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SECRETARÍA DE ENERGÍA

OVERVIEW OF NUCLEAR POWER PROGRAMME IN MEXICO

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Ministry of Energy

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United Mexican States

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Land Area (km2)	1,960,000	380,000
Population	120 M	127 M
GDP (USD per capita)	9,800	44,400
Self-sufficiency of Energy Supply (%)	111	6
Electric Power Consumption (MWh per capita)	2.17	7.83
Installed Electric Power Capacity (GW)	66	234
Operational Nuclear Power (units / MW)	2 / 1620	42 / 41,482
CO2 Emission from Fuel Combustion	431	1,188
CO2 Emission (tCO2 per capita)	3.60	9.35

IEA World Energy Statistics 2016

Energy Reform in Mexico

- ✓ Initiated in 2013 is transforming country´s oil, gas and electricity sectors
- ✓ Broader effort to modernise and diversify the country´s economy and increase competitiveness of industry
- ✓ A new regulatory and institutional framework has brought an end to long-standing monopolies, opening competition in all aspects oil, gas supply and power generation
- ✓ Sustainability and climate change considerations are prominent in Mexico´s energy policy. Mexico was among the first nations to submit a climate plegde in the run-up to COP21
- ✓ The overall aim is to provide for a more sustainable, efficient, transparent and productive energy sector, to increase the benefits drawn from the country's large hydrocarbon resource, while also encouraging low-carbon sources of growth

Energy Reform in Mexico

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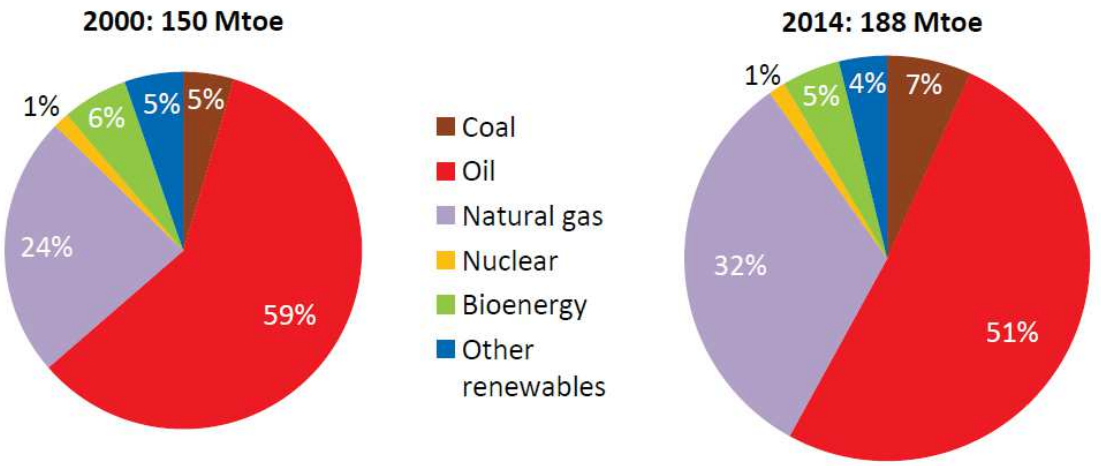
- ✓ Several considerations gave impetus to the Reform:
  - ➢ The state-owned oil company, Petróleos Mexicanos (PEMEX), which had enjoyed a monopoly on upstream development, was not in a position to make the investments necessary to arrest declining oil production from ageing oil fields
  - ➢ In the power sector, limited private sector participation in electricity generation and the monopoly position of the state utility, Comisión Federal de Electricidad (CFE) in the transmission, distribution and retail sectors, translated into inefficiencies across the system that have pushed up costs

Energy Trends in Mexico

- ✓ Primary energy demand in Mexico has increased by 25% since 2000, a rise that mostly matches the expansion of the economy.
- ✓ Energy intensity of Mexico's economy shifted only slightly over this period, from 0.180 tonnes of oil equivalent (toe) required for each $1 000 of gross domestic product (GDP) in 2000 to 0.168 toe/$1 000 in 2014

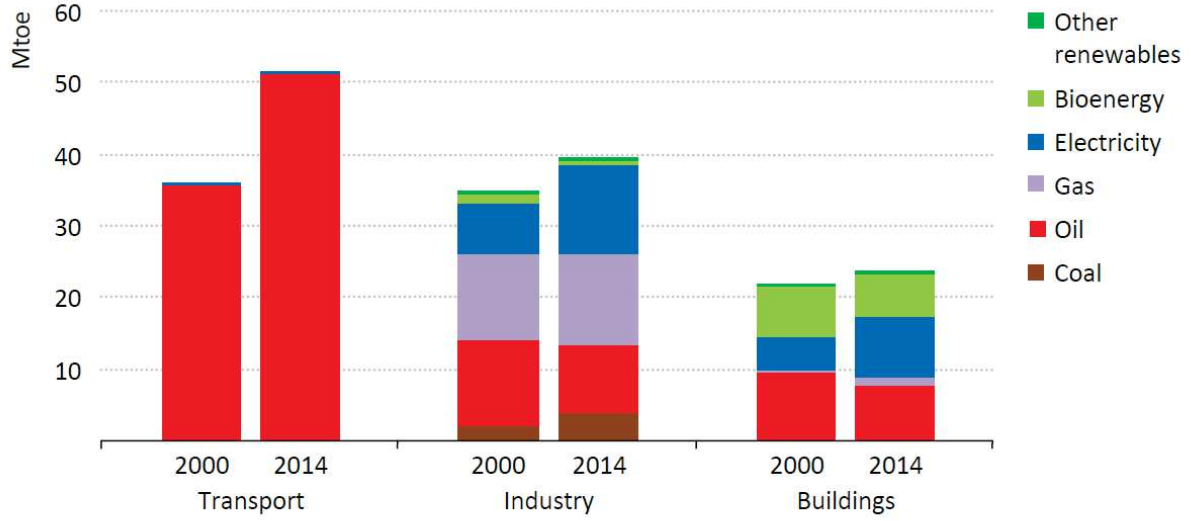


Gas is rapidly expanding its role, but oil remains the dominant force in Mexico's primary energy mix

IEA Mexico Energy Outlook

Energy Trends in Mexico

- ✓ Energy demand for transport accounted for over 40% of total final consumption in 2014, significantly higher than the OECD average of 33%
- ✓ The transport sector is the largest energy consumer of all end-use energy sectors in Mexico, well above industry (28%) and buildings (20%)
- ✓ Industrial energy demand has increased by about 14% since 2000, while the contribution to GDP made by industry has grown by about 17% during the same period, meaning that industrial energy intensity has remained almost flat during the period.



The oil-dominated transport sector is growing fast and has by far the largest share of final energy consumption in Mexico

Energy Trends in Mexico

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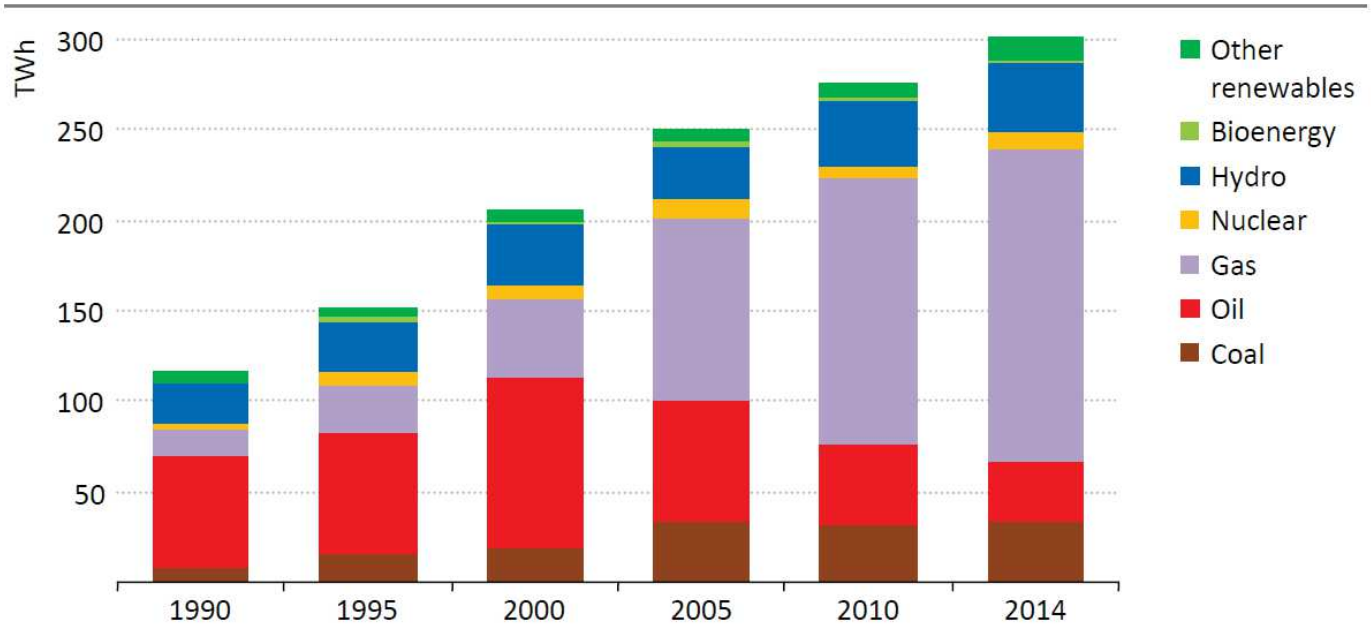
- ✓ Electricity demand in Mexico has more than doubled over the last 20 years and in 2014 accounted for around 18% of total final energy consumption
- ✓ 98% of the population has access to electricity, but per-capita consumption is relatively low
- ✓ Among the end-use sectors, industry accounts for well over half (56%) of final electricity consumption



Electricity generation in Mexico has more than doubled since 1990 and diversified away from a costly reliance on oil

Notes: TWh = terawatt-hours. Other renewables include geothermal, solar PV and wind.

IEA Mexico Energy Outlook

Energy Trends in Mexico

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- ✓ Mexico has abundant renewable energy resources, that – with the exception of hydropower – it has barely started to tap
- ✓ Hydropower capacity, now at 12.5 GW, has been a long-standing part of Mexico's power generation mix, but arid conditions across much of the country leave relatively little scope for further expansion
- ✓ Reliance on wind, geothermal and solar photovoltaic has been limited thus far, but the potential for growth is enormous and policies are increasingly supportive
- ✓ The Energy Transition Law, published in 2015, together with the Electricity Law, provides the legal framework for accelerated deployment of power generation from clean energy, which it defines as renewable sources, nuclear, high-efficiency cogeneration, waste-based generation and thermal power plants with carbon capture and storage

Nuclear power is clean energy

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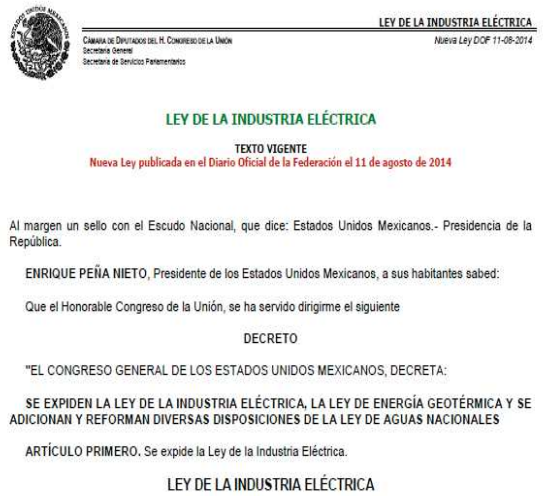
- ✓ The Electricity Industry Law (LIE) published in August 2014, aims to promote the sustainable development of the electricity industry and ensure its continued efficient and safe operation for the benefit of users, as well as the fulfilment of the obligations of public and universal service, the clean energy and the pollution emissions reduction.

- ✓ The LIE defined nuclear energy as clean energy.



LEY DE LA INDUSTRIA ELÉCTRICA

Cámara de Diputados del H. Congreso de la Unión
Secretaría General
Secretaría de Servicios Parlamentarios

Nueva Ley DOF 11-08-2014

LEY DE LA INDUSTRIA ELÉCTRICA

TEXTO VIGENTE
Nueva Ley publicada en el Diario Oficial de la Federación el 11 de agosto de 2014

Al margen un sello con el Escudo Nacional, que dice: Estados Unidos Mexicanos.- Presidencia de la República.

ENRIQUE PEÑA NIETO, Presidente de los Estados Unidos Mexicanos, a sus habitantes sabed:

Que el Honorable Congreso de la Unión, se ha servido dirigirme el siguiente

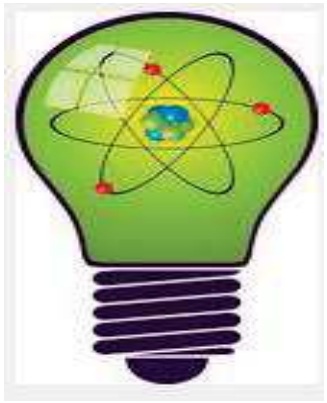
DECRETO

"EL CONGRESO GENERAL DE LOS ESTADOS UNIDOS MEXICANOS, DECRETA:

SE EXPIDEN LA LEY DE LA INDUSTRIA ELÉCTRICA, LA LEY DE ENERGÍA GEOTÉRMICA Y SE ADICIONAN Y REFORMAN DIVERSAS DISPOSICIONES DE LA LEY DE AGUAS NACIONALES

ARTÍCULO PRIMERO. Se expide la Ley de la Industria Eléctrica.

LEY DE LA INDUSTRIA ELÉCTRICA



Institutional Framework

- ✓ For much of the past eight decades, Mexico's energy sector has been constituted in the same way with state-owned companies enjoying monopolies throughout the value chain:
  - ➢ PEMEX for upstream, midstream and downstream oil and gas
  - ➢ Comisión Federal de Electricidad (CFE) for power generation, T&D and retail sales
- ✓ The Energy Reform package initiated in 2013 established new structures for the oil, gas and electricity industries in Mexico
  - ✓ Participation of the private sector in upstream activities of oil and gas
  - ✓ Restructuring of CFE and its unbundling, the introduction of competitive electricity markets for energy, capacity.
  - ✓ Participation of private sector in generation, EXCEPT NUCLEAR

Institutional Framework

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Cabinet-level departments

Ministry of Finance and Public Credit (SHCP)

In charge of setting the fiscal and economic terms of oil contracts and determining other bidding variables.*
Sets price range for certain petroleum products.

Secretariat of Energy (SENER)

Sets general energy policy in all areas, including energy efficiency. Defines which oil and gas fields to open to private bidding. Designs the oil contracts and the terms and conditions of the bids.

Ministry of Environment and Natural Resources (SEMARNAT)

Regulates and supervises the environmental impact and safety of operations of the hydrocarbons sector through the Environmental and Industrial Safety Agency (ASEA).

Independent regulators

National Hydrocarbons Commission (CNH)

Regulates upstream activity, conducts bids and administers oil contracts.

Energy Regulatory Commission (CRE)

Regulates electricity and mid and downstream hydrocarbon operations.

Operating companies

Petróleos Mexicanos (PEMEX)

A productive state enterprise focussed on oil and gas.

Comisión Federal de Electricidad (CFE)

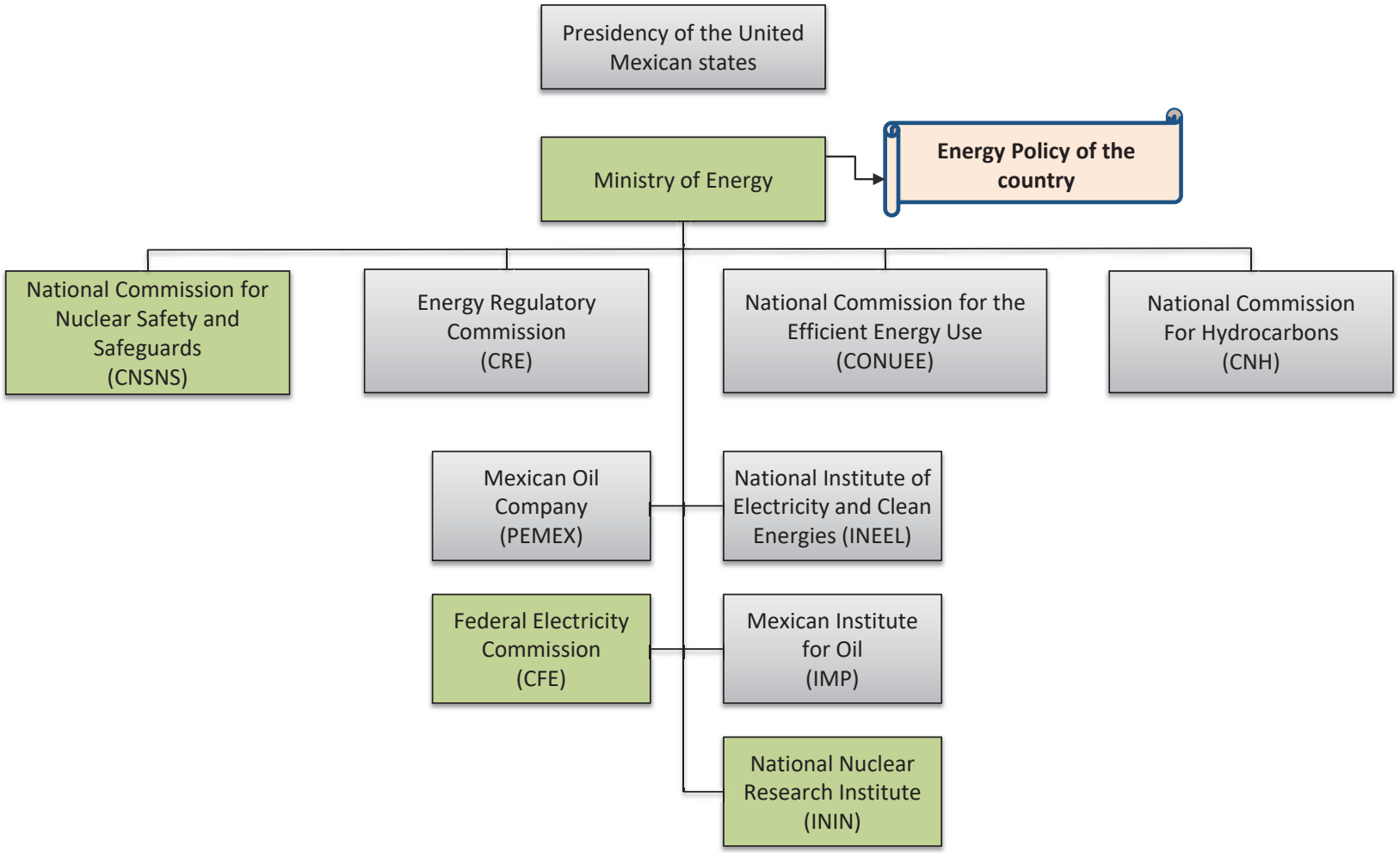
A productive state enterprise focussed on electricity.

The Reform introduced fundamental changes to energy governance in Mexico

Constitutional amendments and new secondary laws that have been passed:

- **Electricity Law**
- **Hydrocarbons Law and Hydrocarbons Revenue Law**
- **PEMEX Law**
- **CFE Law**
- **Mexican Petroleum Fund for Stabilization and Development**

Federal Government Energy Sector



Institutional Framework

- ✓ The Reform is part of a broader vision by the government to pursue energy policies that reconcile energy security imperatives with sustainability and efficiency considerations, and a general recognition of the need to shift to a low-carbon growth model

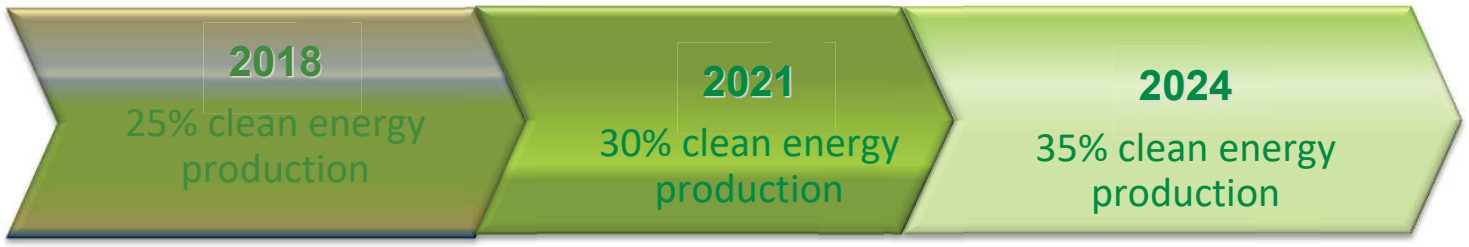
- ✓ The Energy Transition Law (passed in December 2015) and the far reaching climate pledge submitted in advance of the Paris COP21 include:

  - ➢ A commitment to increase the share of clean energy sources in power generation from 21% today to 25% by 2018, 30% by 2021 and 35% in 2024

  - ➢ A commitment to reduce greenhouse-gas emissions (GHGs) by 22% and black carbon emissions by 51% by 2030, relative to a business-as-usual scenario

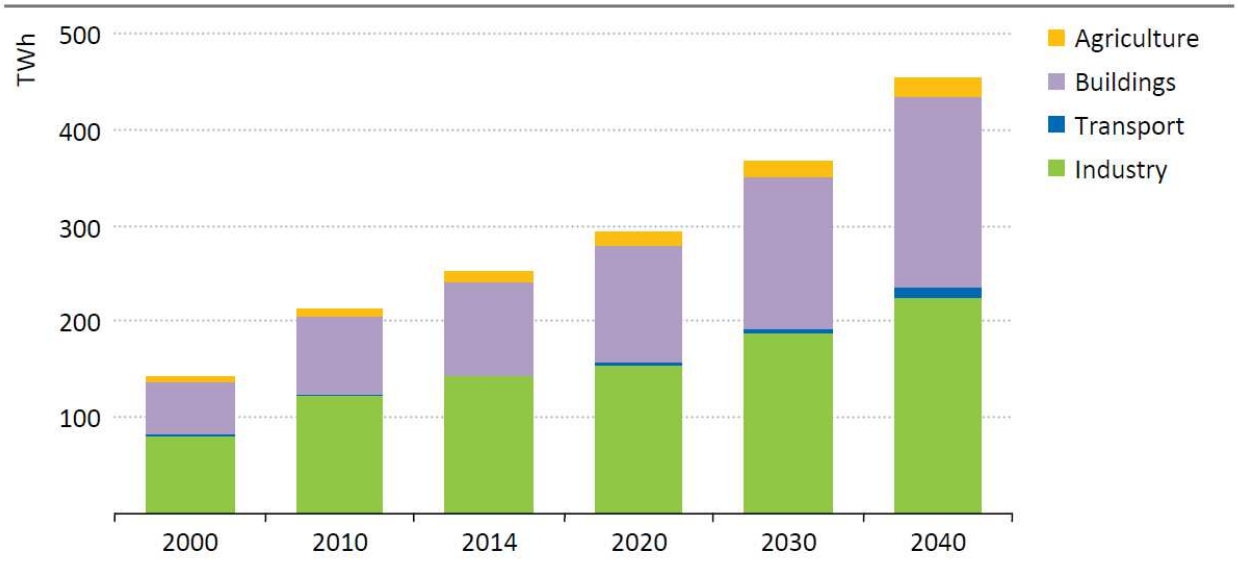
Energy Clean Goals

- ✓ Mexico is taking actions against global warming by reducing pollution emissions from fossil fuels.
- ✓ The Energy Transition Law (LTE) published in December 2015, sets out the obligations of clean energy and the reducing pollution emissions from electricity industry, while maintaining the competitiveness of productive sectors.
- ✓ The specific goals of the LTE are:



Electricity Outlook to 2040

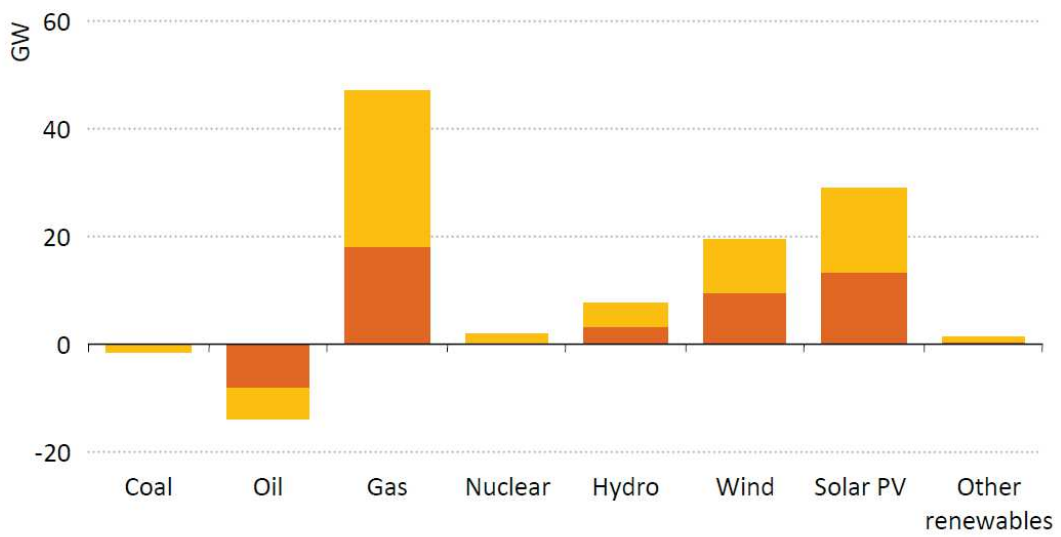
- ✓ Electricity demand in Mexico grows at an annual average rate of 2.4% between 2014 and 2040
- ✓ Per-capita electricity demand also grows by around 50% from 2014 to 2040
- ✓ Industry remains (just) the largest electricity-consuming sector, accounting for 50% of electricity demand in 2040
- ✓ The largest growth in electricity consumption arises in the building sector (residential and services)
- ✓ Electricity consumption in the transport sector rapidly increases, reflecting the effects of government support schemes for electric vehicles.



Industry remains the largest electricity user in Mexico in the New Policies Scenario, although buildings sector demand rises more quickly

Electricity Outlook to 2040

- ✓ Installed electricity generation capacity more than doubles, from 70 gigawatts (GW) in 2015 to almost 160 GW in 2040
- ✓ Gas-fired plants account for half of the increase
- ✓ Oil-fired electricity generating capacity decreases from 17 GW in 2015 to 3 GW in 2040
- ✓ Coal-fired power capacity decreases by 1.5 GW by 2040, as a portion of existing capacity is retired
- ✓ The share of renewables-based electricity generation capacity rises from 25% to 46%
- ✓ 4 GW of nuclear capacity is expected to be built by 2030, in addition to the existing 1.5 GW at the Laguna Verde site

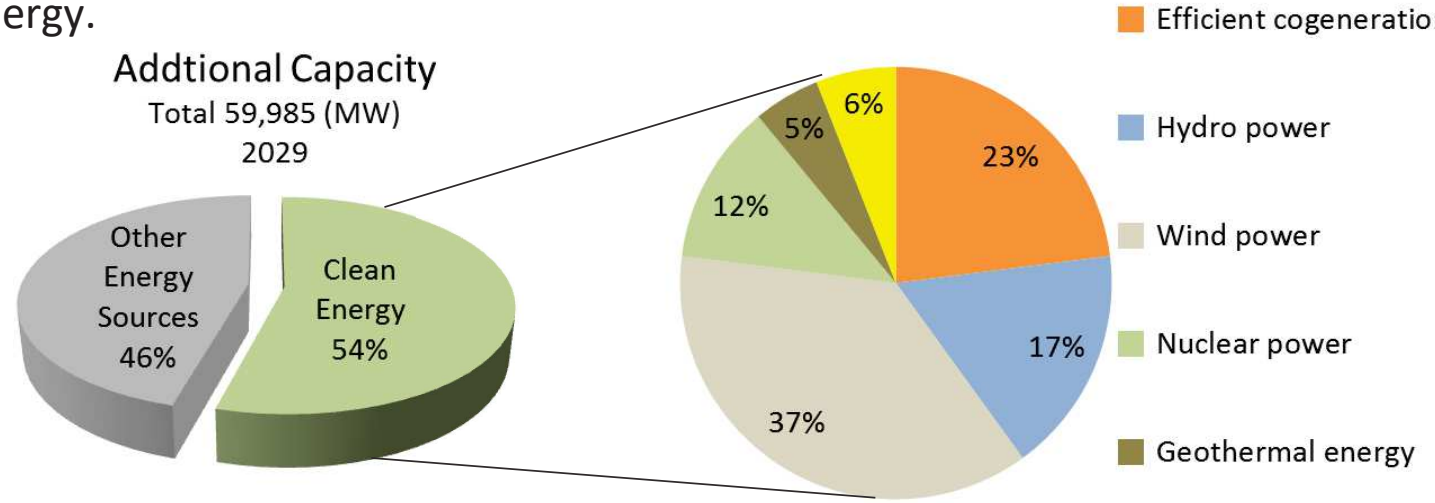


Natural gas and renewables-based power leads capacity increases in Mexico in the New Policies Scenario to 2040

Nuclear Power Programme

- ✓ The National Electricity System Development Program (PRODESEN) is the annual energy planning document that sets the infrastructure for the new power generation capacity. This document shows the optimal energetic mix for supply the demand, at minimum cost, considering the goals in clean energy, efficiency and security of the national electrical system (SEN).

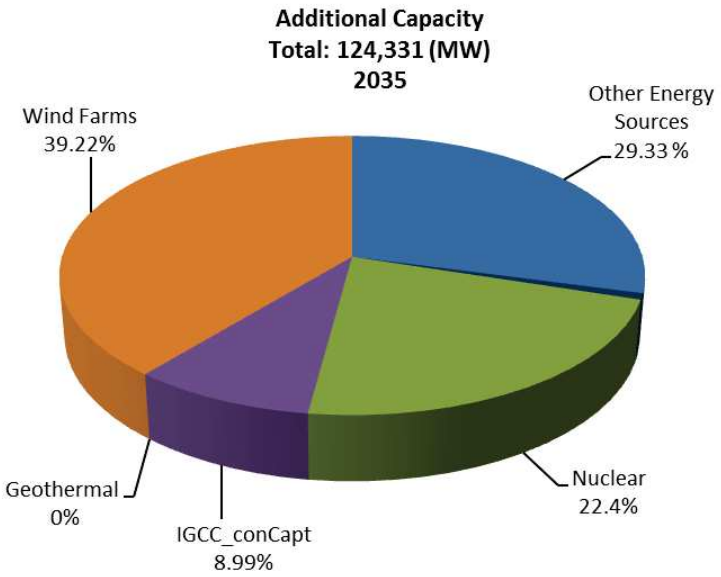
- ✓ The PRODESEN 2015-2029 established three new reactors, this will represent 12% of total clean energy.

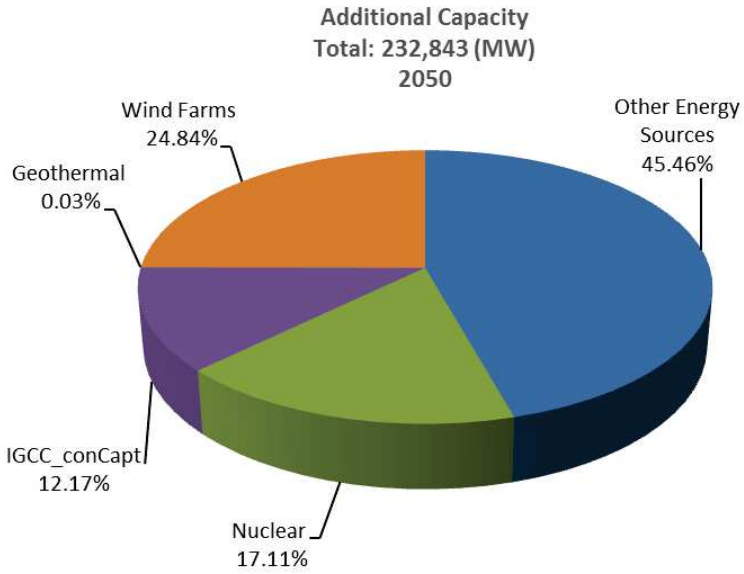


Nuclear Power Programme

- ✓ In addition to the above, in 2013 the National Institute of Electricity and Clean Energies (INEEL) conducted a study to determine the optimal energy mix that would meet the goals of clean energy in the years 2035 and 2050.

- ✓ In both cases, the results are that nuclear power is necessary in the national electrical system with more than three reactors.

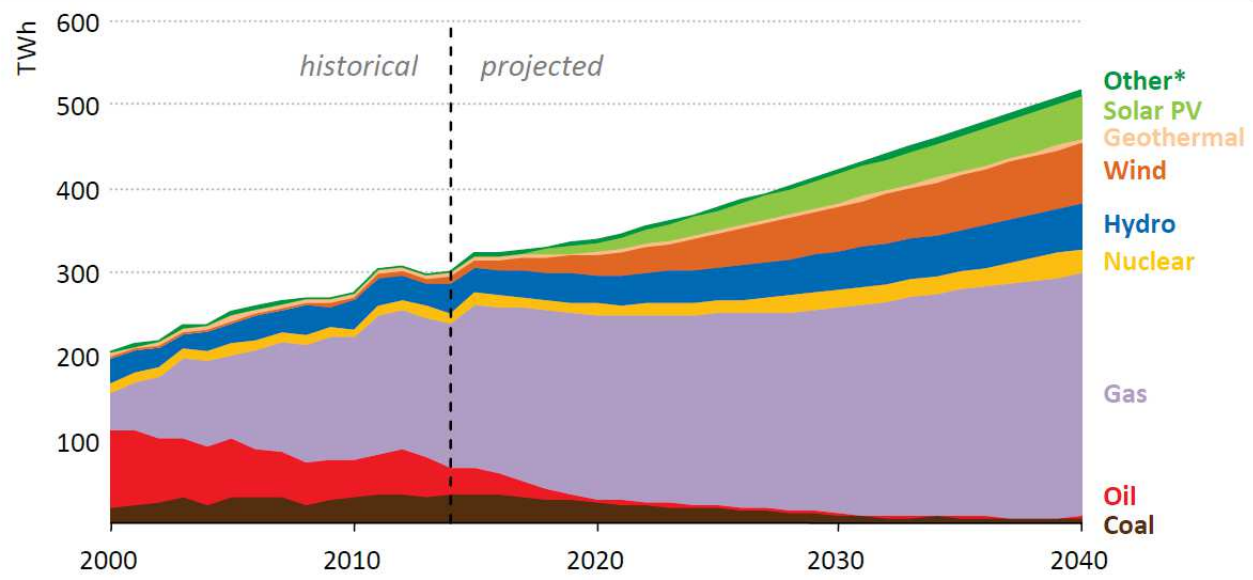




Model based on middle fuel prices

Electricity Outlook to 2040

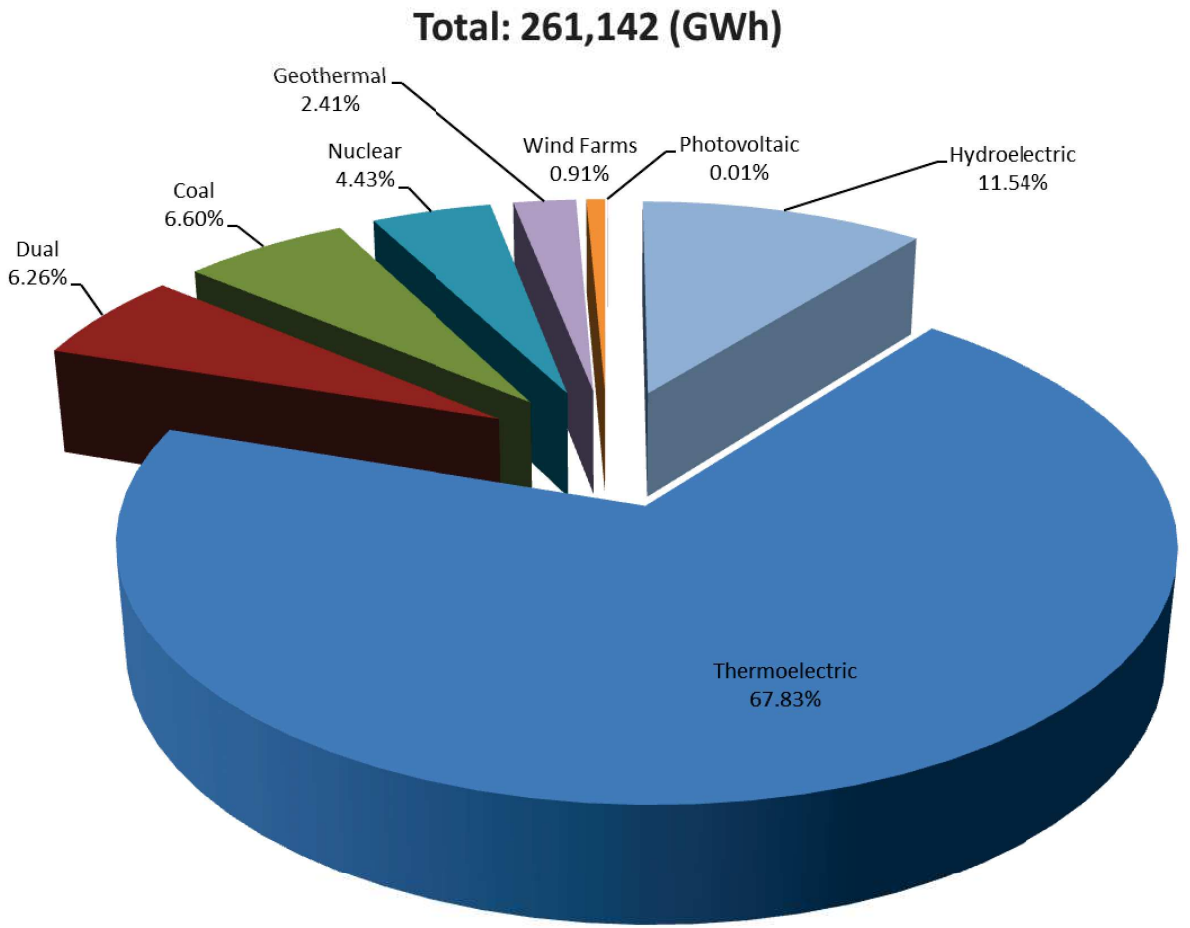
- ✓ Power generation in Mexico rises to more than 500 terawatt-hours (TWh) in 2040, at an annual average growth rate of 2.1%
- ✓ Gas remains the dominant source of power, accounting for around 60% of total electricity generation over the projection period



The power generation mix in Mexico becomes steadily more diverse and less carbon-intensive in the New Policies Scenario

- ✓ Contribution of wind energy grows from 6.4 TWh in 2014 to 71 TWh in 2040
- ✓ While that of solar PV jumps from 0.2 TWh in 2014 to 52 TWh in 2040

Power Generation 2015



Nuclear Policy

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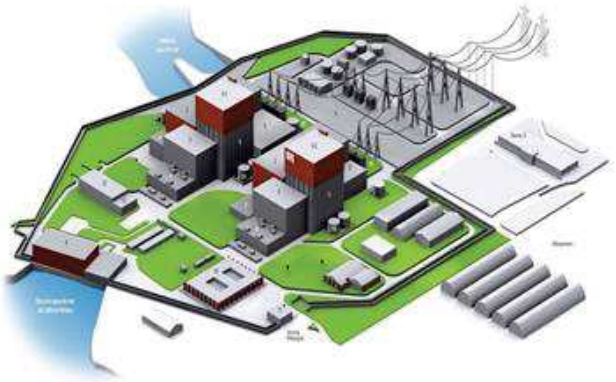
- ✓ To promote the safe, secure and sustainable development of nuclear energy
  - ✓ Strengthening of the nuclear regulatory infrastructure
  - ✓ Radioactive waste management (policy, financing and formal entity)
  - ✓ Update of the regulatory legal framework
  - ✓ Strengthening of the nuclear security, security of radioactive sources and non-proliferation
  - ✓ Expansion of the nuclear power programme and extent of the role of nuclear energy in the energy mix
  - ✓ Stakeholder involvement and public communications strategy
  - ✓ Human resources development
  - ✓ Promote fir mining, milling or processing ores containing uranium series

Nuclear Power in Mexico

Laguna Verde NPP

- ✓ Location: Veracruz State
- ✓ Operator: Federal Electricity Commission (CFE)
- ✓ Regulator : National Commission for Nuclear Safety and Safeguards (CNSNS)
- ✓ Two reactors: General Electric Boiling Water Reactor-5
- ✓ Laguna Verde Unit 1 went into commercial operation in July 1990
- ✓ Unit 2 went into commercial operation in April 1995.
- ✓ Net Capacity: 704 MW each one



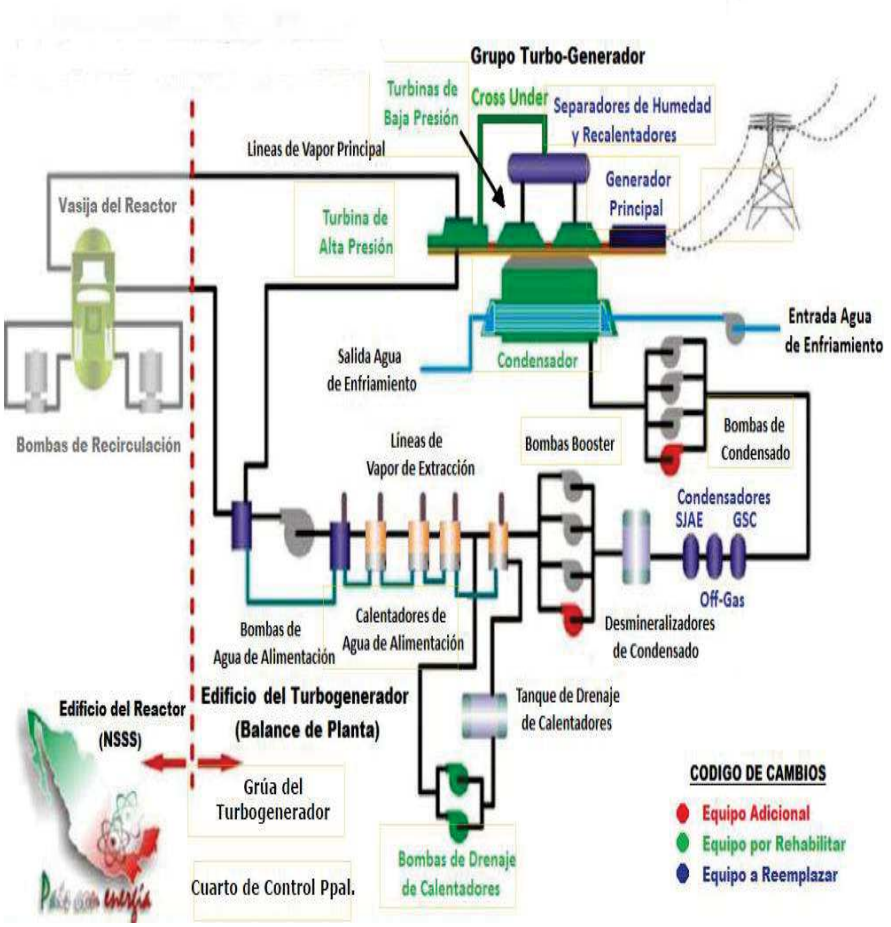
EPU (Extended Power Uprate) Project

- Many nuclear power plants, specially in the United States are turning to the process of increasing their power reactors.

- In 2008, Mexico joined this process through EPU Project
  - Which consisted of the replacement and upgrade of equipment

Power increase in two reactors,
from 704 to 810 (MWe)

The plant capacity is up to 1620 MWe



Nuclear Power in Mexico

Research Reactor

- ✓ Location: Mexico State
- ✓ Operator: National Nuclear Research Institute
- ✓ Regulator : National Commission for Nuclear Safety and Safeguards (CNSNS)
- ✓ One reactors: Triga Mark III
- ✓ Net Capacity: 1 MW (power pulse up to 1500 MW)
- ✓ Training, research and isotope production

Looking Technologies

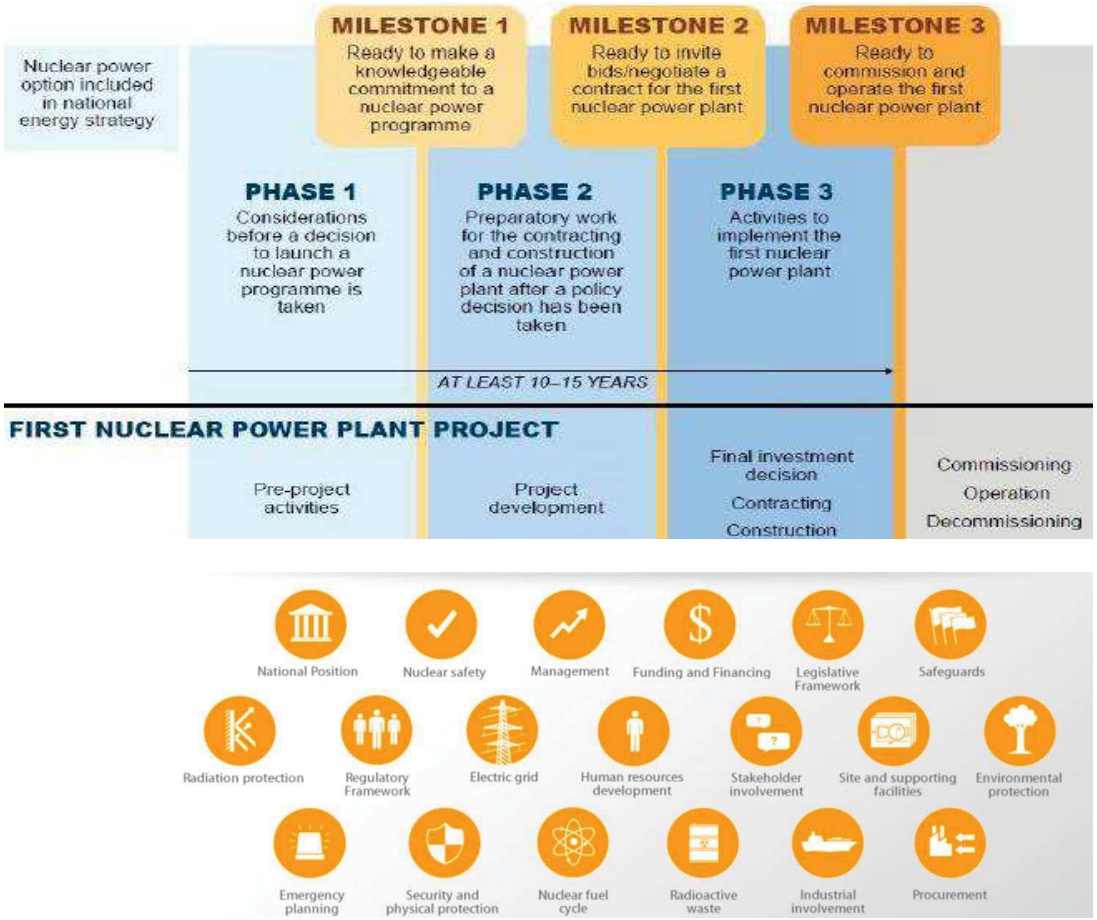
Mexico is evaluating technologies of reactors, with focus in:

- ✓ Operational experience
- ✓ Certification by NRC

Besides we are analyzing financial aspects for the new nuclear projects and the technical requirements for the possible sites.

IAEA Development Programme

Consist in three phases and nineteen issues:



NINETEEN ISSUES

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1. National Position

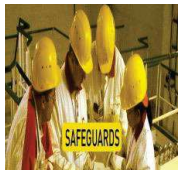
2. Nuclear Safety

3. Management

4.Funding and Financing

5. Legislative Framework

6. Safeguards



7. Regulatory Framework

8. Radiation Protection

KEY INFRASTRUCTURE ISSUES

9.Electrical Grid

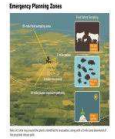
10. Human Resource Development

11.Stakeholder Involvement

12. Site and Supporting Facilities

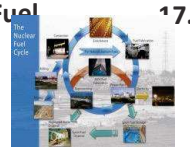
13. Environmental Protection

14. Emergency Planning

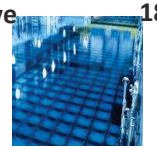


15. Security and Physical Protection

16. Nuclear Fuel Cycle



17. Radioactive Waste



18. Industrial Involment

19. Procurement

Japan – Mexico Relationship

- ✓ Long standing relationship
  - ✓ Treaty of Amity, Commerce, and Navigation concluded in 1888 (Japan's first "equal" treaty with a Western country)
  - ✓ Japan has became the third commercial partner of Mexico (21,500 M USD)
- ✓ Number of Japanese residing in Mexico: 9,437 (October 2015 survey).
- ✓ Population of Japanese descent: approx. 20,000

- ✓ Nuclear Energy
  - ✓ Technically concluded an Agreement of Cooperation on the Peaceful Uses of Nuclear Energy
  - ✓ Development of Human Resources – MoU with JICC
  - ✓ Reactor Technologies
    - ✓ ABWR
    - ✓ APWR
    - ✓ AP100
    - ✓ Atmea

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Thank you!

Alejandro Huerta

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