

# **Perspectives on the electricity sector and reform in Mexico**

**Juan Rosellón**

Carreón, Jiménez and Rosellón, [The Mexican Electricity Sector: Economic, Legal and Political Issues](#) , Stanford Institute for International Studies, Stanford University (forthcoming, Cambridge University Press).

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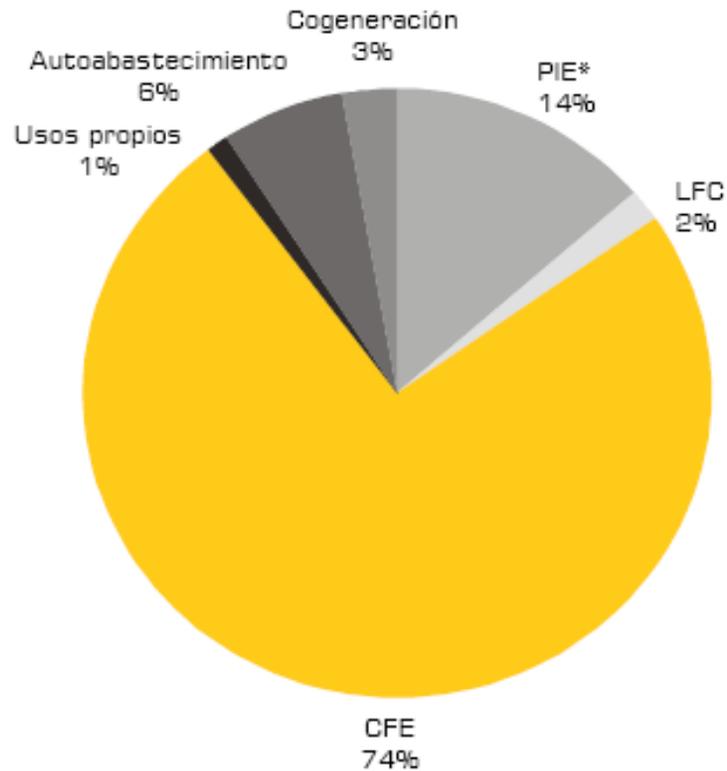
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# How is electricity produced in Mexico ?

Gráfica 13  
Capacidad efectiva de la generación en México, 2003  
49,672 MW



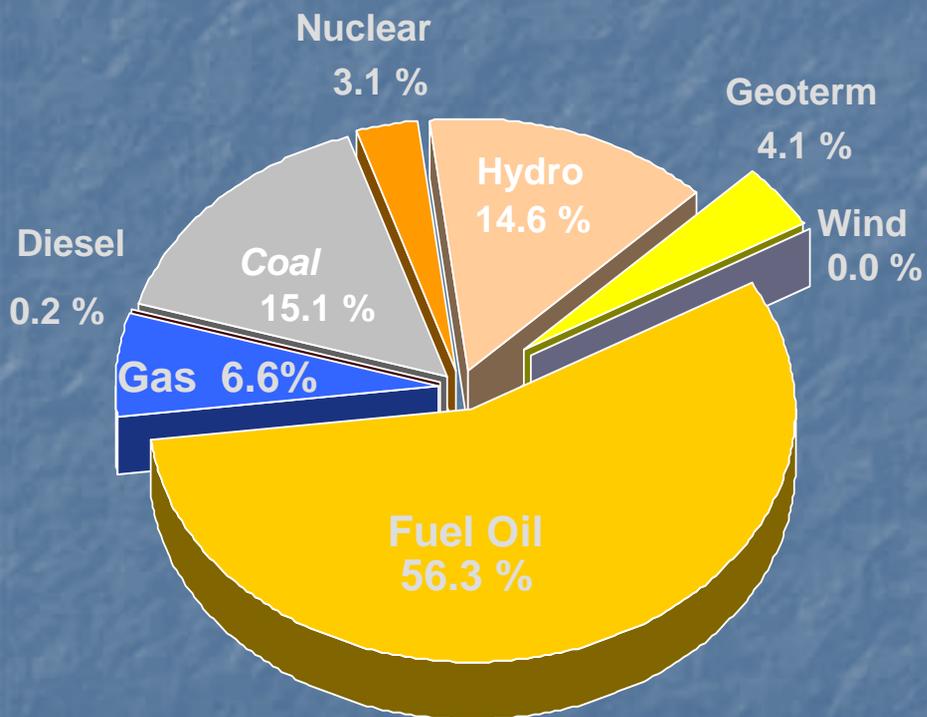
\*/ Considera la capacidad efectiva neta contratada por CFE.

Fuente: Comisión Federal de Electricidad y Comisión Reguladora de Energía

# Increase of Natural Gas for Electricity

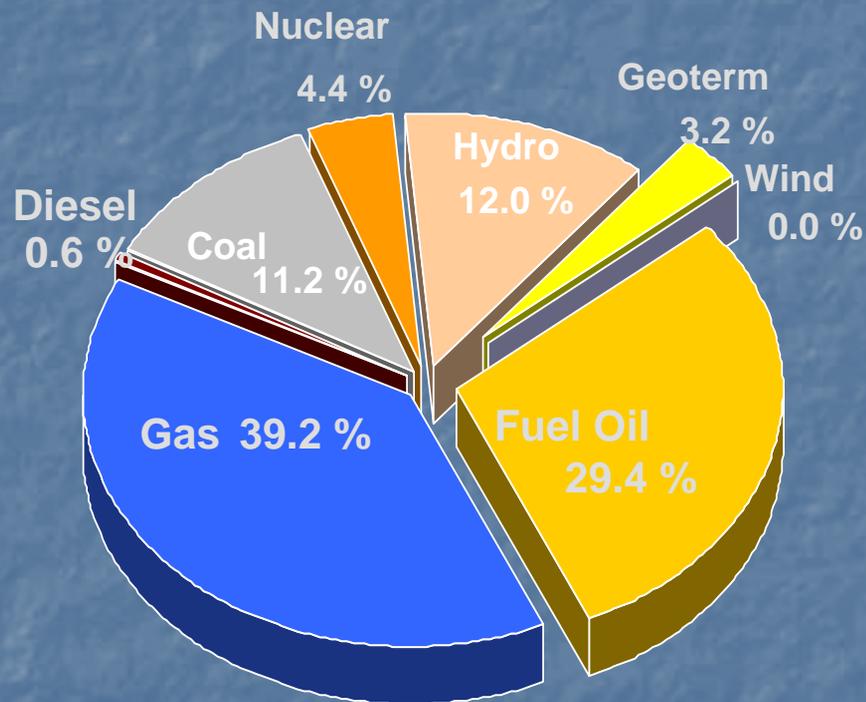
**1994**

137,538 GWh

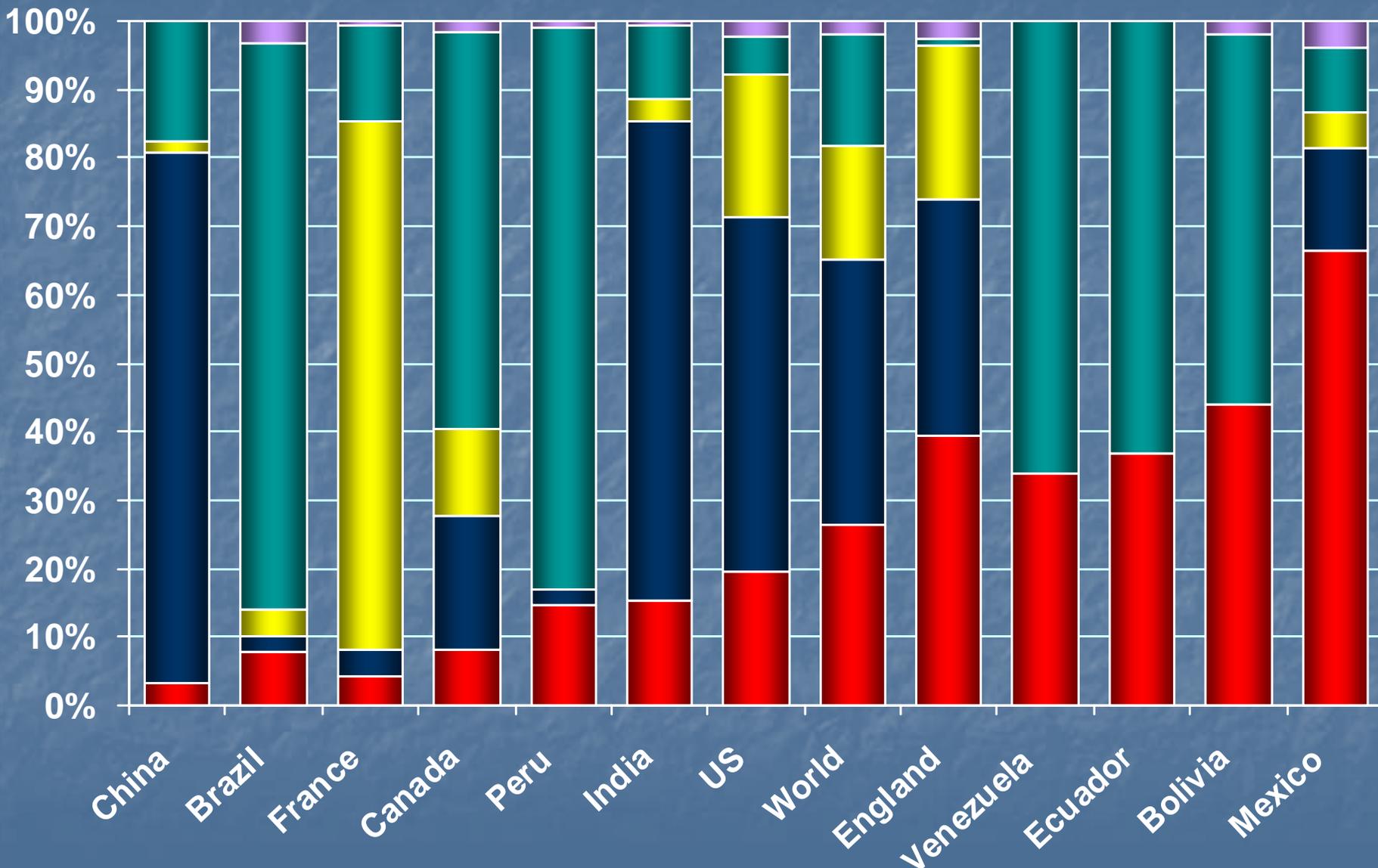


**2004**

<sup>1/</sup> 208,634 GWh



# Electricity generation by source type, 2002



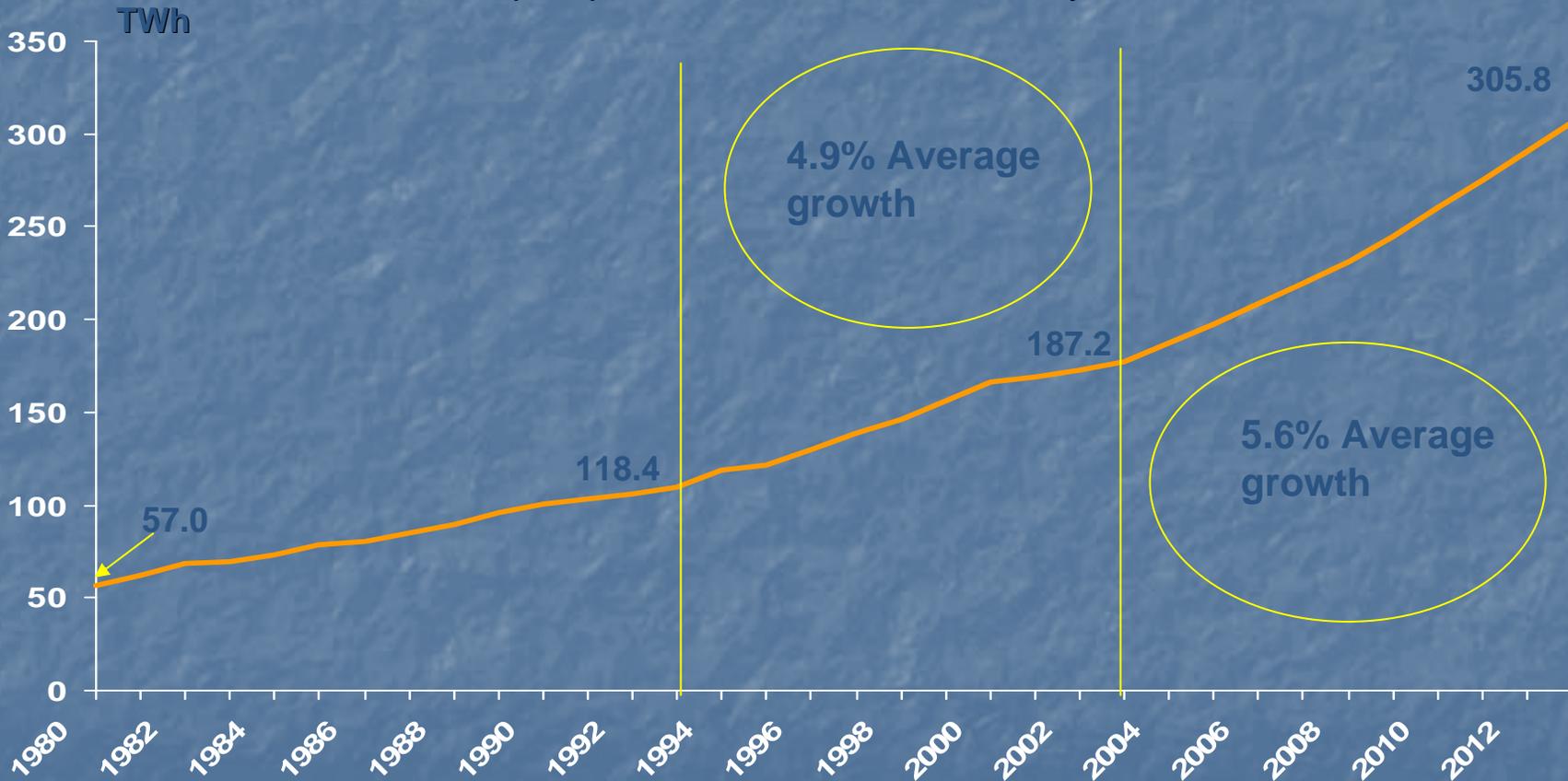
\* / 2003 data

Source: OECD and CFE

■ Hydrocarbon 
 ■ Coal 
 ■ Nuclear 
 ■ Hydro 
 ■ Other

# Electricity demand grows at a greater pace than the economy

Evolution and prospective increase of electricity demand in Mexico



Does not include self-supply generation, transmission losses and exports.

Source: SENER, Prospectiva del sector eléctrico 2004-2013.

# Supply

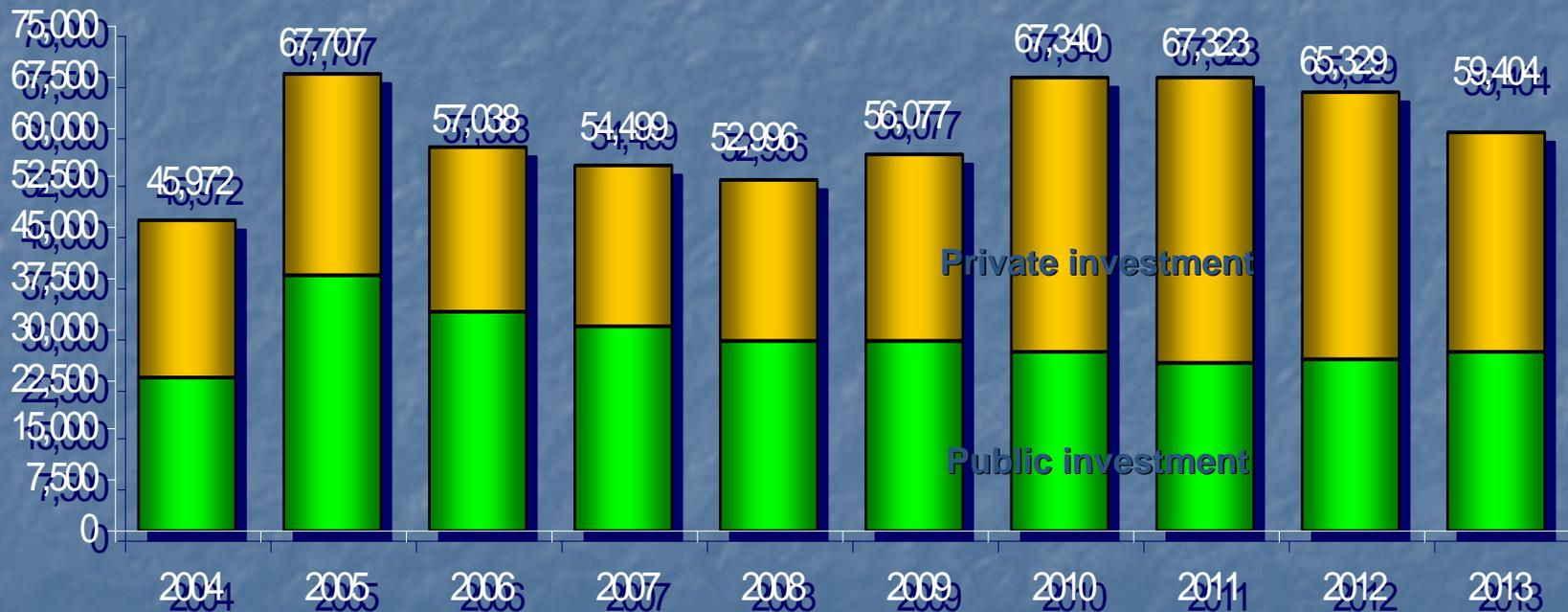
- Most of the total capacity (about 41 GW in 2002) is supplied by hydroelectric and conventional steam plants fired mainly with oil (23% and 42% of the total, respectively).
- Combined cycle generation accounts for only 18%, although these plants are the newest. About 44% of the generating power plants are at least 30 years old.
- About 90% of the 18,700 MW of new capacity scheduled to open by 2006 is gas-fired combined cycle. By 2011, half of Mexico's expected total generating capacity of 64,000 MW will be gas fired
- In total, from 2003-2011, the expected investment cost USD \$60 billion, with about 40% for generation, 24% for transmission, and 21% for distribution.
- Of this total, the Ministry of Energy envisions private sector investment schemes will contribute USD \$39 billion.
- The (smaller) requirements in the public sector will still impose a strain on the budget and could divert resources from other social priorities (education, social security, or poverty relief).

# The national electricity sector requires large investments in order to satisfy demand growth

Investment requirements in the electricity sector 2004-2013\*

Total accumulated investment:  
593 billion pesos

Million of pesos 2004



\* Includes CFE y LyFC

Source: SENER, Prospectiva del sector eléctrico 2004-2013.

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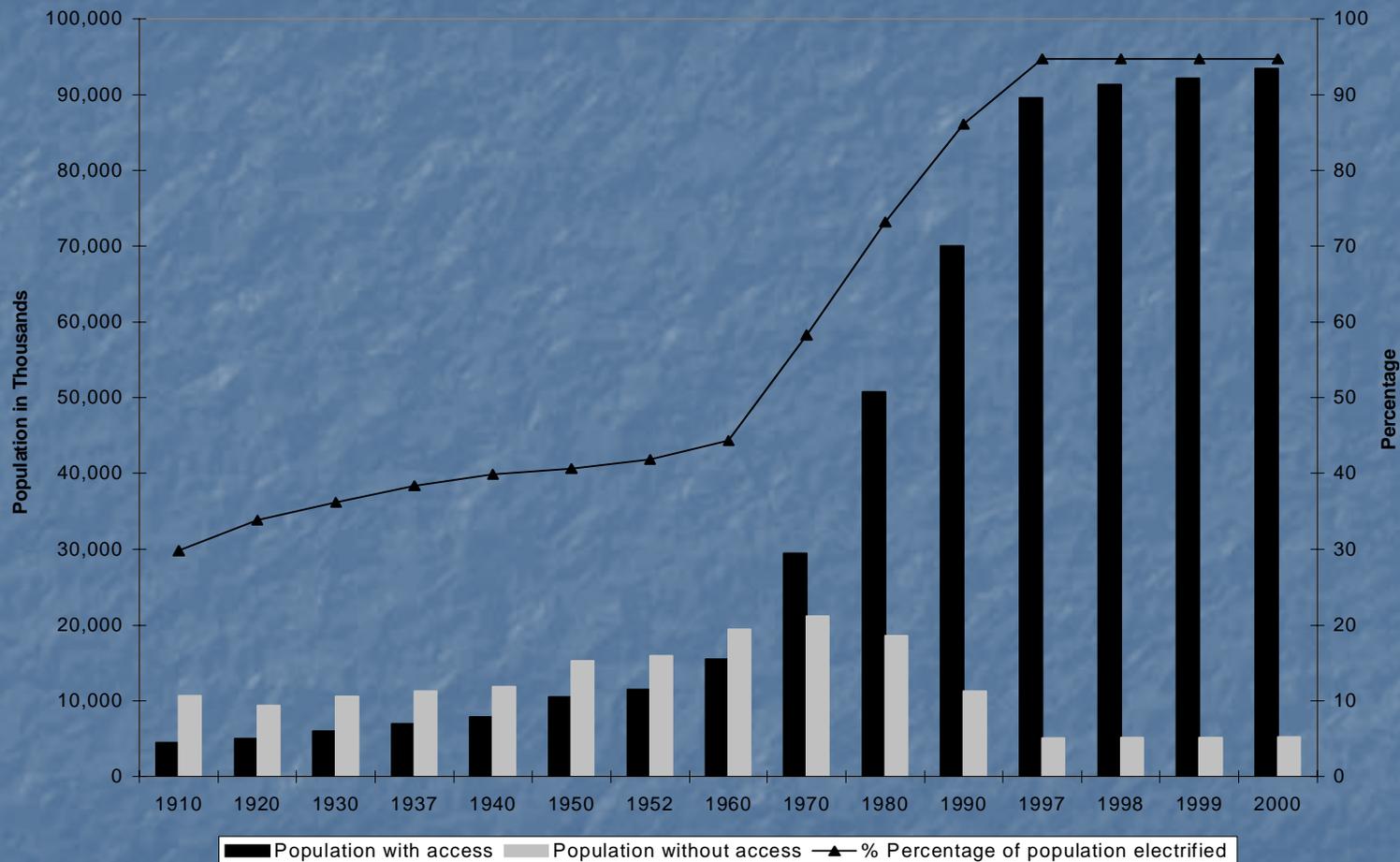
# Evolution of the Mexican legal framework

- (1890-1926) Birth of the industry, there is only private participation.
- (1939-1960) Both the State and private agents participate in electricity generation.
- (1960-1992) Private participation is restricted to self-supply projects.
- (1992- to date) The State dominates the electricity industry but with help of IPPs, cogeneration and self supply.
- (1999, 2000) Several proposals (including Zedillo's and Fox's)

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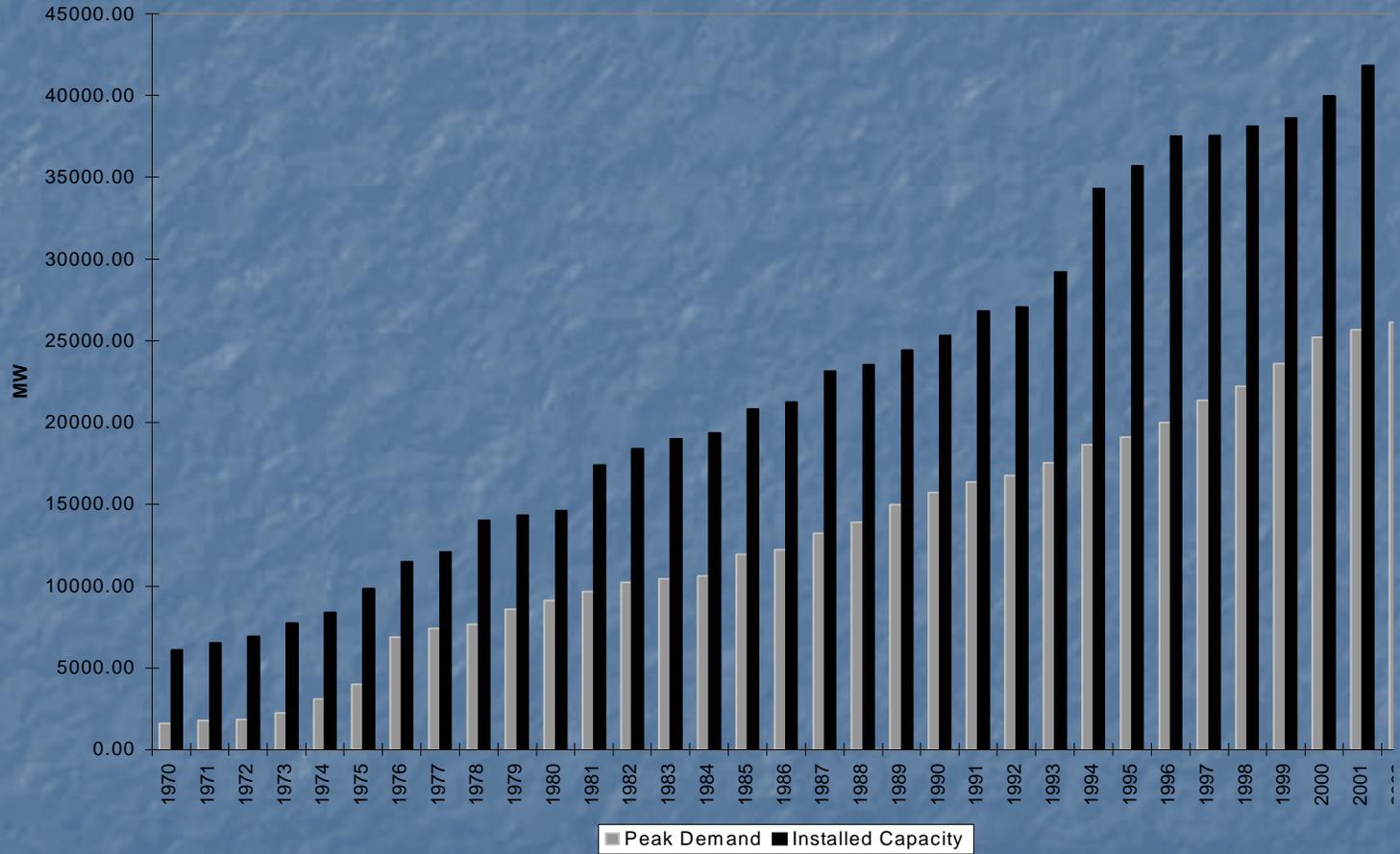
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**Figure 9: Population with access to electricity**



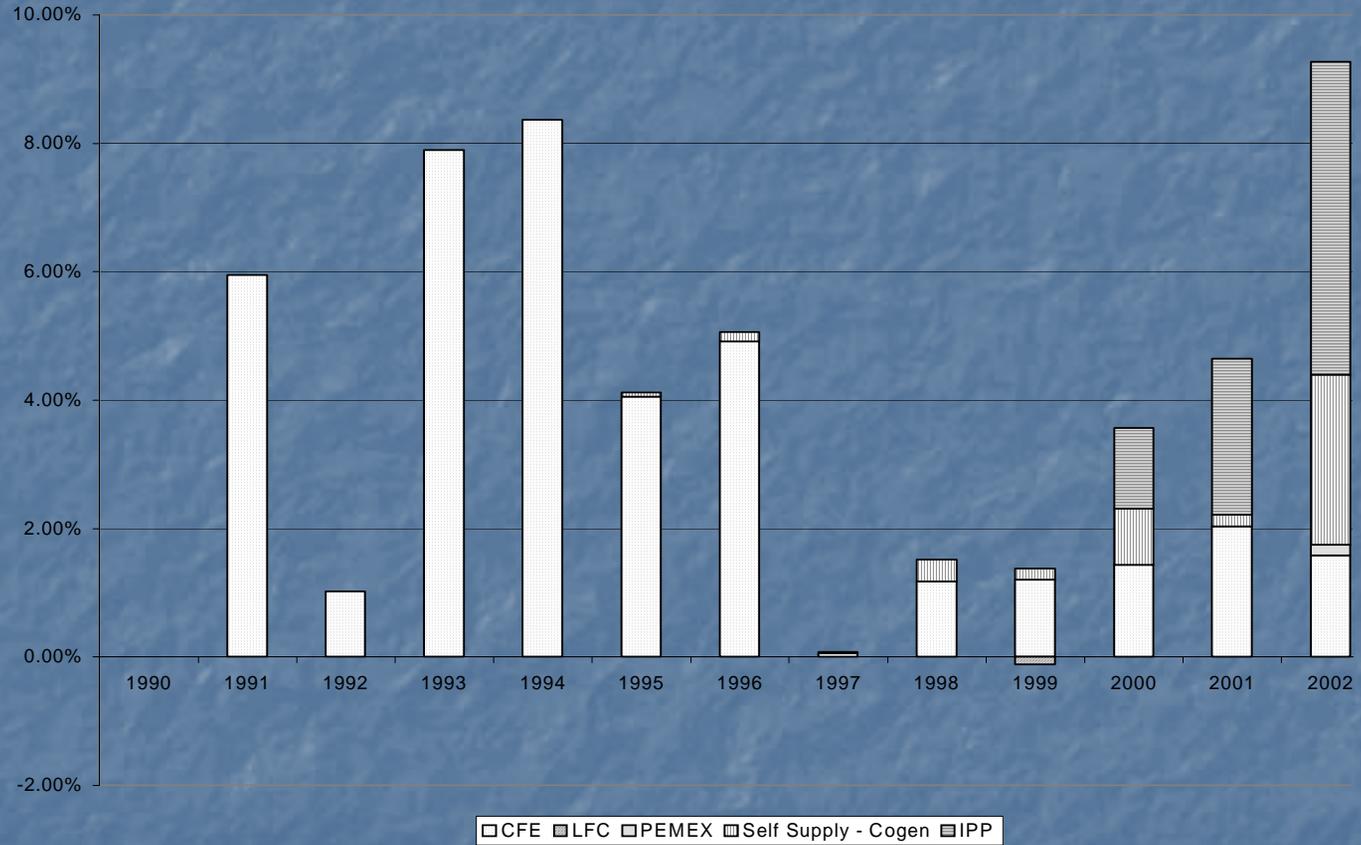
Source: CFE.

**Figure 2: Demand and Generation Capacity Growth**



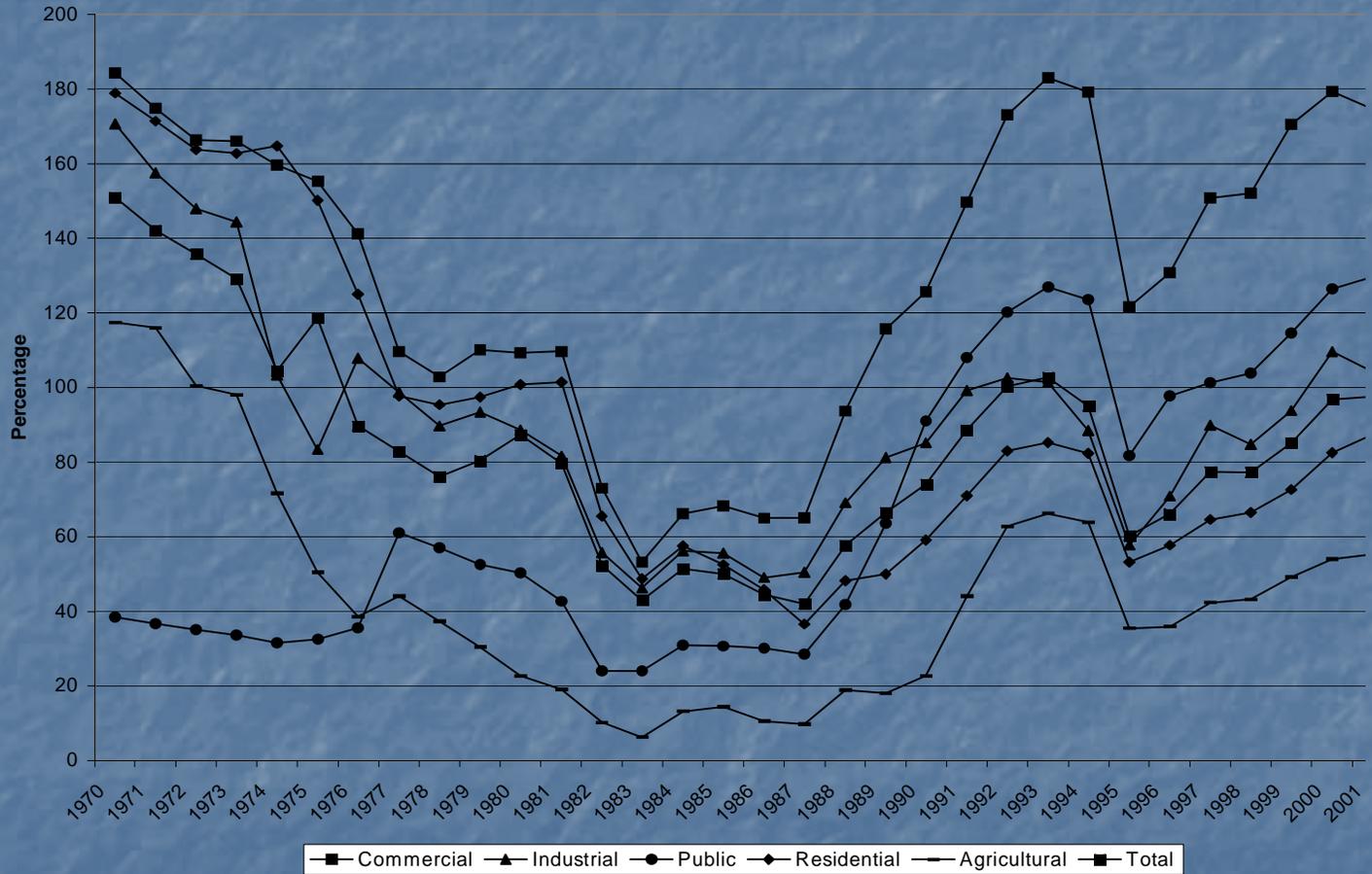
Source: Secretaria de Energia and Comision Federal de Electricidad

**Figure 7: Growth in New Generating Capacity**



Source: Secretaria de Energia and CFE

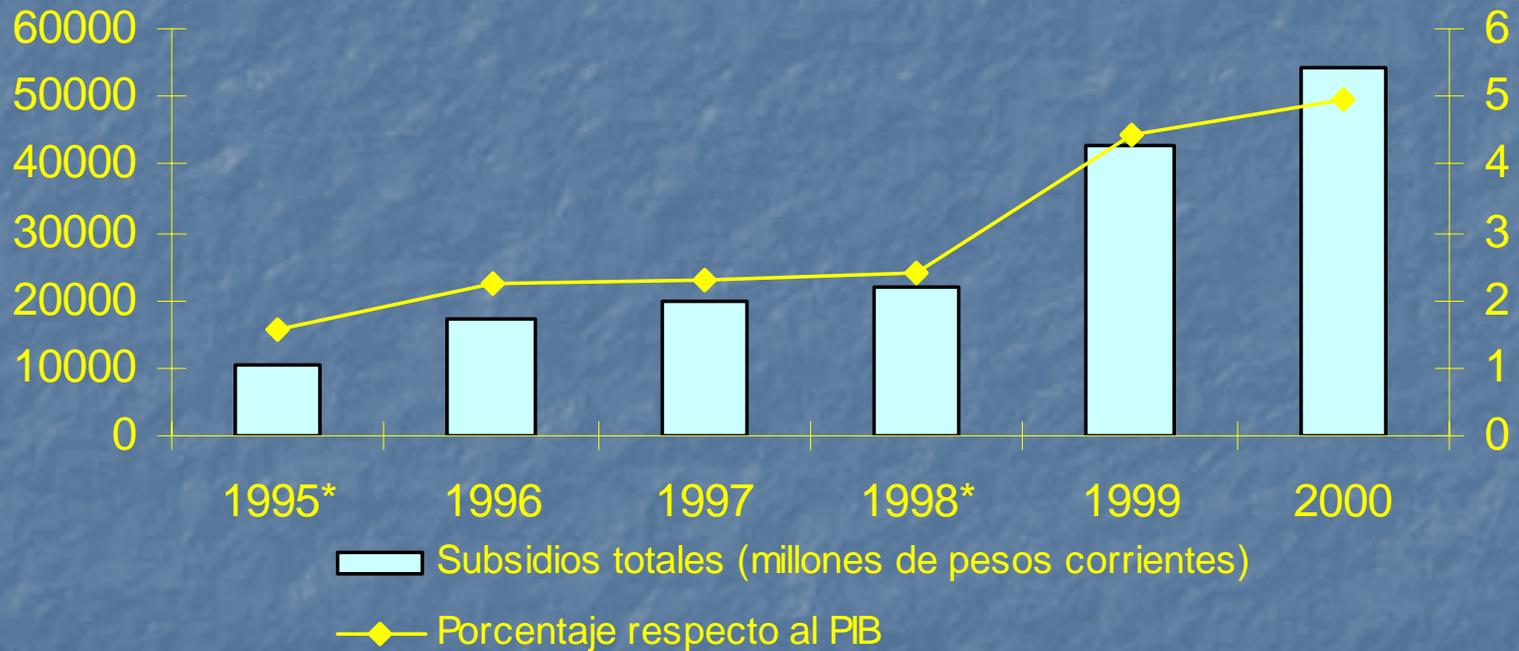
**Figure 4: Mexican Electricity Tariffs as a % of US Tariffs**



Source: CFE – SENER.

# Subsidies

## Evolution of subsidies



# Subsidies

**Table 5: Mexican Electricity tariff/cost ratios**

<i>Consumer Class</i>	<i>1995</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002*</i>
Residential	0.47	0.42	0.40	0.43	0.41	0.41	0.42	0.50
Commercial	1.31	1.16	1.13	1.21	1.19	1.07	1.07	1.05
Public Service	0.88	0.79	0.81	0.94	0.92	0.88	0.90	0.90
Agricultural	0.33	0.28	0.28	0.30	0.29	0.28	0.29	0.30
Medium Industrial	0.88	0.84	0.91	0.92	0.91	0.85	0.87	0.93
Large Industrial	0.81	0.83	0.91	0.90	0.90	0.85	0.83	0.90
<b>Average</b>	<b>0.71</b>	<b>0.70</b>	<b>0.74</b>	<b>0.79</b>	<b>0.74</b>	<b>0.70</b>	<b>0.70</b>	<b>0.74</b>

\* Estimated

Source: Secretaria de Energia

# Subsidies

- Net subsidy of around USD\$5 billion a year
- Subsidies could be more than 1% of GDP (total tax collection, outside the oil sector, is only 10% of GDP).
- The subsidy scheme for residential consumers is regressive
- The poorest 10% group only received 6% of total subsidies, while the richest 30% received more than 35%.
- A new 31-category tariff scheme adopted at the end of 2000 marks a further step at rationalization; still, the residential tariffs remain below cost—implying a subsidy for 98% of users.

# The shadow market

- A “shadow” (or virtual) market implemented by CFE in a nodal fashion since September 2000.
- Nodal prices are determined in the 1,400 nodes of the main transmission grid through the use of a power flow model.
- Merit order rule for generation dispatch in one-day-ahead and real-time market.
- Bids submitted to CENACE by different thermal CFE’s generation plants administratively separated that function as different power producers.
- The distribution companies are also divided into several distribution units.
- A MW-Mile method used to set transmission tariffs for tensions greater than or equal to 69 Kv.

# The shadow market

- Tariffs are calculated as the maximum between “fixed costs plus variable costs” and “operation and maintenance costs”.
- Administrative fixed costs are added to this amount (long-run incremental cost of the transmission network), and allocated among consumers of the current grid and consumers of the future expanded grid according to their impact over the complete network
- Estimation of transmission congestion rents as well as detect main congestion in transmission links. Annual estimated rents arising from congestion amount USD 1.4 billion
- In the Yucatan area a 179 MW generator could make use of its market power in the area due to congestion in transmission links, actually charging USD 2000 per MW electricity price. Similar results are reached for the central and the Northeast areas.

# Flared gas by Pemex

Millions of cubic feet per day



(%)

90.4

92.3

94.0

94.4

96.7

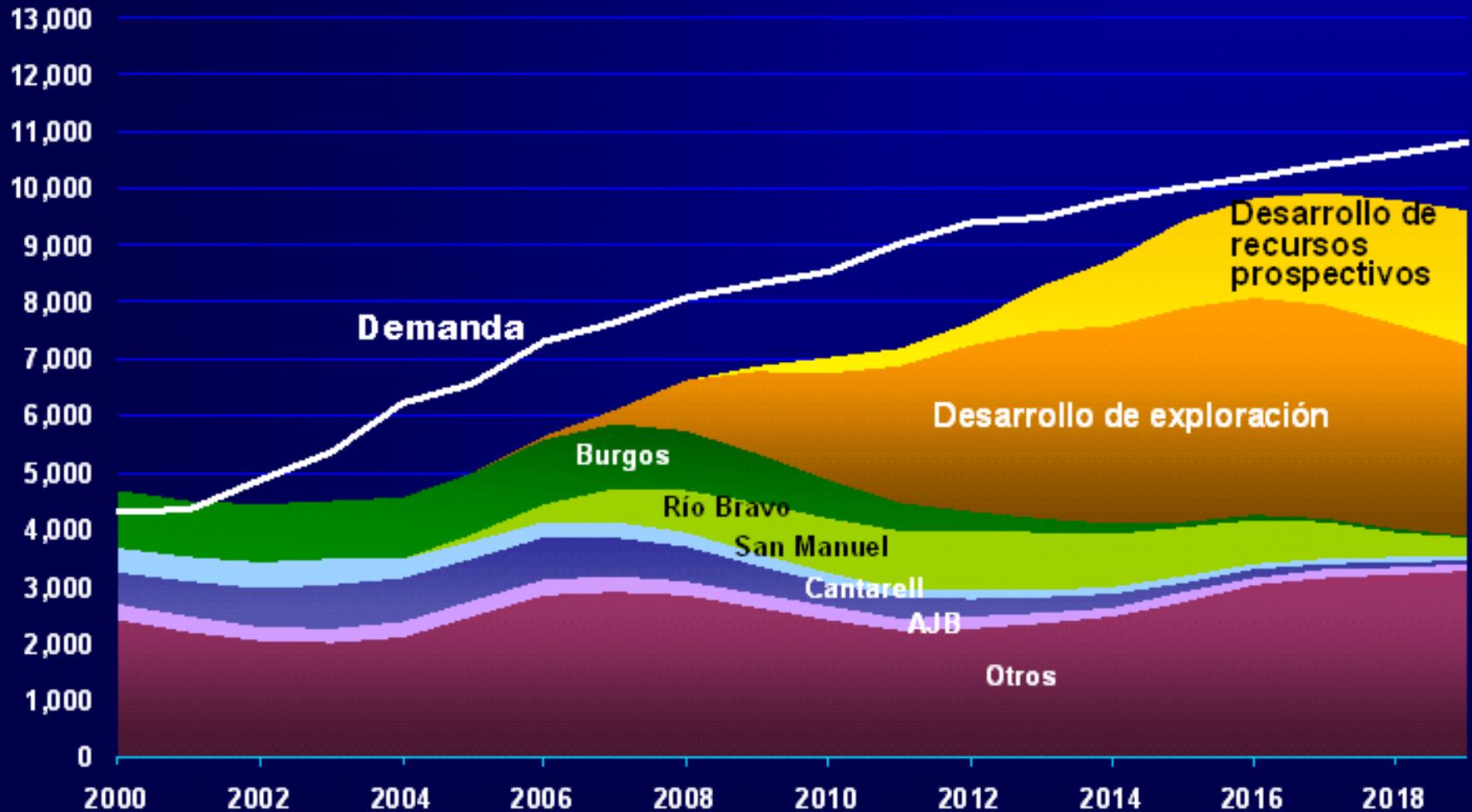
97.6

# Potential LNG projects



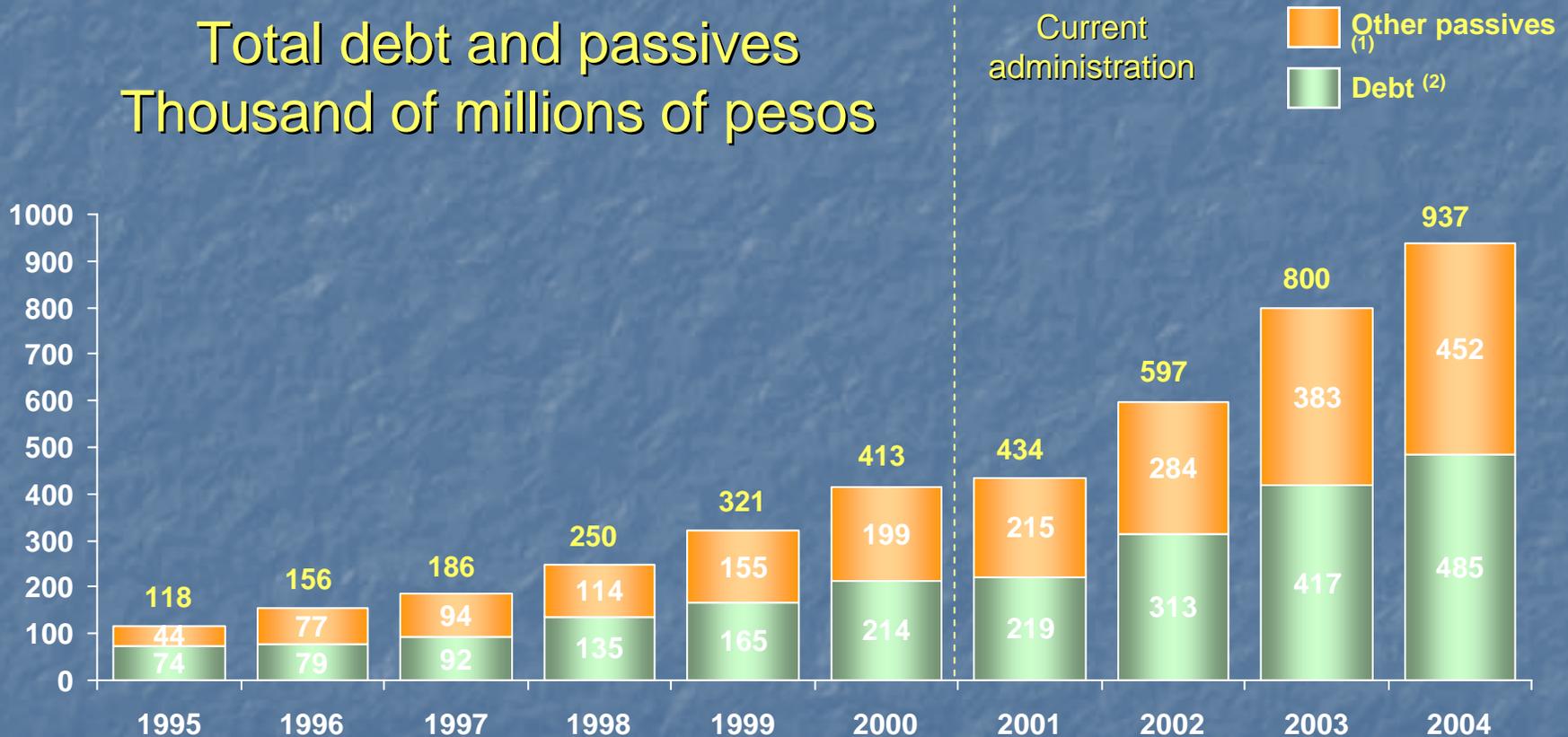
# Third Scenario: growth of gas production (annual investment of USD 15,000 million)

Millions of cubic feet per day



# PEMEX' Debt

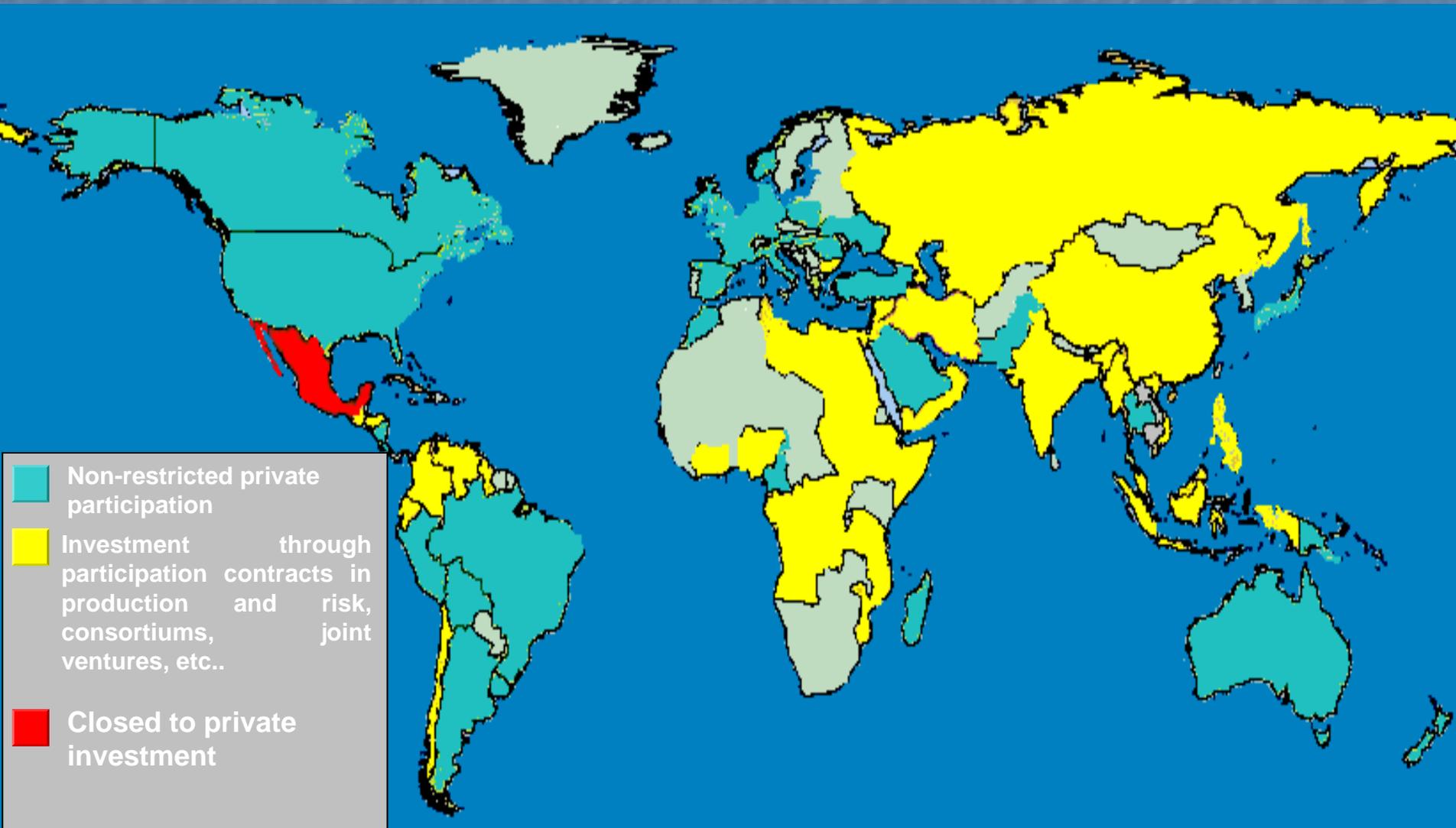
Total debt and passives  
Thousand of millions of pesos



(1) Includes labor debt

(2) Includes documented debt (short and long term), contract receipts, and sales with pending bills.

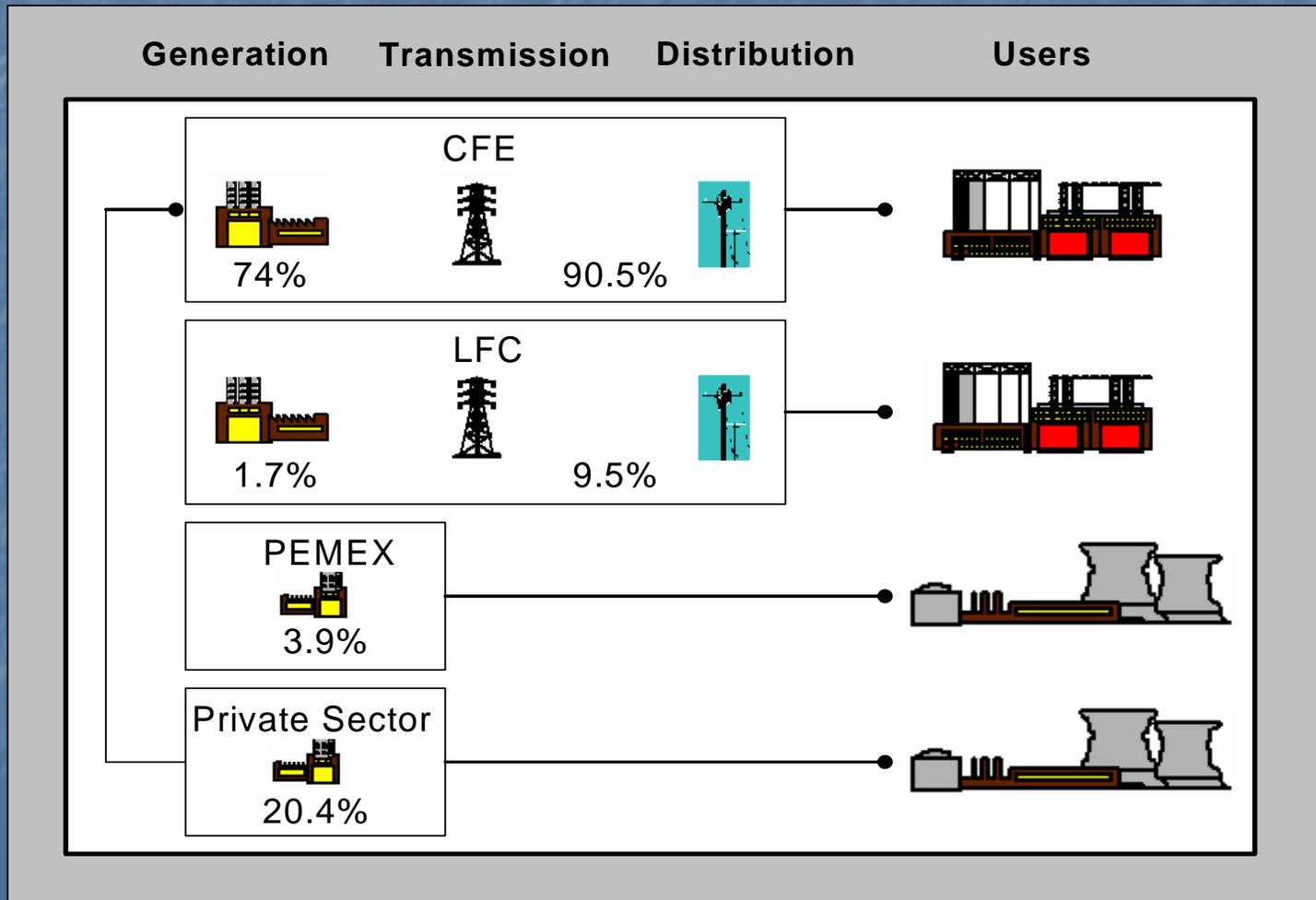
# Energy reforms in hydrocarbon sectors worldwide



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# Current structure of the Mexican electricity sector



# Market architecture in the Mexican electricity sector

- The Mexican electricity sector needs (+,-) 28 thousand MW and USD 60 within the next 10 years
- Only part of the growth needs of generation capacity expansion is under construction or in a bidding process

# Market architecture in the Mexican electricity sector

- Reasons for electricity reform in Mexico:
  - Enormous financial and technical challenges for CFE and LFC in order to satisfy alone the total demand increase.
  - Long term IPP's PPAs are a burden to public budget. 2003 debt: USD\$4.3 billion.
  - Investment requirements for the electricity sector are equivalent to the total public resources needed in infrastructure for two and a half years, and needed in poverty relief for various years
  - IPPs alone are not enough to meet all the growth in demand (stopgap measure)

# Market architecture in the Mexican electricity sector

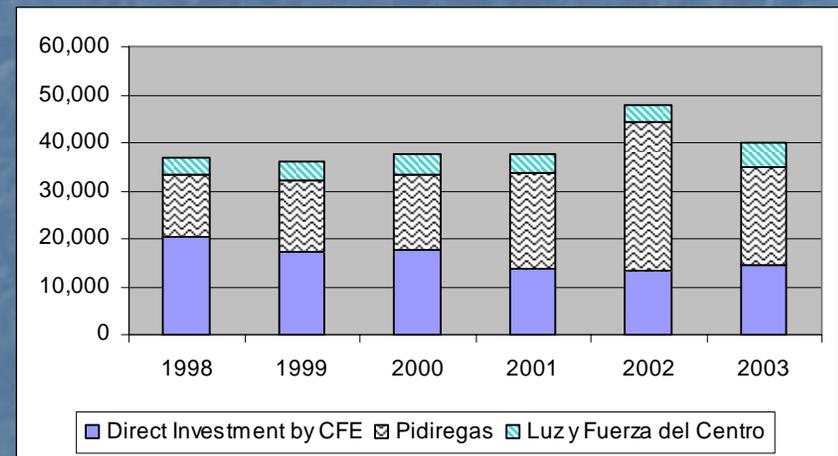
- Reasons for electricity reform in Mexico:
  - There are several indicators of the chronic underinvestment due to continuing severe restrictions on public debt.
  - First, reserve margins have slipped—to just 1% in summer 2002—and have been maintained in part by delaying the retirement of old plants.
  - Second, the government has slashed the authorized budgets for maintenance and repair to levels on average 30% lower than the level that CFE executives think is required.

# Market architecture in the Mexican electricity sector

## Pidiregas

- Total investment in the electricity sector was MXP39.9 billion in 2003, a marked decline from investment levels in the previous year. More than 90% of investments are carried out by CFE and private investors.
- CFE investments include its own budgetary investment, as well as “financial investments” in the form of PIDIREGAS. PIDIREGAS investments constantly increased until 2002, but then declined abruptly in 2003. Total investment in electricity corresponded to 0.6% of GDP in 2003.

Figure 2.6 - Investment in the Electricity Sector (Million MxP 2004)



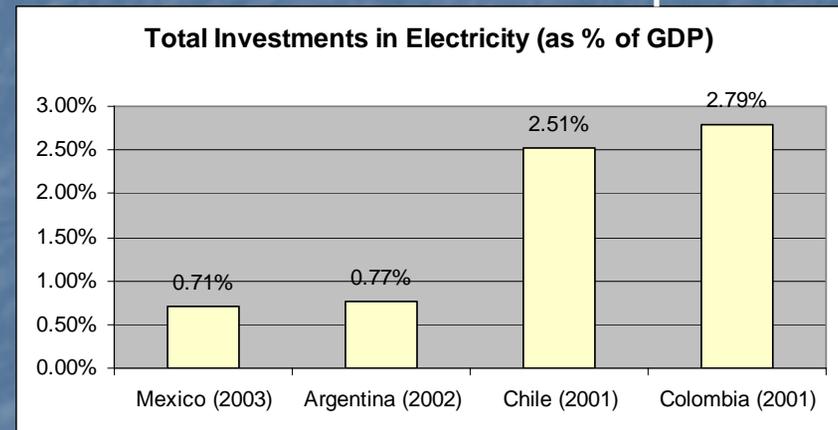
■ Source: Secretaría de Energía,

# Market architecture in the Mexican electricity sector

## Pidiregas

- The reduction in investments is largely due to the deteriorating financial situation of CFE, which in turn is due to (i) increasing liabilities from earlier investments undertaken using the PIDIREGAS scheme; (ii) increasing fuel costs; (iii) and increasing pension obligations (*pasivo laboral*).
- In the electricity sector, the challenge will be to find new financing instruments that allow for such massive amounts of money to be mobilized. This is indeed complex given the shortcomings of the current PIDIREGAS scheme and other structural constraints.

Figure 2.7: Investments in Electricity as a Share of GDP – International Comparison



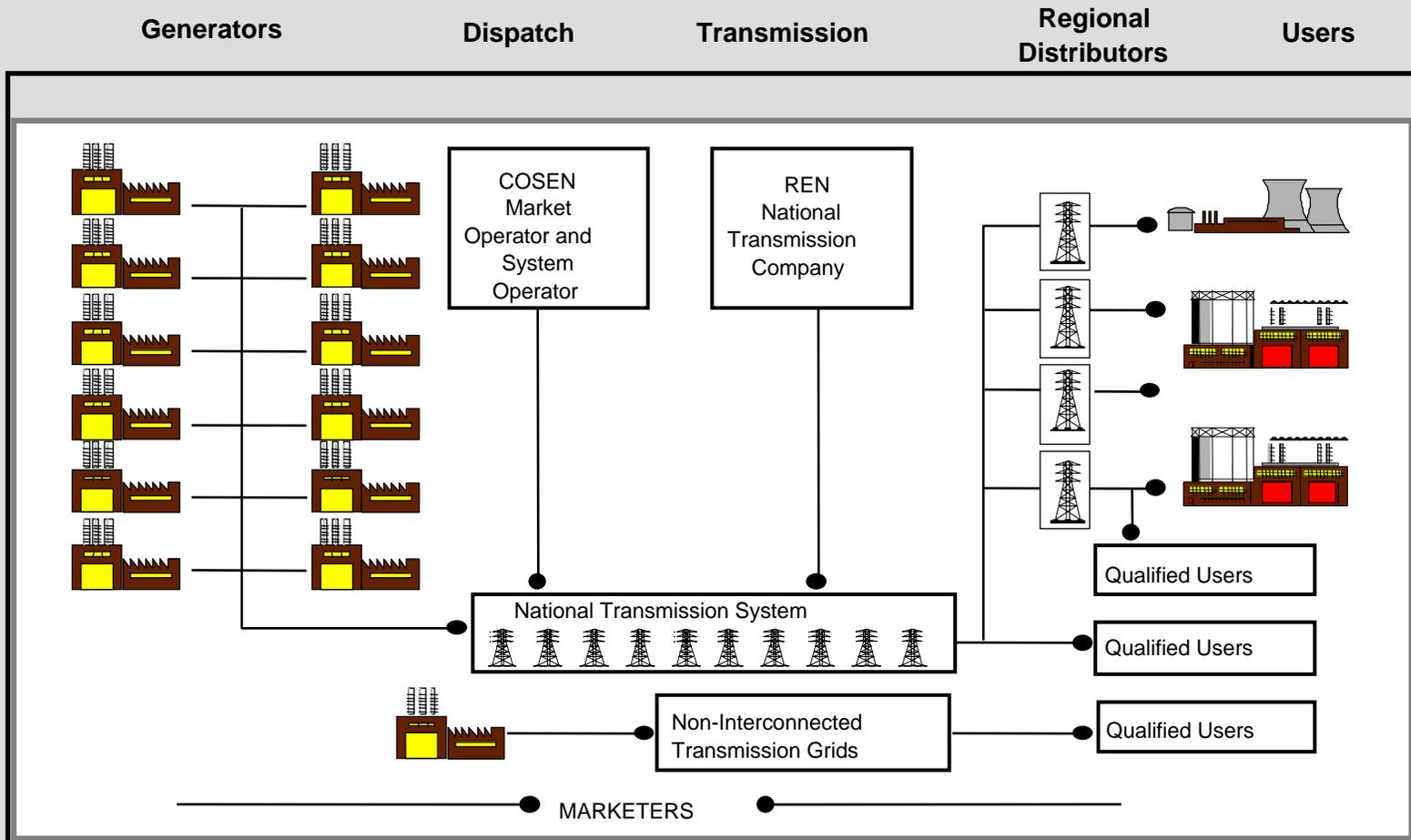
Source: WB calculation for Mexico; Servén and Calderón for other countries.

# Market architecture in the Mexican electricity sector

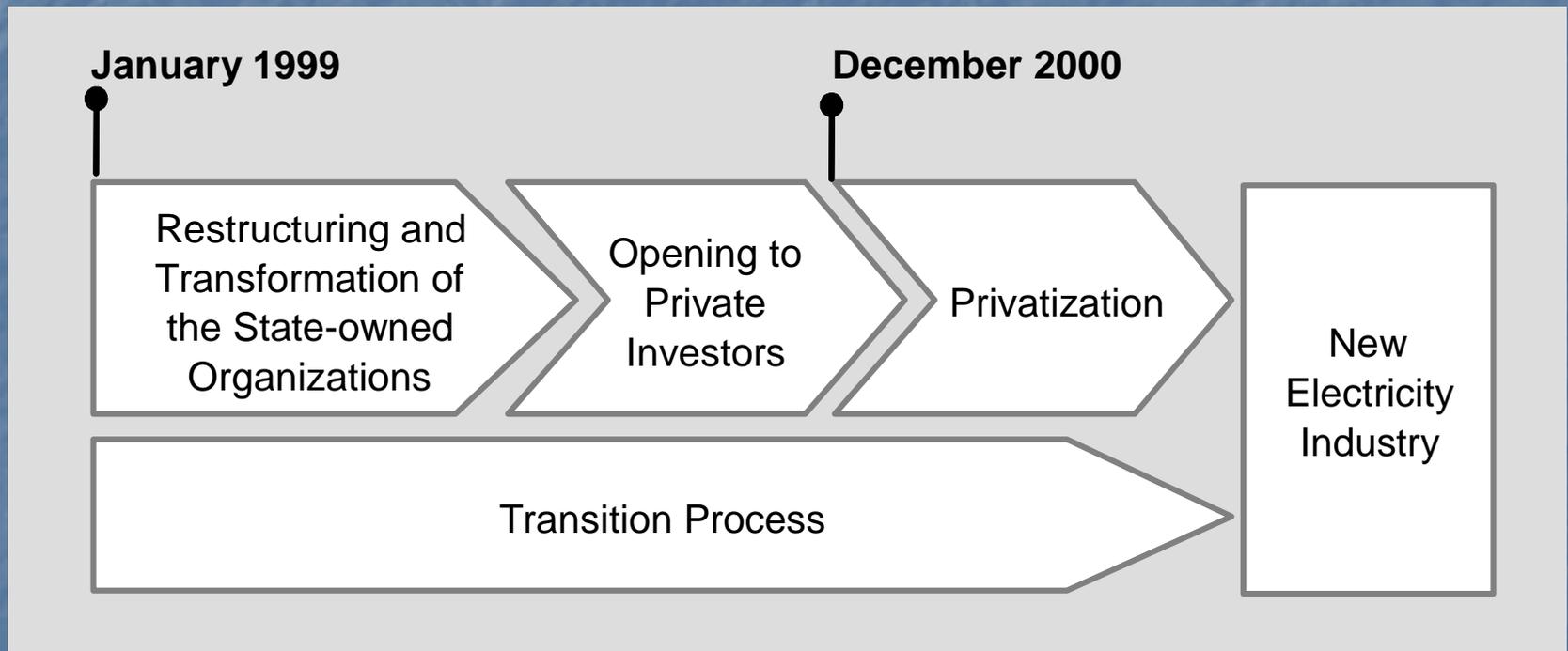
## Pidiregas

- PIDIREGAS is not true private investment. With true private sector participation, the firms would make investment decisions and bear the risk. Now the decisions are public, the risk of loss is public, and firms only get the possibility of profits.
- Only potential benefit of the PIDIREGAS is that the private execution of the investment could be more efficient. Likewise, it seems unlikely that the firms can get lower-cost financing from the market than the government could get directly.
- The main problem with current arrangements that involve the private sector is the institutional setting in which CFE is a monopsony buyer from generation facilities.
- Fiscal impact in the short-term of PIDIREGAS: one key condition to approve a PIDIREGAS project is that it has to generate sufficient revenues to pay for itself. Today, this requirement is not always respected.
  - Transmission lines do not generate revenues in integrated utilities, but a substantial number of PIDIREGAS are for this type of infrastructure.
  - IPPs have been documented selling power below production costs, creating the definite need for public transfers under the power purchase agreements.

# Zedillo's reform proposal



# Zedillo's reform proposal



# Fox's reform proposal

- An electricity market is created but without privatization of publicly owned assets
- Constitutional changes are needed so as to restrict the State monopoly to dispatch functions and nuclear generation
- Exclusivity of the State in incumbent generation and transmission is established in the electricity law

# Market architecture in the Mexican electricity sector

- Analysis of proposals
  - Lack of incentive mechanisms for transmission expansion
  - The theoretical and practical solution to this problem is not an easy one
  - Lack of incentive mechanisms for generation expansion
  - In particular, the price rule for ancillary services. In Zedillo's proposal this rule might promote collusion in generation. "Australian" solution.

# Market architecture in the Mexican electricity sector

- Analysis of Fox's proposal
  - Main virtue is its potential political viability
  - The inefficient structure of subsidies is recognized
  - ¿But how to achieve competition under incumbent State competitors in transmission and generation?
  - “Intelligent” regulation.

# Market architecture in the Mexican electricity sector

- Analysis of Fox's proposal
  - Problems with vertical integration
    - Relationship between State firms in generation and transmission: same "holding" company; access problems
    - CFE and its subsidiaries: cross subsidies, especially problematic if CFE is allowed to engage in marketing activities

# Market architecture in the Mexican electricity sector

- Analysis of Fox's proposal
  - Horizontal market power of CFE in generation
  - ISO:
    - Risk of capture by CFE
    - ¿Objective function?
    - ¿Forward energy market (bilateral contracts); market for LT capacity reserves; other markets?
    - ¿Centralized, decentralized, TRANSCO?

# Market architecture in the Mexican electricity sector

- Analysis of Fox's proposal
  - Distribution systems:
    - ¿How will concessions be granted: who will organize auctions, exclusivity, physical and commercial bypass, geographic zones, tariff regulation, foreign investment?
    - ¿Marketing allowed within the same distribution area?
    - ¿Vertical integration between distribution and generation?

# Market architecture in the Mexican electricity sector

- Analysis of Fox's proposal
  - IPP regime: will its energy be traded within the "pool": ¿subsidies? ¿social returns?

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# Political and institutional constraints

- The Mexican electric system (as any other system in the world) can't be seen separately from the political and economical standpoint since both have shaped the power sector.
- Fundamental issues remain unsettled in Mexico's electricity sector because of the combination of economical, political, and legal factors: the composition of both chambers (deputies and senators), the judicial decisions about the legality of regulatory schemes, the role of the public opinion, especially on issues of nationalism and sovereignty, the new role of the CRE, the evolution of tariffs in the near future, etc.

# Political and institutional constraints matter

- CRE does not have the authority to actually establish tariffs.
- Zedillo's proposal never passed congress. February 1999 proved to be a difficult time for such negotiations as few were willing to compromise with the July 2000 Presidential elections on the doorstep
- Politically, it has proved extremely difficult to raise residential and agricultural tariffs.
- Thus, practical way to make the sector financially sound is to reduce costs—yet that, too, is politically challenging as it requires confronting the powerful unions that are embedded in CFE and, especially, LFC (*Sindicato Mexicano de Electricistas*, SME).

# Political and institutional constraints

- In May 2001, President Fox proposed reforms to the LSPEE which would have modified the terms and limits of the self-generation and co-generation schemes to make them more attractive to private investors.
- Fox administration was already projecting that by the year 2011, about half of the country's generation would take place under the self-generation and co-generation schemes.
- However, on July 4th, 2001, the Mexican Congress filed a petition before the Supreme Court for review of the proposal and argued that the proposed articles envisioned giving the Executive Branch (which would control tendering and operation of these projects) more power than allowed under the Constitution.
- The Supreme Court ruled in favor of Congress, but the Court did not restrict itself just to the immediate issue of separation of powers.
- It also speculated about the consistency of the entire LSPEE framework for private generators with Article 27 of the Constitution (this was recently resolved in favor of current IPP's legal structure)

# Political and institutional constraints

- Available data shows public opinion opposes privatization as well as private investment in the energy sector
- 35% of the population opposed private investment—when asked—and only 17% supported a strategy of attracting new private funds in the industry.
- 60% believe worker rights would not be respected, and a majority believes that private investors will force higher tariffs.
- In many other Latin American countries, the decade of liberal reforms has yielded a similar (and powerful) coalition of illiberal crusaders. Mexico: the 1990s liberal reforms were ridden by corruption.
- Reformers face a problem of credibility with the public
- One strategy would be a massive campaign to alter public opinion by explaining the benefits of reform

# Political and institutional constraints

- The subject of electricity reform left the technical arena and has almost totally evolved in the political arena.
- Participation of the labor unions as well as the multi-dimensional negotiations between political parties are the main determinants of reform proposal success.
- A common factor in all the many proposals is the lack of technical discussion on the specifics of the electricity sector.
- Even the Fox proposal seems to be totally unaware of the highly complicated task of designing an electricity market under the presence of a vertically and horizontally integrated incumbent state firm.

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# Conclusion

- Each of the three analyzed market architectures (IPPs, Zedillo, Fox) might be feasible, but with all the mentioned caveats.
- It seems the more market orientation and private participation the more efficiency gains, partly because the Mexican generation sector is based on CCT.
- However, there is a big risk that the political constraints translate in a poor market design (California ghosts).
- It seems intuitive to follow a strategy of first developing a sound design of CFE's shadow market, and then base each successive step on technically sound decisions, and according to the institutional and political consolidation of the country.