, distribution and availability of goods and services, including health services;
- A growing number of climate refugees fleeing conditions that do not support livelihood, which could cause tension and affect security conditions in different regions of the country.

  Desertification is already claiming 1,000 square kilometers of farmland every year and an estimated 80,000 farmers have found it necessary to migrate.

MEXICO'S GREENHOUSE GAS (GHG) CONTRIBUTIONS in 2010:

- Mexico emitted 748 million tons of carbon dioxide (CO_2) equivalent ($MtCO_2e$) GHGs into the atmosphere, an increase of 33% compared to 1990 emissions.
- **Mexico was the 11th highest emitter of GHG emissions globally (1.3%) and the 2nd highest in Latin America.**
  The top 3 GHG emitting countries were China (22%), U.S.(13%), and India (5.4%). UNEP
- **However, on a per capita basis (average emissions per person), Mexico was only the 100th highest at 5.8 metric tonnes of CO_2 equivalent per capita.**
  The U.S. was 20th, China was 70th, and India was 162nd. EDGAR



MEXICO'S GHG EMISSIONS SOURCES

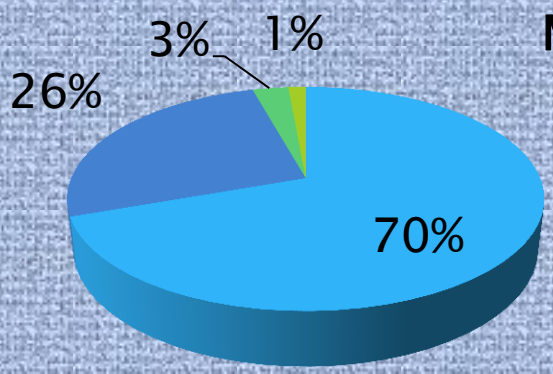
(latest available 2006, national emissions – 709 MtCO2e):

- Generation of energy 21.2%
- Transportation: 20.4%
- Other energy consumption: 4.3%
- Manufacturing & Construction: 7.9%
- Fugitive emissions (e.g. leaks): 6.7%
- Industrial processes: 9.0%
- Land Use & Deforestation: 9.9%
- Disposal of food and waste: 14.1%
- Agriculture: 6.4%

ENERGY (69.3%)

CO_2 emissions

Methane emissions



MEXICO'S GHG EMISSIONS BY TYPE (2006)

- Carbon dioxide (CO2) 69.5%
- Methane (CH4) 26.1%
- Nitrous Oxide (N2O) 2.9%
- Other (PFC, HFC, SF6) 1.4%

Methane's global warming potential is 34 times greater than CO2 (IPPC).

ADDRESSING CLIMATE CHANGE IN MEXICO

Among the 58 countries responsible for more than 90% of global energy-related CO_2, the 2014 Climate Change Performance Index, which measures climate protection performance, ranked Mexico 17th.
The US ranked 40th and Canada ranked 55th!

Though no country is doing enough to prevent dangerous climate change, Mexico has played a very active and constructive role in comparison to many other governments and is far ahead of many other countries in its policy commitment to addressing climate change issues.

In 2012, Mexico was the 3rd country after the UK and Brazil to pass a dedicated Climate Change Act.

MEXICO'S GENERAL LAW ON CLIMATE CHANGE

sets the following targets:

- **To reduce emissions of CO_2 by:**
  - **30% below business-as-usual levels by 2020 (meaning 30% below what they would be without any intervention), and**
  - **50% below 2000 levels by 2050;**
- **For 35% of Mexico's electricity to come from renewable resources by 2024 (40% by 2035 and 50% by 2050).**

It also calls for:

- developing high efficiency, rapid, mass public transportation;
- raising energy-efficiency standards for motor vehicles;
- redirecting fossil-fuel subsidies to promote the use of non-fossil fuels, energy efficiency measures, and sustainable public transportation;
- minimizing waste and, when viable, utilizing methane gas emissions from waste for the generation of electrical energy;
- mandatory emissions reporting and a climate change fund.

Mexico's climate change law addresses may other issues, including:

- reducing the vulnerability and increasing the resilience of society and ecosystems to the adverse effects of climate change;
- applying sustainable management practices for agriculture, forestry, wetlands, coastal-marine ecosystems, fishing and aquaculture resources;
- conservation and sustainable use of natural resources, water resources, ecosystems and their biodiversity;
- facilitating food security;
- guaranteeing the right to a healthy environment.

The law also states that federal, state, and municipal governments will all be involved in achieving these goals.

Mexico's national targets for reducing emissions are not mandatory and achieving these goals will depend on the government's political will and leadership.

In December 2013, the Mexican government passed an Energy Reform to open up Mexico's major energy producing sectors to private and foreign investment.

This could threaten compliance with Mexico's emission reduction goals as it will allow international energy companies* to increase oil production, including developing unexplored oil and gas reserves and further exploitation of Mexico's deepwater oil and shale-gas reserves - both of which involve significant environmental impacts (e.g. high use of water resources, harmful waste, GHG emissions, oil spills).

However, the objective of the Energy Reform is also to promote and increase growth in renewable energies.** It provides for a wide variety of renewable energy producers to be able to build and operate power plants from sources such as wind and solar, in particular for providing electricity. Plans include extending the electrical transmission grid to reduce energy losses and distribute increasing renewable energies.

* Companies such as ExxonMobile, BP, Shell, Chevron, and possibly companies in Asia (desmogblog)
** Dr. Enrique Ochoa Reza, Director General of the Mexican Federal Electricity Commission (CFE)

Government incentives help to achieve growth in renewable energy.

In January 2014, Mexico introduced a carbon tax on fossil fuels – fuels with a higher carbon content have a higher tax. This makes renewable energy more competitive relative to fossil fuel and encourages a shift to cleaner energy sources. Revenues could help fund the transition to renewable energy.

Since natural gas is the fossil fuel that generates the least CO_2 emissions per ton, it is exempt from Mexico's carbon tax. Therefore the tax does not discourage hydraulic fracturing (aka fracking) for natural gas.

Mexico's Income Tax Law also provides an incentive for energy generation from renewable sources.

Whether or not Mexico succeeds in meeting its emissions reduction goals will depend on how well the government can balance the further development of its oil and gas resources (which will result in higher levels of GHG emissions) with the climate change leadership the country has established, based on building a sustainable future economy with renewable energy as the key to achieving energy security and climate change goals.

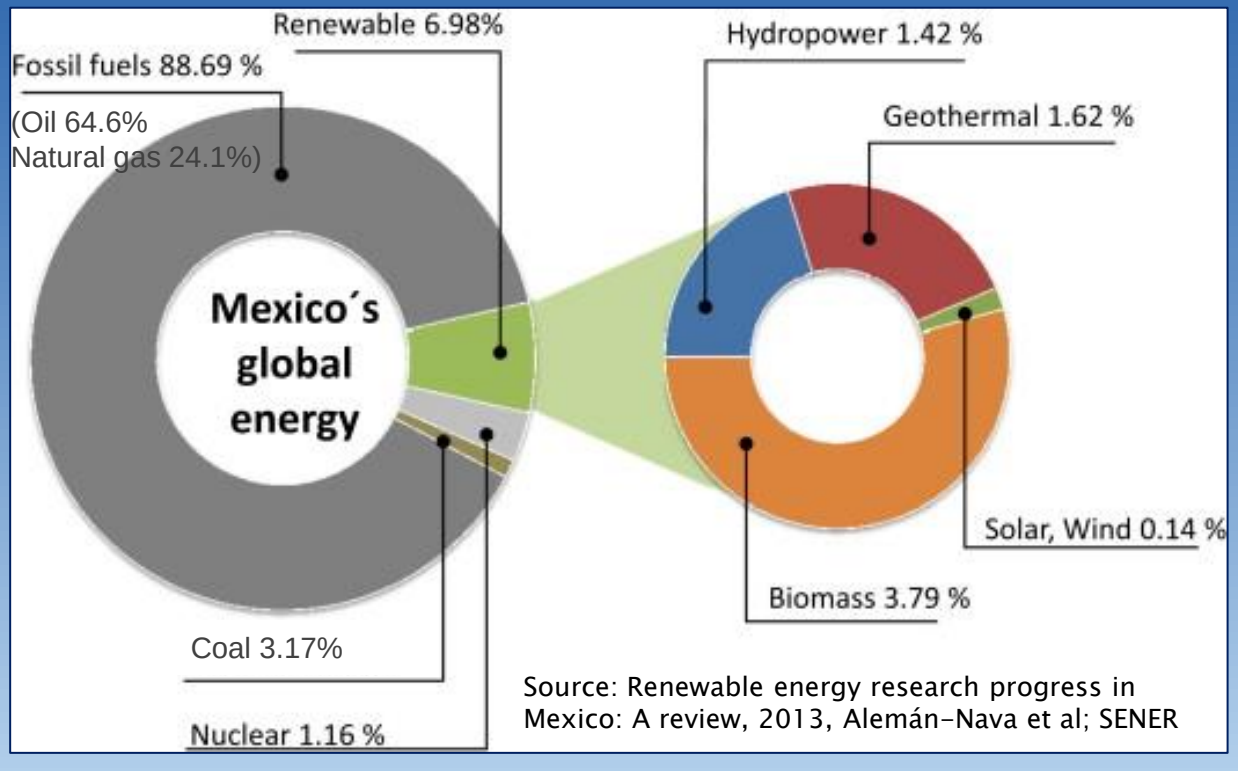
ENERGY PRODUCTION AND CONSUMPTION IN MEXICO

Pemex's Ku-Maloob-Zaap wells, the country's most productive, in the Gulf of Mexico

The most effective way to reduce emissions of carbon dioxide – the greenhouse gas most responsible for global warming – is to reduce consumption of fossil fuels.

MEXICO'S ENERGY PRODUCTION

Mexico produced 219.5 million tons of oil equivalent energy during 2011. An estimated 92% came from fossil fuels (including coal) and only 7% from renewable sources.



Source: Renewable energy research progress in Mexico: A review, 2013, Alemán-Nava et al; SENER

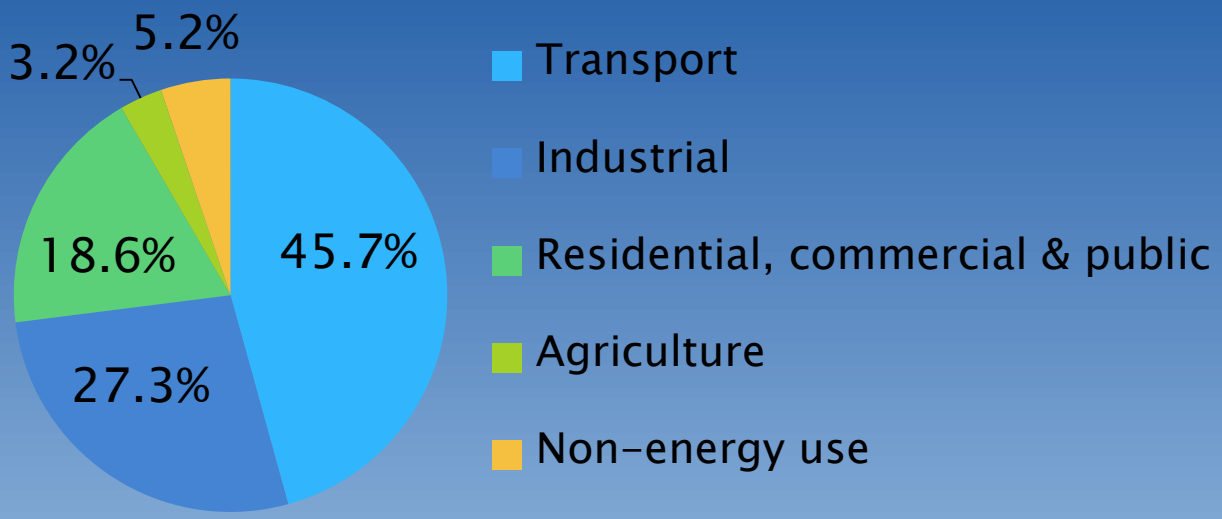
Mexico is one of the 10 largest oil producers in the world, producing 2.6 million barrels of oil per day and exporting approximately half (2011). It also imports 27% of its energy supply, mostly natural gas and gasoline.

MEXICO'S ENERGY CONSUMPTION

Approximately 40% of Mexico's energy is consumed in fossil fuel processing and losses and in electricity generation losses. Approximately 60% is used for final energy consumption:

Mexico plans to reduce energy losses by modernizing electric lines and substations and by improving distribution.

Final national energy consumption, Mexico 2011



Primary energy supply for national energy consumption, Mexico 2011

- fossil fuels (oil, natural gas, coal) 89%,
- nuclear 1.6%,
- renewables 9.4%

SENER. National Energy Balance 2011

TRANSPORTATION IS A LARGE CONSUMER OF ENERGY

Road transport is Mexico's fastest growing emissions sector. In 2011, 40% of Mexico's CO_2 emissions came from transportation.

Alternative transport to cars in cities, reducing vehicle use for long-distance transport, and the use of electric vehicles would help reduce emissions.

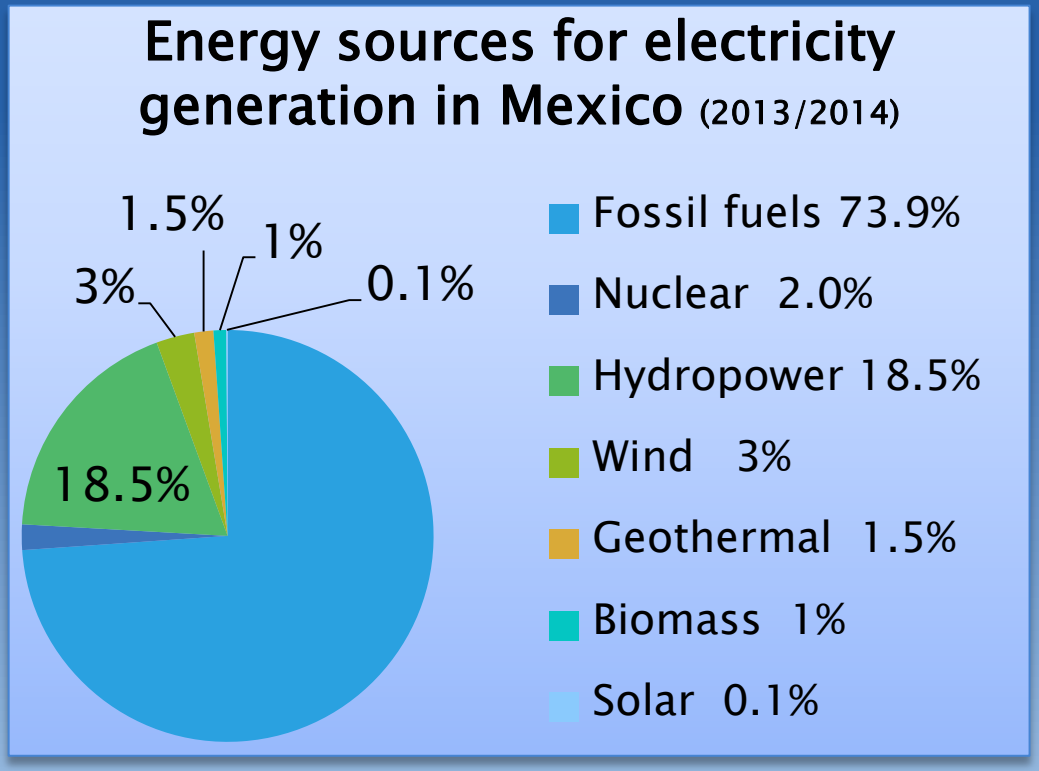
Mexico's climate change strategy promotes:

- low-emission, energy efficient public transportation systems, including the railway system and freight transportation;
- non-motorized transportation, including cycling;
- common use of electric vehicles in public transportation.

Mexico City is promoting the use of plug-in hybrid and electric vehicles and has further developed a Bus Rapid Transit system. In 2012, it launched all-electric taxi fleets. Electric vehicles are now being built in Mexico and quick-charging stations are starting to be installed in Mexico City and other locations.

MEXICO'S ELECTRICITY CONSUMPTION

Electricity represents a substantial percentage of Mexico's energy consumption and in 2011 was responsible for 31% of CO_2 emissions.



Renewable energy sources provide approximately 24% of total electricity generation capacity – almost 15,000 megawatts (MW) of the installed capacity. (2013).

In 2013, the national Electricity System (SEN) had approximately 63,000 MW of electricity in operation – 85% from public utilities and independent producers and 15% from the private sector.

Almost 98% of Mexicans have electricity.

U.S. Embassy—Renewable & Electricity Factsheets, 2014/2012; SENER, CFE and CRE, 2012/ Director General of the Mexican Federal Electricity Commission (CFE), 2014; Mexican Energy Reform 2013, PwC, SEMANAT

RENEWABLE ENERGY IN MEXICO

Solar panels are used to pump large quantities of water to storage tanks at higher elevations in Oaxaca

La Ventosa wind farm, Oaxaca

Renewable energy is generated from natural and inexhaustible resources, such as sunlight, wind, and tides, which can be transformed into useful energy.

MEXICO'S RENEWABLE ENERGY SOURCES

Mexico's main renewable sources or energy are hydropower, geothermal, wind, solar, and biomass.
Renewable energy can provide long-term cost savings and keep millions of tons of GHG emissions out of the atmosphere.

In Mexico:

- There are already renewable energy projects in 90% of Mexican states.
- Investment in renewable energy increased from US$ 352 million in 2011 to US$ 2 billion in 2012.
- In May 2014, the government announced a goal to increase its share of renewable energy to 33% of installed electricity generation capacity by 2018. Substantial increases in solar and wind power capacity are planned.
- 1 MW of energy is enough to power approximately 1,000 homes.

HYDROPOWER is the potential energy of water converted into electricity in hydroelectric plants where flowing water is used to spin one or more turbines connected to a generator.

It is the renewable energy source with the highest installed capacity within Mexico – 11,603 MW (72 stations) (2012, CFE)

Mexico's largest hydro-electric plant is the 2,400 MW , 262 metre, Manuel Moreno Torres in Chiapas.

Mexico's first and largest geothermal power plant: the Cerro Prieto facility, near Mexicali in Baja California, has 180 MW installed capacity.

GEOTHERMAL energy is the energy stored as heat under the surface of the earth, which emerges to the surface as steam. It can be used to run turbines and generate power, or run through pipes for direct heating, such as for buildings or pools.

Mexico is ranked 4th in geothermal power generation worldwide, with 958 MW installed geothermal power. (2012, CFE and CRE)

WIND energy wind turns the blades of a wind turbine, which spins a shaft and generator to create electricity. Large wind farms have hundreds of wind turbines connected to the electric power system.

Mexico's installed capacity in wind projects is 1,844 MW (2013, CFE) – the majority in the Isthmus of Tehuantepec region in Oaxaca, which has Mexico's most favourable wind conditions and is one of the world's best wind resources.

The government expects to have 8,922 MW of wind power installed by 2018 and the Mexican Wind Energy Association has set a target of 12,000 MW by 2022, enough to power several million homes.

In Nuevo Leon, Mexico's largest onshore wind farm, Ventika, will have 84 wind turbine generators (shown at right), each with an output of 3 MW. It is scheduled to be completed in 2016 and will have a total capacity of 252 MW.

In 2012, the baking company Grupo Bimbo started-up operation of *Piedra Larga Wind Farm* in the state of Oaxaca. It will provide 90 MW of power, enough to run 65 of Bimbo's plants and offices in Mexico, and save around 180,000 tons of CO_2 emissions annually.

Retailers Wal-Mart de Mexico and Soriana have also launched wind farm projects in Mexico. (They are also installing rooftop solar panels on their stores.)

SOLAR power is the conversion of sunlight into electricity, either directly, using photovoltaic (PV) cells, or indirectly using concentrated solar power – solar radiation is concentrated using lenses or mirrors and then used as a heat source for a power plant.

The potential for solar energy in Mexico is one of the highest in the world due to Mexico's high average radiation levels, particular in the six northern states. Mexico is already the largest solar energy producer in Latin America, with a total installed capacity of 67 MW and another 142 MW of projects under construction.* Mexico is also the main supplier of solar PV panels in Latin America.

The government expects capacity to increase to 628 MW by 2018.

In La Paz, Baja California Sur, in September 2013, the $100 million, 39MW Aurora Solar 1 plant, came online. It has over132,000 solar PV panels and generates enough to supply energy for 60% of La Paz's 220,000 people.

*U.S. Embassy—Mexico City Renewable Energy Factsheet 2014

BIOMASS energy comes from many organic sources, such as wood, agricultural wastes and crops that are grown for electricity production, and livestock waste. Heat energy is released when the plant material is burned.

Bioenergy can be used for power generation, industrial applications, production of liquid biofuels for transportation, or for direct heat use.

Most biomass energy in Mexico is currently 'traditional biomass' and is used directly:

It is estimated that about 25% of Mexicans cook with wood on open fires or with old, inefficient firewood stoves, which are also used for household heating.

Mexico has an ongoing program to distribute fuel-efficient cookstoves, which would substantially reduce GHG emissions, wood consumption, and health impacts of smoke from traditional firewood stoves.

Only a small percentage of biomass is installed in Mexico's energy system:

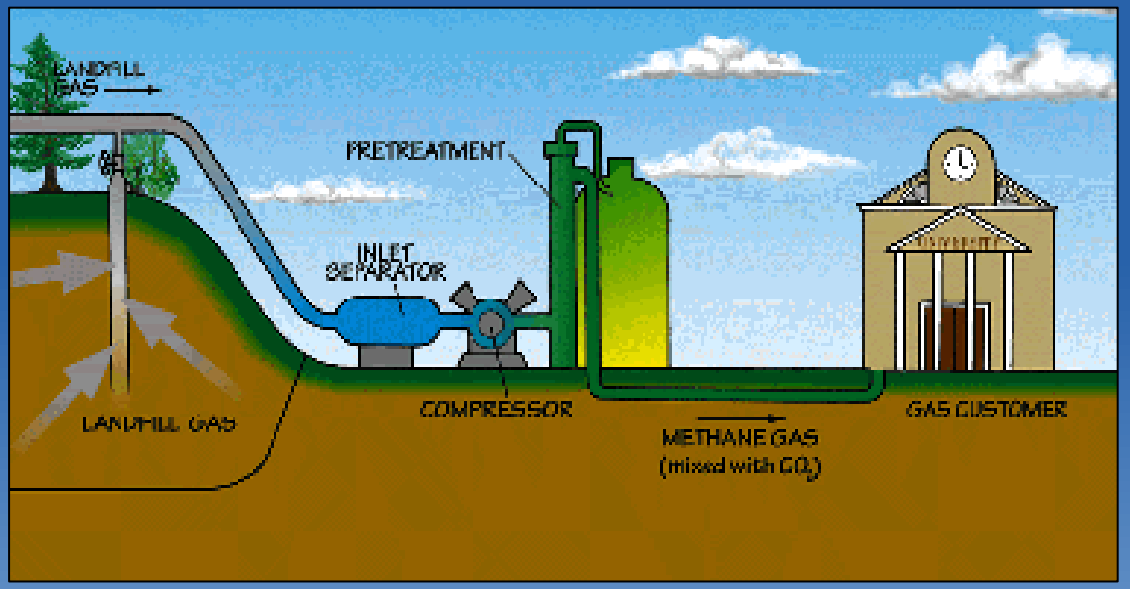
Mexico's biomass installed capacity is 548 MW (2012),* mostly from sugar cane bagasse biomass.

*REEEP Policy database, 2014

A woman prepares corn tortillas on a fuel-efficient wood stove.
Courtesy of Ecoders

BIOMASS:

BIOGAS FROM LANDFILLS – All landfills generate a byproduct known as landfill gas, which is 50-80% methane. Methane can be captured from landfills and used to produce biogas.



LANDFILL GAS TO ENERGY – In 2011, one of the world's largest landfills, the *Bordo Poniente* Landfill in Mexico City, was shut down, greatly reducing the city's GHG emissions. The city is building a biogas plant to capture the methane gas produced by the landfill to fuel a power plant that could supply electricity to up to 35,000 homes. Several other cities in Mexico are also utilizing this technology.

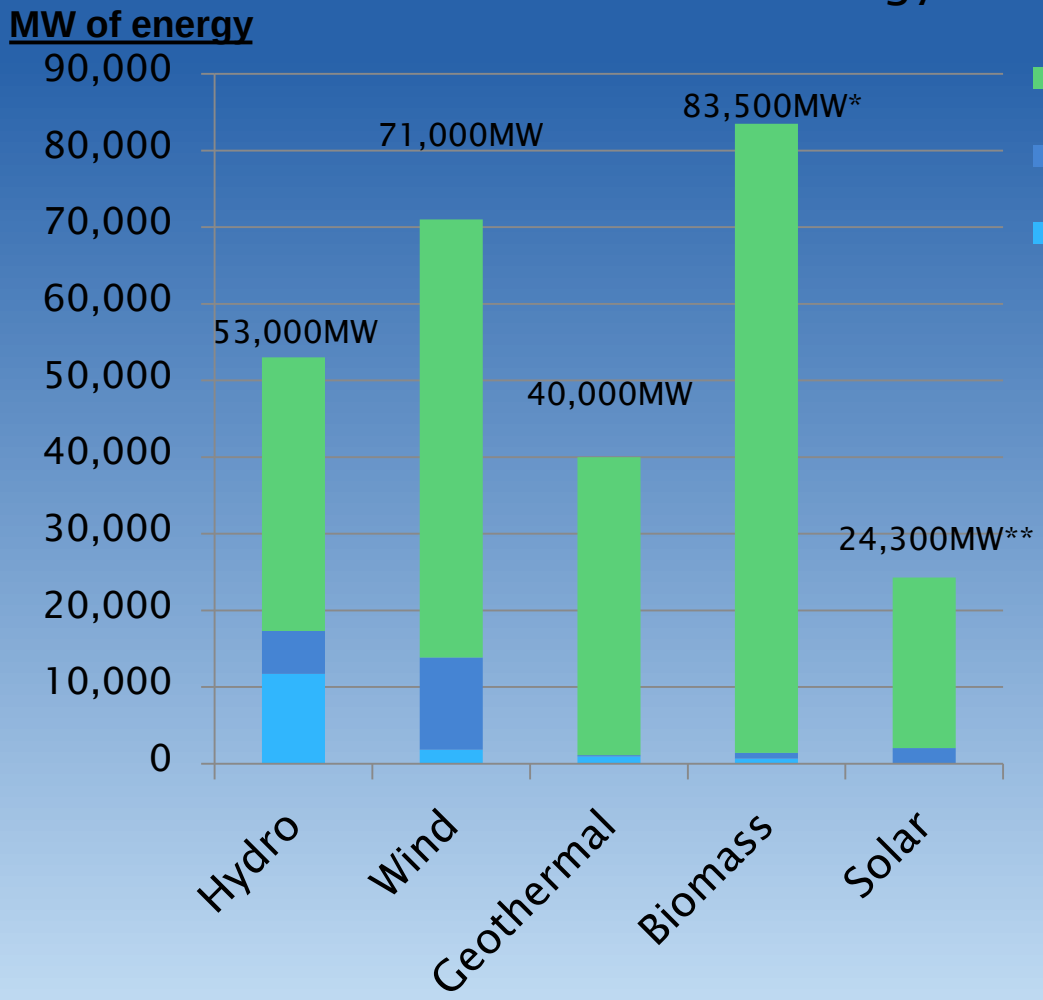
It is estimated that Mexico disposes of over 28 million tons of solid waste in 186 landfills and could generate enough methane to produce 652 to 912 MW of power. (SENER)

AGRO-FUELS: The generation of power from livestock waste also has substantial potential. For example, it is estimated that pig manure in Mexico can generate 246-492 MW.

Prospects for Renewable Energy 2012-2016, SENER

MEXICO HAS ABUNDANT RENEWABLE ENERGY POTENTIAL

It is estimated that by 2025, an additional 20,500 MW of renewable energy will be installed.



*Estimated potential for biomass is 83,500-119,498 (SENER 2012) but production should not impact food security or the environment (e.g. deforestation, biodiversity). The use of biofuel from corn in countries like the U.S. has already caused a shortage of land for food-based agriculture in some countries and significant increases in the price of corn, a staple for countries like Mexico and Guatemala. It also takes 1700 litres of water to produce 1 litre of biofuel.

**Estimated potential for wind to 2030, but it's potential is practically unlimited (Gobierno Federal, SENER, gtz)

Prospective Renewable Energy 2012-2026 SENER, Ministry of Energy (SENER) 2012, CRE 2012, AMDEE

RENEWABLE ENERGY HAS ABUNDANT POTENTIAL AND BENEFITS

The potential of Mexico's wind energy alone (71,000 MW)
OR,
assuming an efficiency (the ratio of energy output from the solar cell to input energy from the sun) of 15%, a 25 square kilometer solar plant in Chihuahua or the Sonora desert would be sufficient to supply all of the electricity currently required by the country. (Gobierno Federal, SENER, gtz)

Renewable energy also supports local economies and creates local jobs – investment in new renewable energy can create more than 3 times more jobs than those created by fossil fuel investment. For example, according to Mexico's National Strategy, the installation of 18,000 MW of renewable energy would create close to 147,000 jobs.

University of California Berkley, "Putting renewables to work: How many jobs can the clean energy industry create?" Political economy research institute; Global Sustainability Institute, Tecnológico de Monterrey.

Solar ovens are a labour-saving, healthy alternative to cooking over traditional wood fires. They can be left outside during daylight hours to cook many types of food. Over 20,000 'HotPots' have been distributed in 16 Mexican states.

In 2010 the government launched a project (partially funded by the World Bank) to provide electricity installation of solar panels to 50,000 households in 2,500 of the poorest and isolated communities in Mexico, over a 5-year span.
(SENER)

ADDITIONAL INFORMATION

While renewable energies have few environmental concerns, offshore drilling and fracking can have many substantial environmental impacts.

OFFSHORE OIL DRILLING

Expanding offshore drilling increases the risk of oil spills, which can bring catastrophic harm to marine life and devastating losses to coastal communities, including impacting fishing and tourism. Oil spills can come from oil tankers, platforms or pipelines transporting the oil to onshore facilities – usually from leaks and accidents. Hurricanes can also cause spills. Other environmental concerns are:

- The oil captured at offshore drilling sites releases greenhouse gases in its production and refining, transportation in boats and trucks, and when it is used as fuel.
- Offshore drilling operations produce many toxic wastes and other forms of pollution.
- To estimate the size of an oil reserve, seismic survey ships tow multiple airgun arrays that emit thousands of high-decibel explosive impulses to map the seafloor. This can disrupt and harm marine animals, including fish, whales, and dolphins.

FRACKING FOR NATURAL GAS

Shale gas is natural gas that is found trapped within shale formations and is the majority of today's natural gas.

Extraction involves a technique called fracking, in which chemicals are mixed with large quantities of water and sand and injected into the ground at very high pressure to create fractures in the underlying shale rock formations and extract the natural gas below the surface. According to the U.S. Environmental Protection Agency, at least 65 of the chemicals known for use in fracking are hazardous. Fracking also produces large amounts of toxic and radioactive wastewater (EPA).

Because of the large volumes of water used, fracking can deplete surface and ground water supplies. It can also contaminate these water sources due to spills and leaks or from wastewater. Other environmental concerns are:

- the release of hazardous air pollutants,
- leaking of methane gas,
- noise pollution from fracking operations,
- increases in seismic activity – in some places earthquakes have been linked to fracking,
- disruption of the environment, including wildlife.

Although Mexico's has large shale gas reserves, many are in the northern region, where droughts have already threatened fresh water supplies, and there may not be enough water to use thousands of gallons per well for extraction.

CLIMATE CHANGE IN MEXICO

Michelle Mech
michelle.mech@gmail.com

ACKNOWLEGEMENTS

Translation: Martin Nava, Pro Estero, Ensenada

Support: Ramón Velasco Medina, Superintendent, Preparatoria de San Patricio de Melaque