

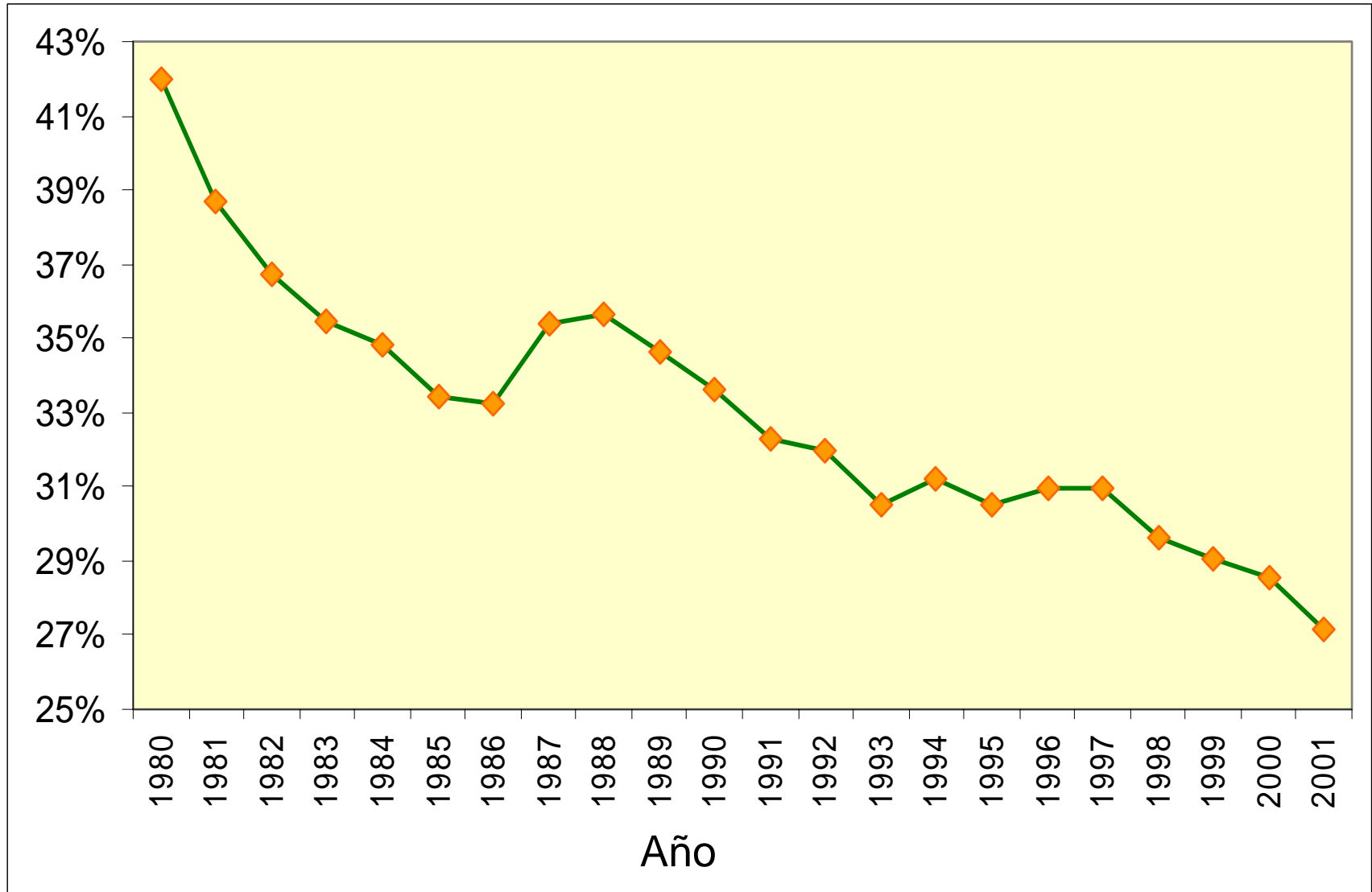
Commission for Environmental Cooperation  
*Building the Renewable Energy Market in North America*  
Montreal, Canada, 28–29 October 2004

# Renewable Energy in Mexico: Is Regulatory Change Enough for Market Entry?

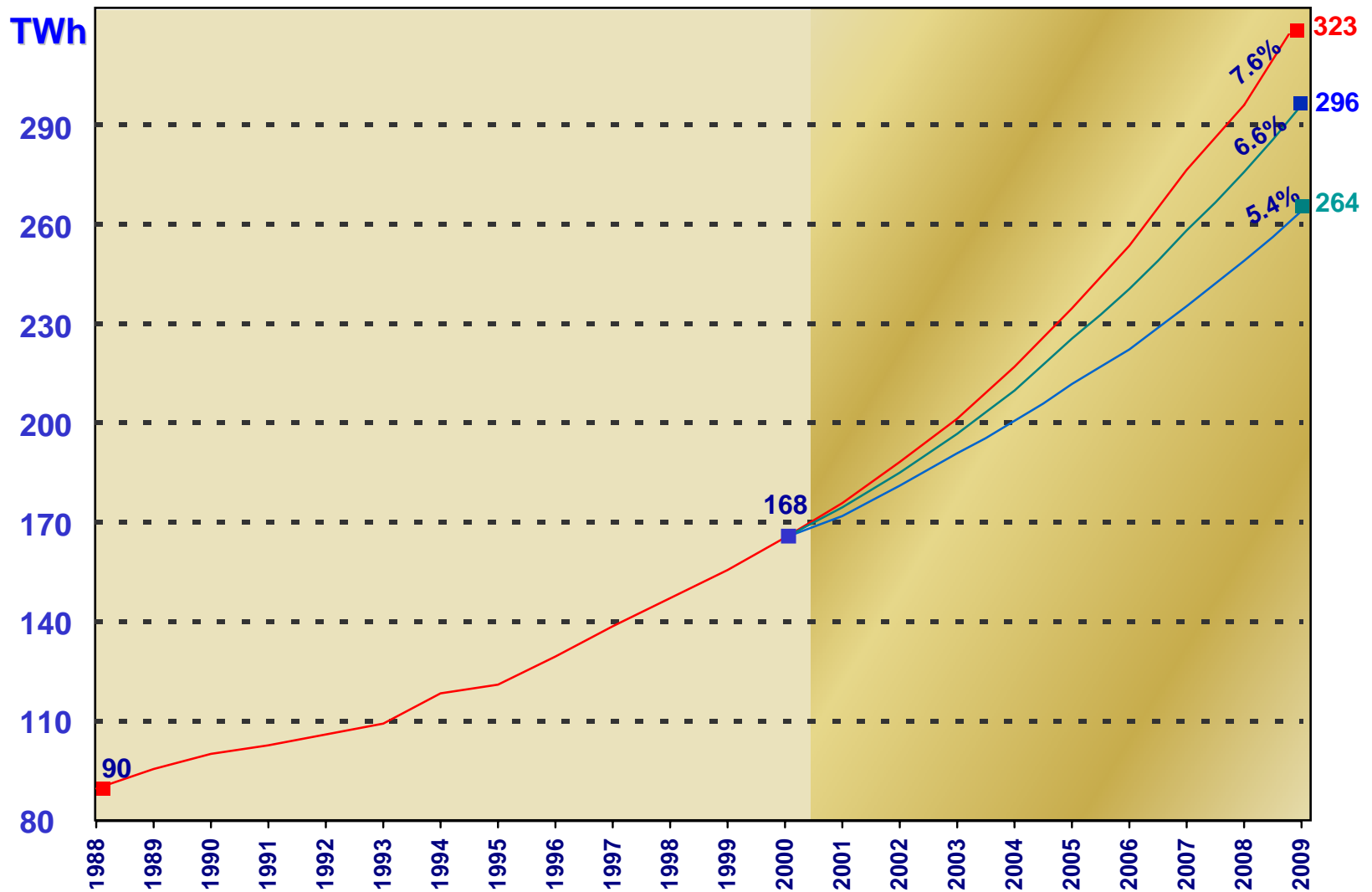
**Jorge M Huacuz**  
Non-Conventional Energy Unit  
Alternative Energy Sources Division  
Electrical Research Institute  
IIE

Nine premises leading  
(hopefully) to one conclusion

# Premise 1: Oil Fuels the Mexican Economy (Decreasing Trend of Renewables in the Power Sector)



# Premise 2: A Growing Need for Power (Expected Electricity Demand 2000-2009)



# Premise 3: The Mexican Power Sector

## Still growing, but also ageing

**Total Current Generating Capacity: 45,600 MW**

Two government-owned utilities serve the whole country: 95% grid coverage

**New Power Requirements**

**2003-2012: 20,399 MW**

- **Committed: 6,729 MW**
- **Not Committed: 13,670 MW**

Fossil fuels: 73.84%

Large-scale hydro: 21.05 %

Nuclear: 2.99%

Geothermal: 2.1%

Wind & other renewables: <<1%

Natural gas combined cycle: 27.13%

Other fossil-fuelled: 8.5%

Large-scale hydro/geothermal: 8.1%

Other renewables (wind): 0.49%

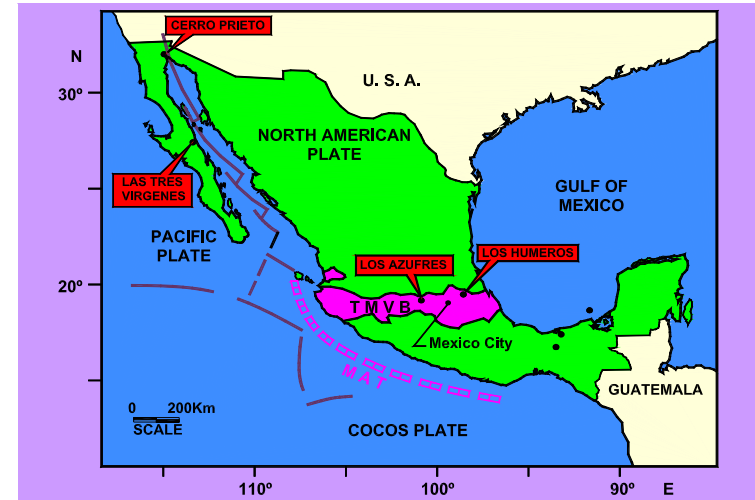
Not defined: 55.78%

# Premise 4: Renewable Energy Resources in Mexico

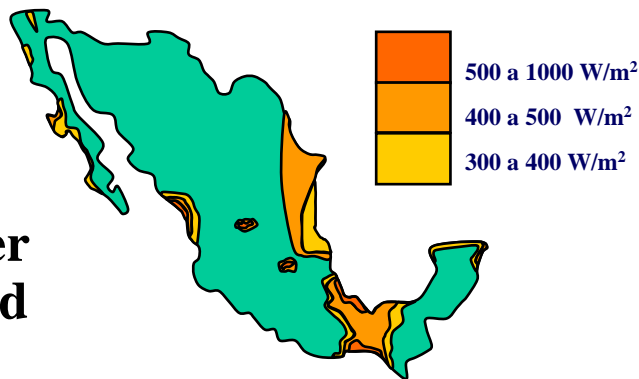
## Diverse & Abundant, but not fully assessed



**Mean solar irradiance:**  
**5 kWh/m<sup>2</sup>-día**  
**Largely available**



**Wind potential:**  
**5,000 MW**  
**Commercially viable now. Larger resource estimated**



### Geothermal Energy

- **Temperature >250°C: >2,000 MWe**
- **Temperature <250°C: >40,000 MWt**
- **Waste hat from geothermal fields: N/Q**
- **Geopressurized fields: N/Q**

N/Q: Not Quantified

# Premise 4: Renewable Energy Resources in Mexico

## Diverse & Abundant, but not fully assessed



### Bioenergy:

- **Total potential: N/Q**
- **Forest residues & energy plantations: N/Q**
- **Agricultural residues and cattle dung: N/Q**
- **Urban residues: ca 1,000MW**
- **Sugar cane bagasse: ca 250MW**



### Micro y mini-hydro:

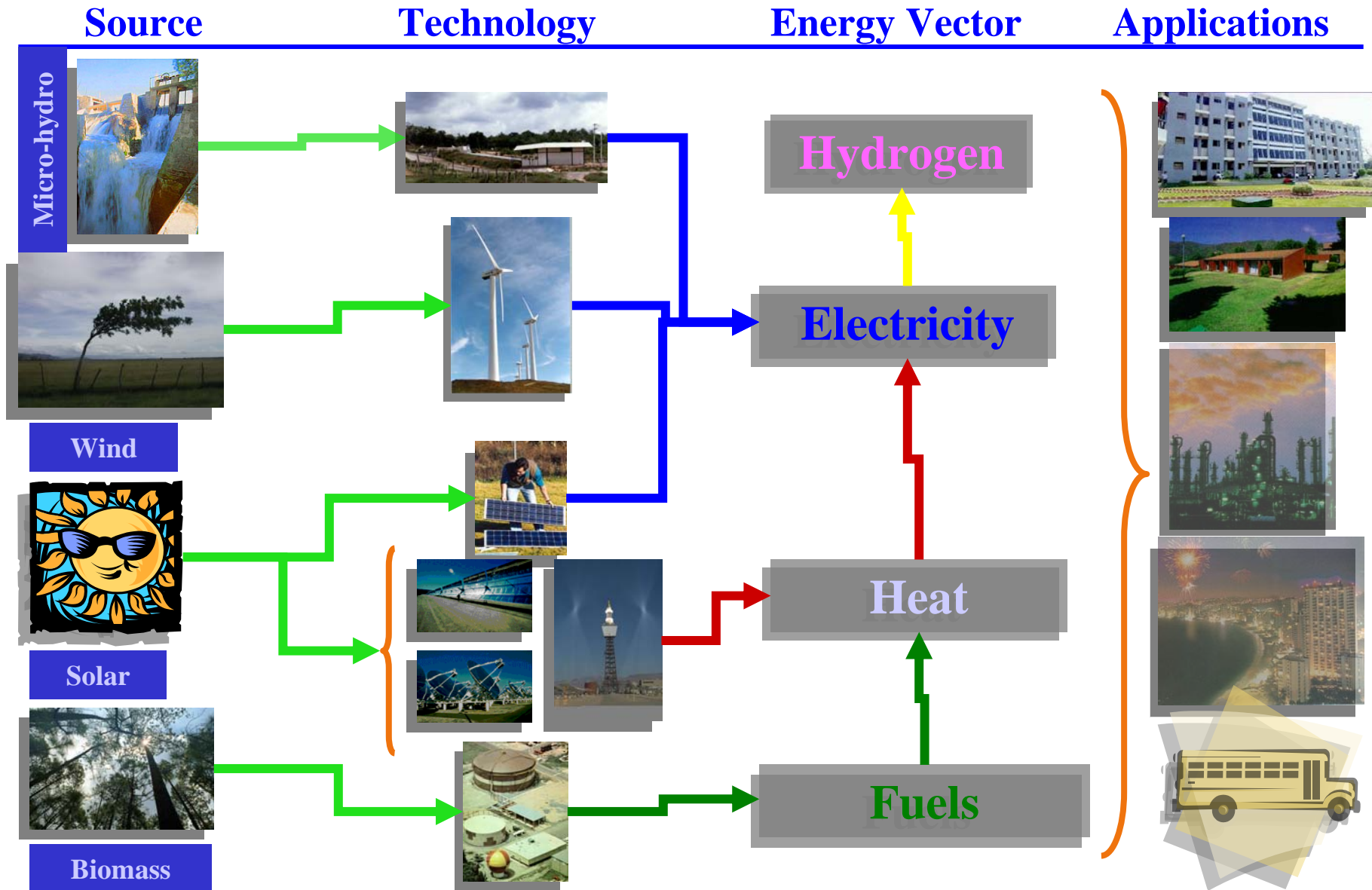
- **Total potential: N/Q**
- **At least 3,500 MW**

**Ocean energy**  
**Total potential: N/Q**  
**11,000 km coastline**



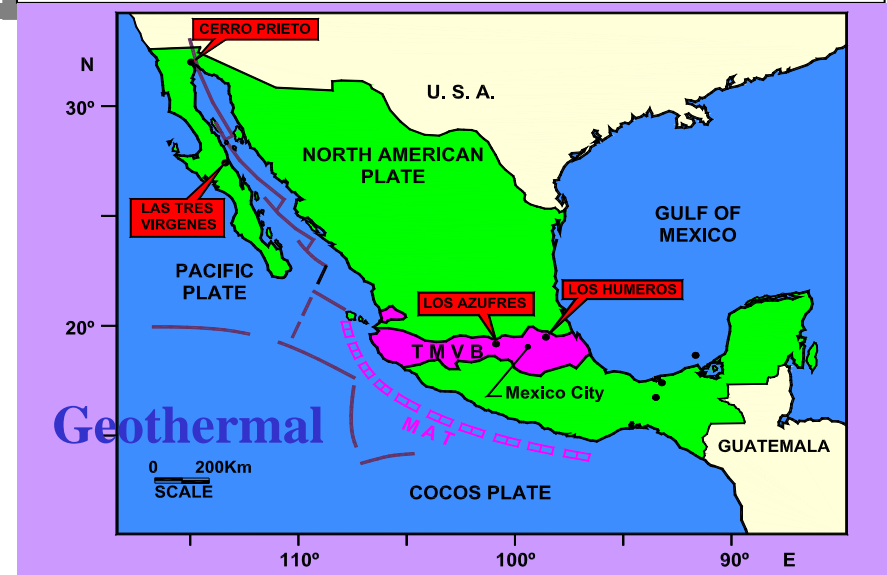
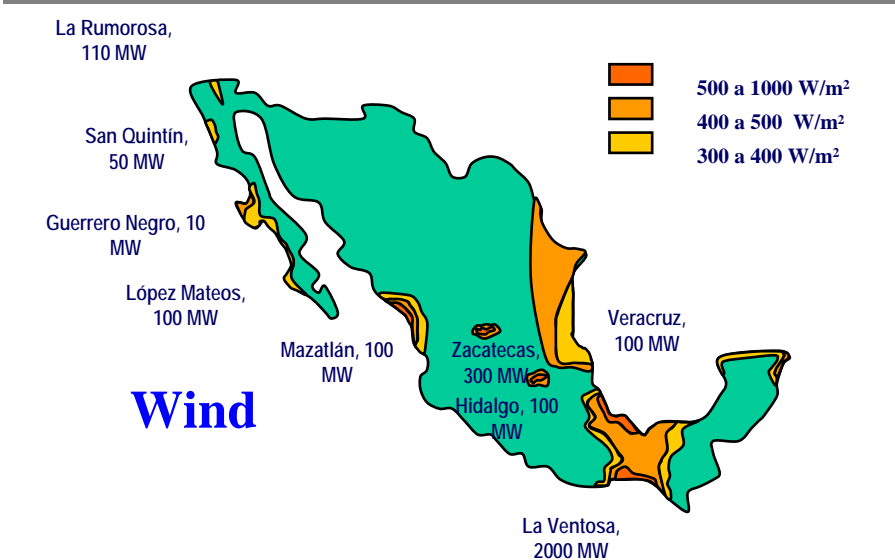
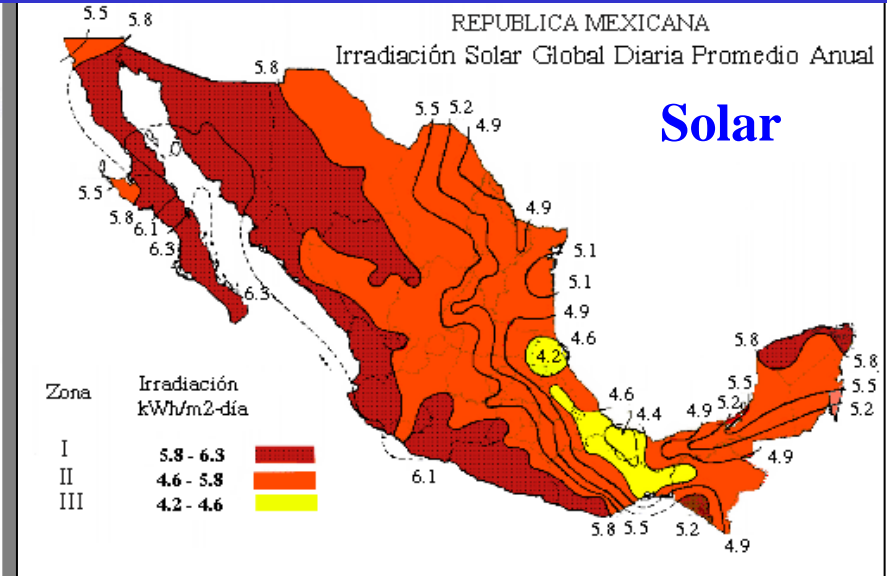
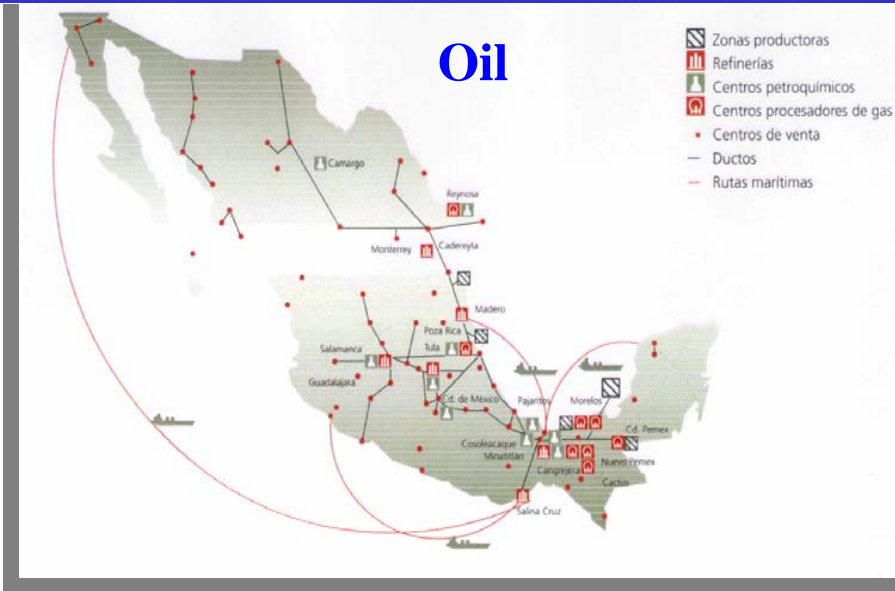


# Premise 5: Large number of technology options A hard choice for decision makers





# Premise 6: Renewable energy resources are disperse Energy planning is centralized



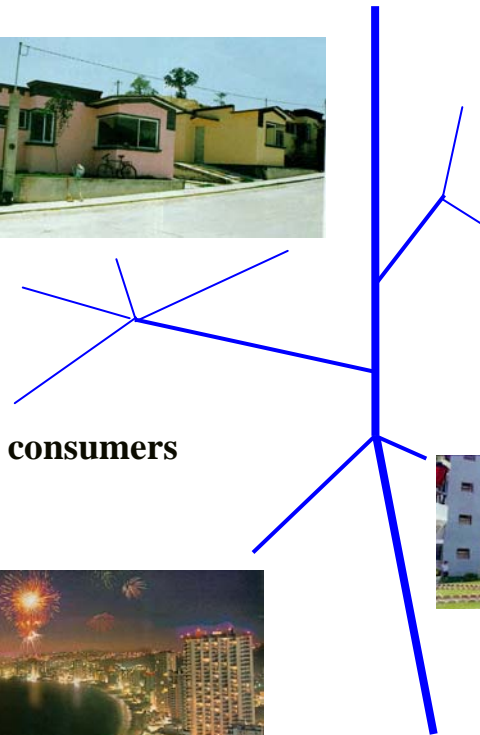
# Premise 7: The concept of the electric system is evolving

## Current Concept

Centralized, based on cost



Central generating station



consumers

## Emerging Concept

Disperse, based on value



Central generating station



gensets



Fuel cells



Efficient use

batteries

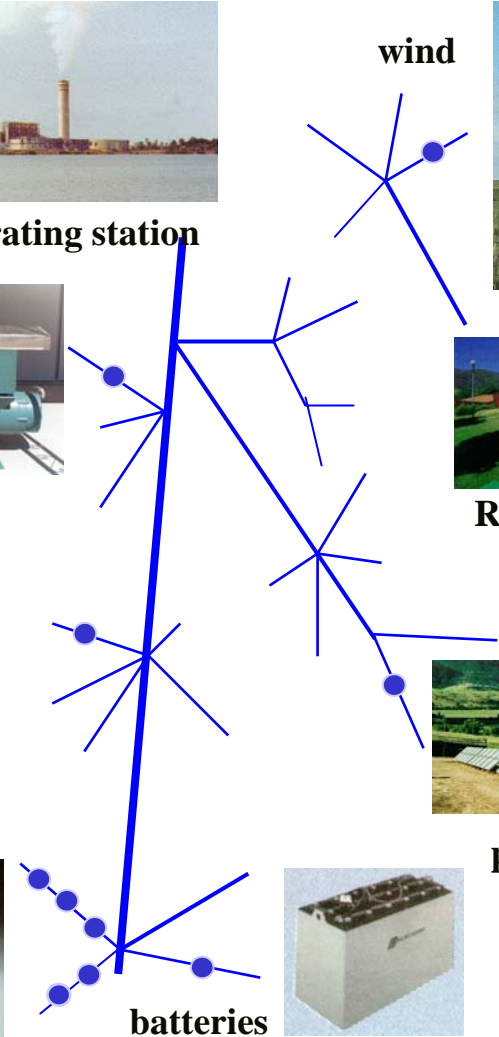
wind



Remote loads



photovoltaics



## **Premise 8: Strong emphasis on market creation Too little effort on local capacity building**

The realities:

- Limited human resource base
  - For project identification and development
  - For systems engineering and construction
- Basically no RE industrial infrastructure
- Very few technological stocks

**Premise 9: Growing number of RE promoters in Mexico  
Less coordination & cooperation than desirable**



# Current Legal and Regulatory Framework for Renewable Energy in Mexico

# Public Electric Service Law

- **Self supply**
    - ✓ Electricity produced to satisfy the generator's own needs.
    - ✓ No sell to third parties allowed.
    - ✓ Creation of self-generating companies with third parties allowed.
    - ✓ Surplus electricity can be sold to the grid
    - ✓ Electricity swaps with the national utility allowed
  - **Co-generation**
    - ✓ Joint production of heat and electricity
    - ✓ Production of electricity from waste heat
  - **Independent power production (IPP)**
    - ✓ Electricity generation with no capacity limits
    - ✓ For sell to CFE only
    - ✓ In compliance with CFE's expansion plans
    - ✓ Bidding for least energy cost (US\$/kWh)
  - **Electricity for export**
- } For self-supply only

# Legal, Institutional and Policy Issues

- **Renewables not considered “national assets” by Constitution**
- **Direct sales to CFE on \$/kWh basis, not always competitive**
- **Distributed green power, at odds with “bigger is better” paradigm:**
  - Main concerns** {
    - Intermittency**
    - Power quality**
    - Safety**
    - Cost**
- **Regulatory framework needs to improve**
- **Oil availability, a “mental brake” for change**
- **Long administrative red tape for new projects**



# Interconnection Contract for Intermittent Energy Sources

- **Dispatch.** Subject to energy availability with the following provisions:
- **Electricity Swaps.** Based on *Total Short Term Cost* (Dispatching Cost)
  - Between equal hourly periods
  - Between different hourly periods
  - Between different months along one year
  - Payment for energy not consumed
- **Emergency Energy.** 1.5 times the applicable tariff
- **Complementary Energy.** Under contract only
- **Ancillary Services.** Proportional to plant capacity factor

# Swapping Rules

- **One-to-One** compensation between *homologous hourly periods*
- Compensation between *different hourly periods* according to:

$$ES_P = X_S ES_S = X_i ES_i = X_b ES_b$$

*ES = Surplus Energy*

*X = Compensation Factor*

$$ES_{pmcomp} = \frac{CTCP_{imgen}}{CTCP_{pmcomp}} * ES_{imgen}$$

$$ES_{imcomp} = \frac{CTCP_{pmgen}}{CTCP_{imcomp}} * ES_{pmgen}$$

$$ES_{pmcomp} = \frac{\$300MWh}{\$400MWh} * 2000MWh$$

$$ES_{imcomp} = \frac{\$400MWh}{\$300MWh} * 2000MWh$$

$$ES_{pmcomp} = 1500MWh$$

$$ES_{imcomp} = 2667MWh$$

*mgen = month when electricity is generated*

*mcomp = month when needed electricity is compensated with surplus electricity*

## Other pending issues for the short term

- Extension of interconnection contract to non-intermittent RE sources
- Awarding capacity credits to wind farms
- Net-metering for small photovoltaic projects
- Land ownership rights for project development
- Electric wheeling capacity at potential project sites
- Ad hoc regulation and permitting procedures

# Niches of Opportunity

		SECTOR OF THE ECONOMY				
TECNOLOGY		POWER	MUNICIPAL	INDUSTRIAL	WATER	RURAL/AGRO
O P P O R T U N I T I E S	Solar Thermal	Bulk power		Co-generation	Desalination, Cleaning & disinfection	
	Solar Photovoltaics	Peak-shaving & grid support	Public lighting, signaling	Cathodic protection, remote control, alarms, telecommunication.	Weather stations, remote control, telecommunic ations	Rural electrification, tele-education
	Wind	Bulk power, optimal hydroelectric dispatch.	Self generation for municipal services	Self generation	Pumping	Water pumping, grain grinding
	Biomass	Bulk power from energy plantations	Trash-to-energy, biogas from water treatment plants	Bulk power from energy plantations	Biogas and electricity from water treatment plants	Biogas and electricity from cattle manure
	Small Hydro	Distributed generation	Self generation for municipal services	Self generation	Retropumping	Mini-grids & productive uses

# **In conclusion**

- **Large potential for green power in Mexico**
- **Technical and non-technical changes required to tap this potential**
- **Strategies to remove barriers need to be developed and implemented**
- **Capacities to identify and tap niches of opportunity need to be developed**
- **Mechanisms to level the playing field for renewables must be introduced**
- **Effective coordination among stakeholders, necessary**
- **New energy culture must be fostered.**

# Electrical Research Institute (IIE)

An aerial photograph of the Electrical Research Institute (IIE) campus. The image shows several large, multi-story buildings with red-tiled roofs, interspersed with lush green trees and landscaped areas. A winding road is visible on the right side of the campus. The overall scene is a well-maintained institutional or research facility.

[www.iie.org.mx](http://www.iie.org.mx)

*Thank you.....*