

"Hydropower Development in Brazil: Experiences and perspectives"

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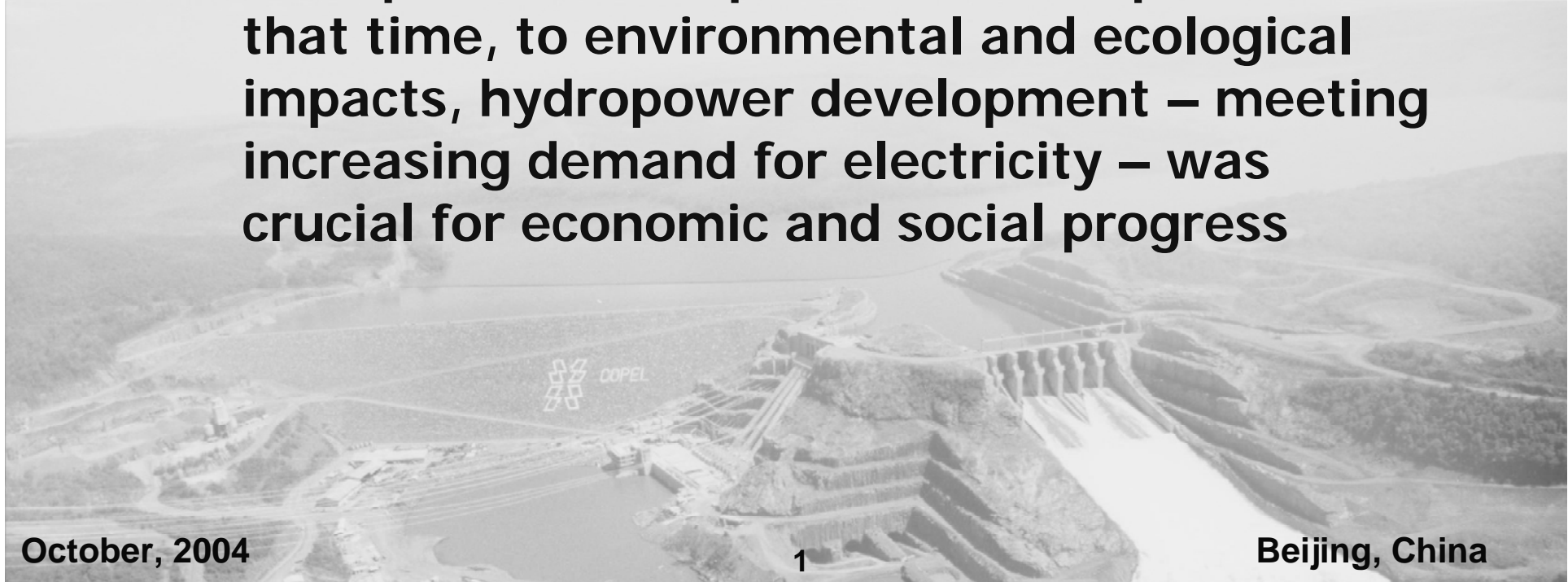
United Nations Symposium on Hydropower and Sustainable Development

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From the Fifties to the Eighties

- **Hydropower in Brazil: the most important mean to provide clean, low cost, renewable energy, relying on established technology**
- **In spite of inadequate attention paid, at that time, to environmental and ecological impacts, hydropower development – meeting increasing demand for electricity – was crucial for economic and social progress**



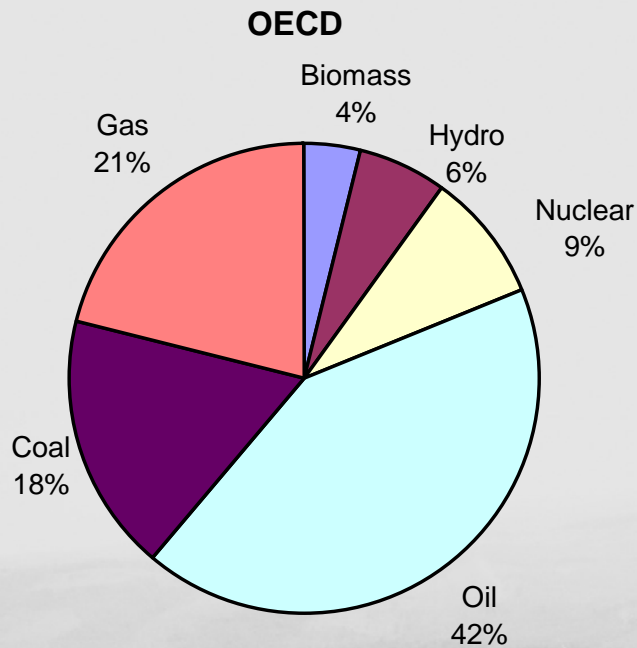
From the Fifties to the Eighties

- **State-owned companies: 98% of the industry, with the following capital structure:**
 - **Debt: International Multilateral Agencies**
 - **Equity: From a specific electricity tax (IUEE), among other government financial resources**
- **The basis was set to today's Brazil global energy system – one of the least carbon-intensive in the world**



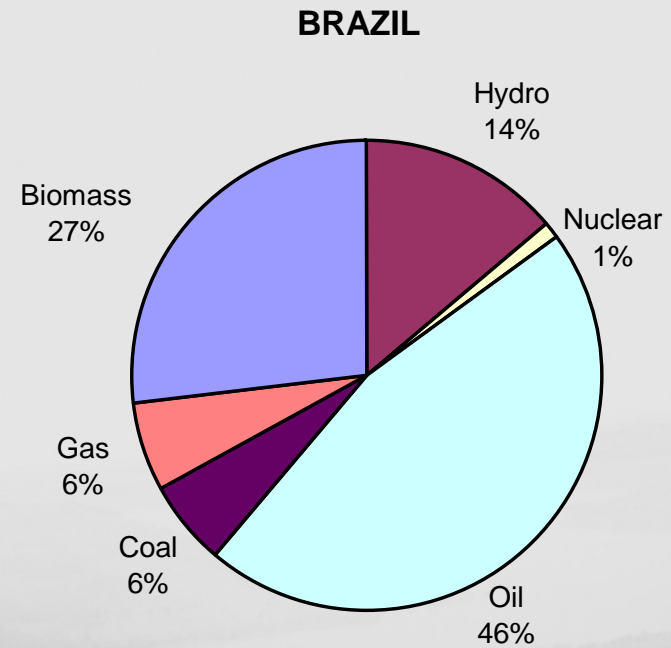
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Primary Energy Demand



Year 1998

Population: 1.0 billion
 Energy Demand: 5,503 Mtoe
 Per capita Demand: 5.50 toe
 Renewable Energy : 10%



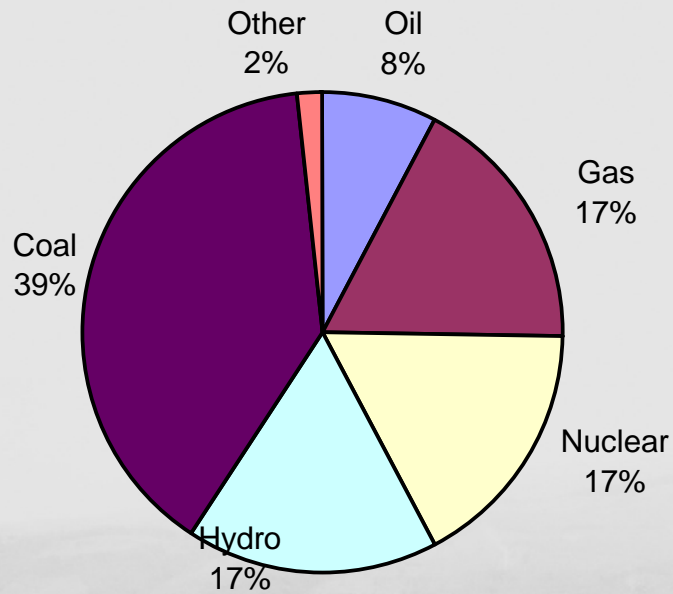
Year 1998

Population: 160 million
 Energy Demand: 180 Mtoe
 Per capita Demand: 1.13 toe
 Renewable Energy : 41%

Source: J. Goldemberg, Meio Ambiente Brasil (Aspásia Camargo, João Paulo Ribeiro Capobianco, José Antonio Puppim de Oliveira - Orgs), 2002.

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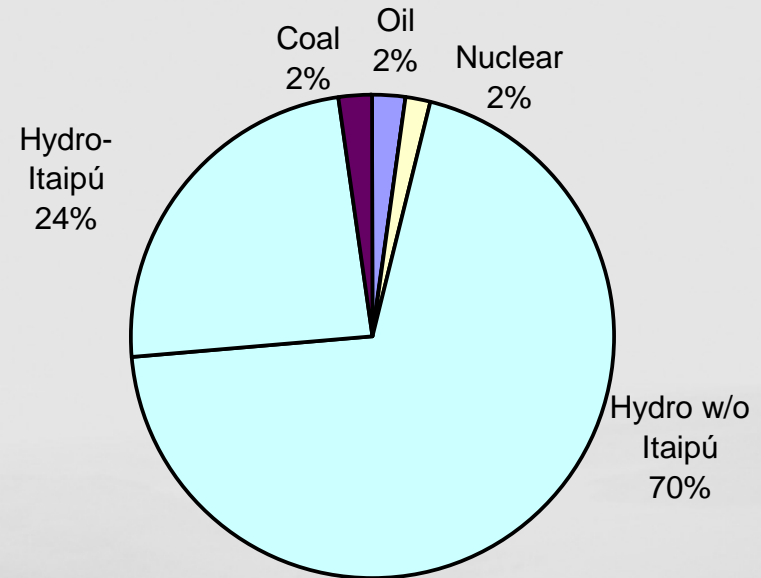
World Electricity Production



Year 2000 - 15,400 Twh

Source: Balanço Energético Nacional - 2002

Brazil (and Itaipú) Electricity Production Under Integrate Operation (ONS)



Year 2000 - 357 Twh
(94% Hydro)

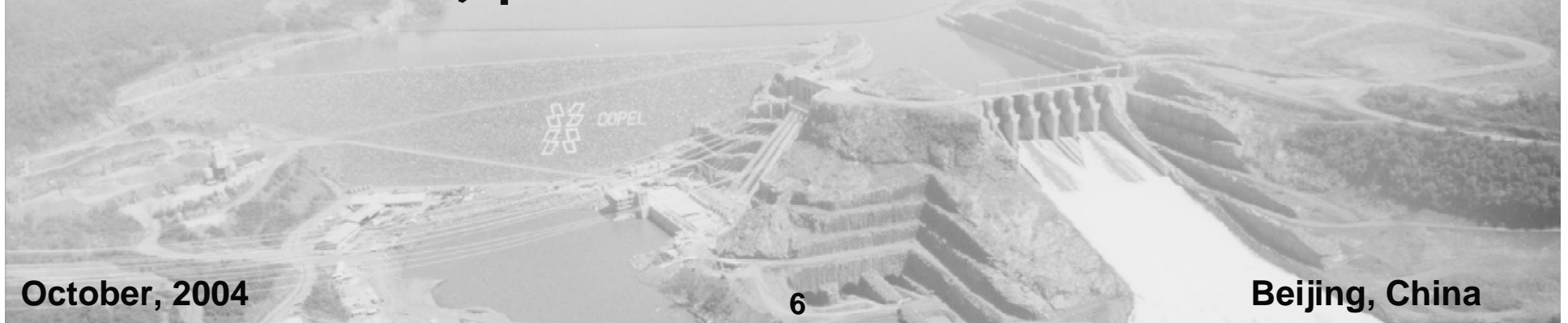
Source: ONS - Dados Relevantes - 2001

Around the Eighties

- Growing awareness that economic development is to be pursued in a socially responsible and environmentally sustained manner
- International Agencies slow down support to hydropower generation projects (no more loans/debt)
- The new Brazilian Constitution abolishes that specific electricity tax – IUEE (no more equity)

Around the Eighties

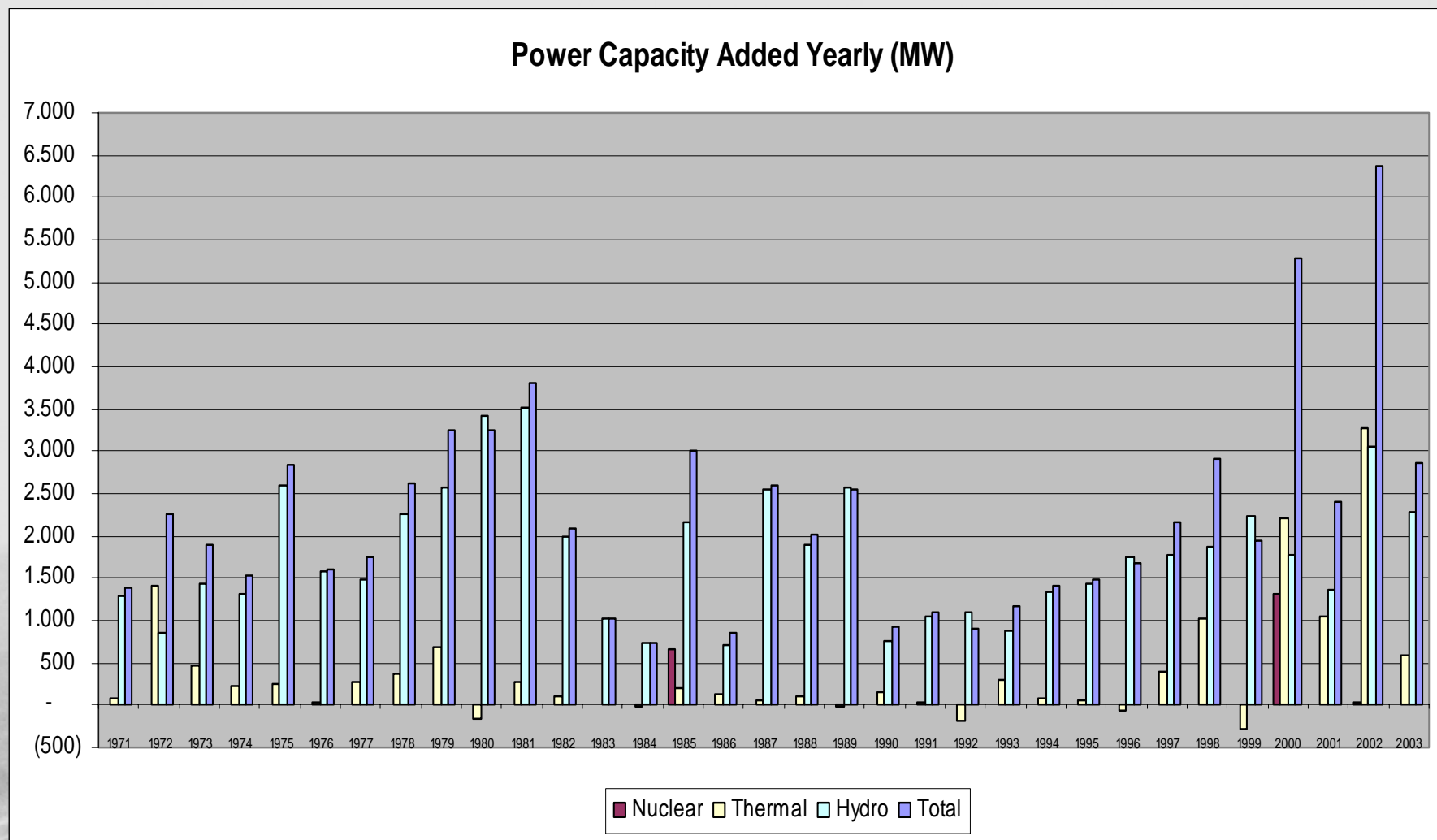
- **One Brazilian Mistake: electricity with the same prices in the whole country – from 1974 to 1992**
- **Another mistake: electricity tariffs used as instrument to combat (unsuccessfully) inflation**
- **As a consequence, the tax-payer (and not the customer) paid the US\$ 27 billion bill**



The Nineties

- **Insufficient investment in electricity generation and transmission capacity, specially from 1990 to 1996 (less than 1250 MW per year, on average, including 2100 MW of the last 3 units of Itaipu)**
 - **Remember: no more loans, no more debt; no more IUEE, no more equity**
- **Modernization of the gas & oil sector, with the end of the monopoly of the state owned Petrobrás on exploration and production concessions (Law establishes a 5 year transition period (1997-2002) to have domestic oil prices following international prices trends)**

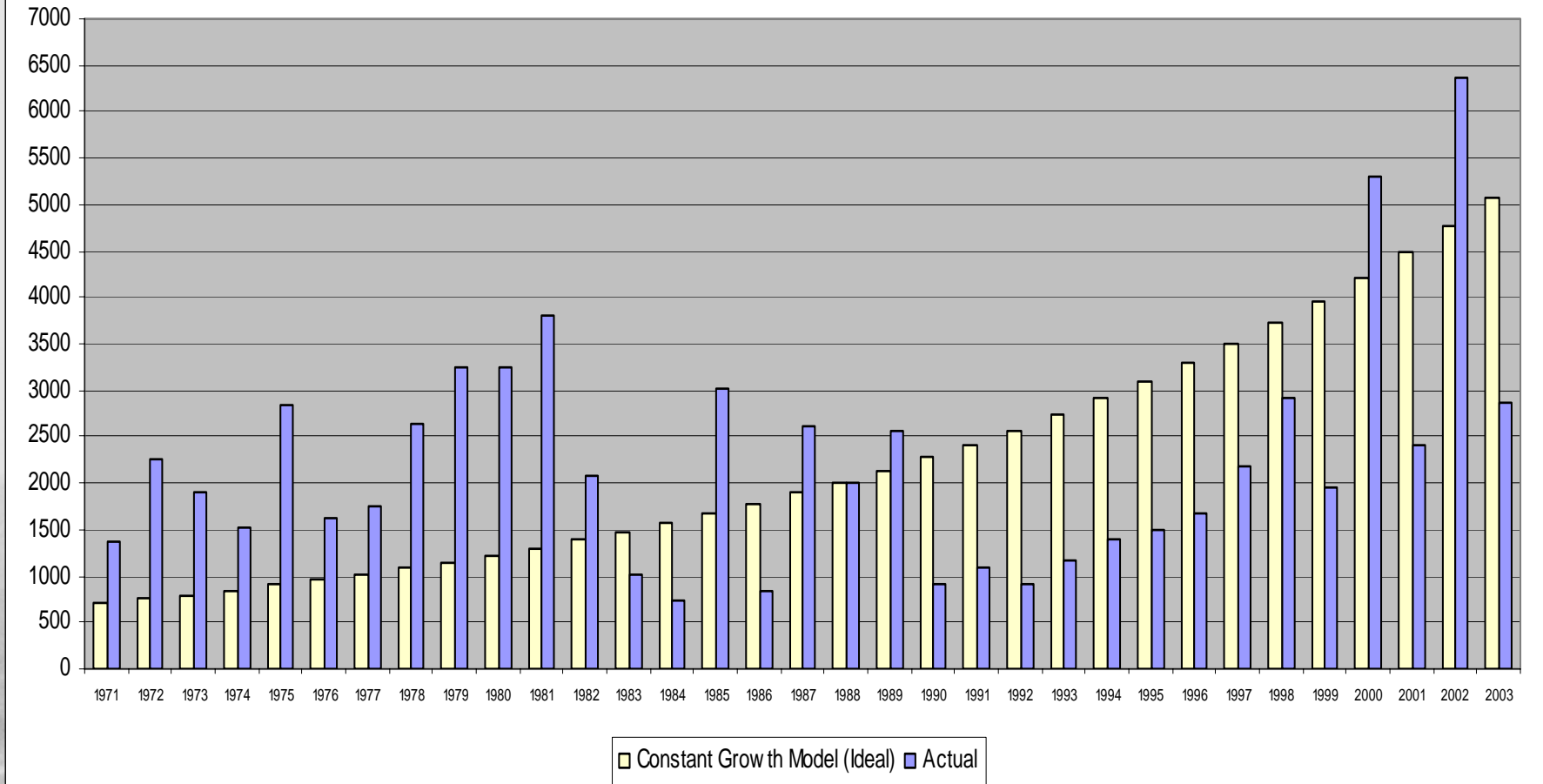
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Source: Balanço Energético Nacional–2002 e ONS-Dados Relevantes 2003

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Power Capacity Added Yearly (MW): Ideal x Actual



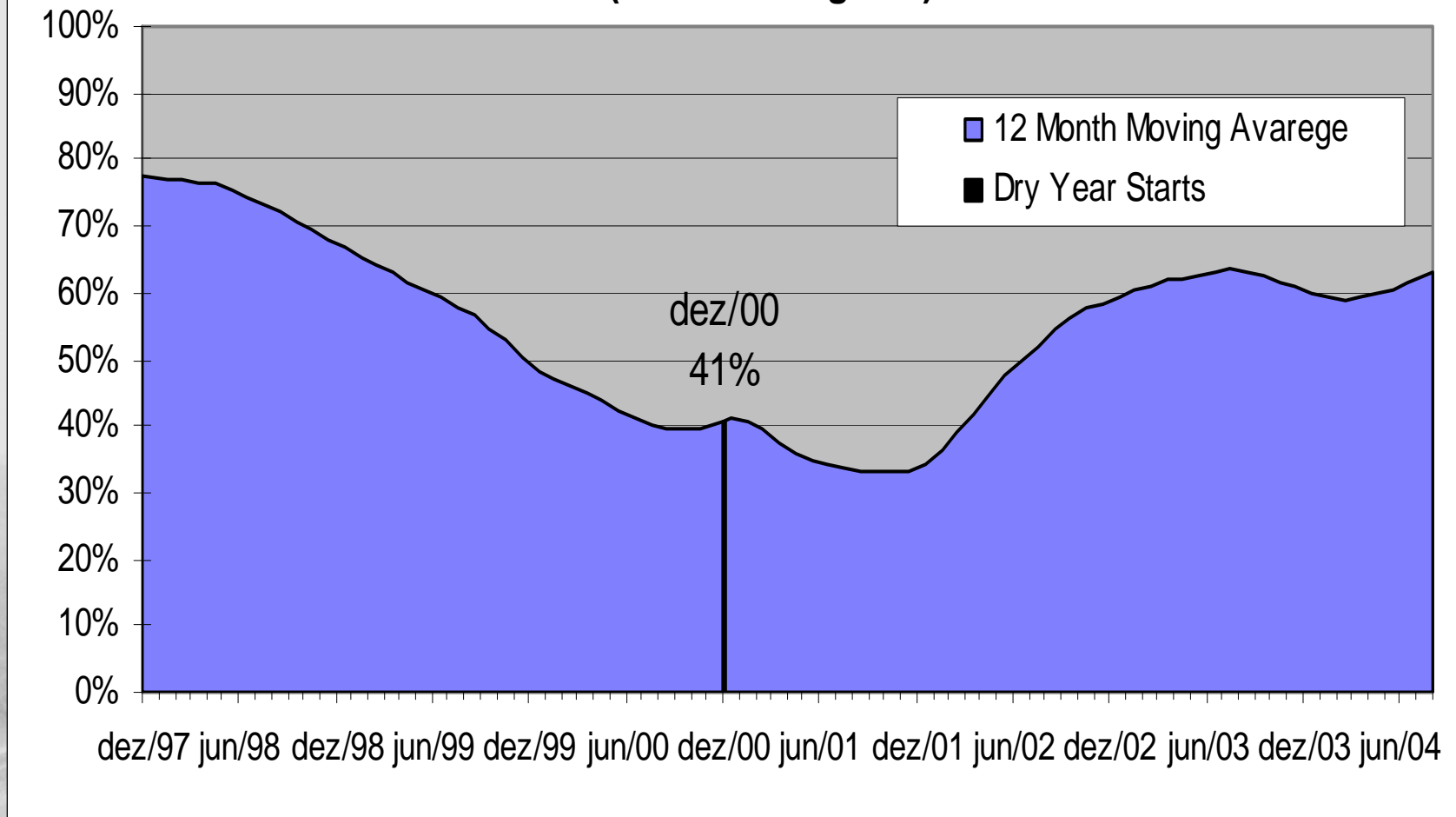
The Nineties

- **Modernization of the Power Sector: creation of an independent regulatory agency (ANEEL-1996), an independent system operator (ONS-1998), a National Council for Energy Policy (CNPE-1998) and the Wholesale Energy Market (MAE-1998-up to 2004)**
- **Electricity distribution (1995) and generation (1998) have been opened up to private capital. Private investors now own 64% of electricity distribution (2.3% in 1995) and 26% of generation (0.3% in 1998)**

The 2001 Brazilian Electricity Crisis

- Insufficient investment in electricity generation and transmission capacity in the last 15 years, specially in the 1990-1996 period
- Depletion curve indicates that it has been extracted more energy than the hydro electrical system was designed to provide, in the 1997-2000 period

Energy Stored in Brazilian Reservoirs (S-SE-CO Regions)



The 2001 Brazilian Electricity Crisis

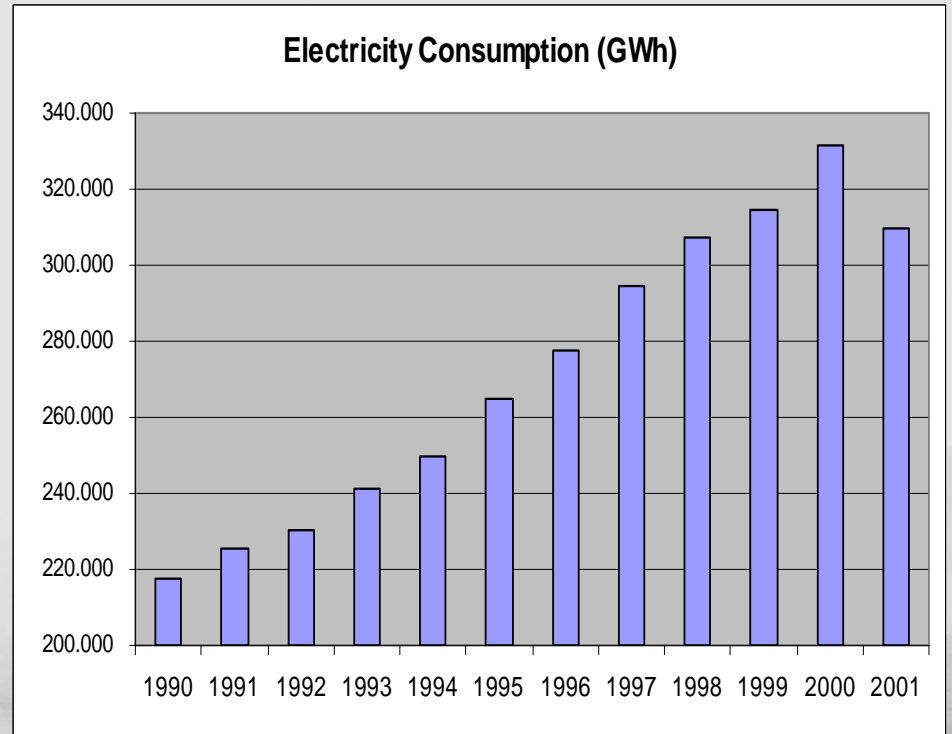
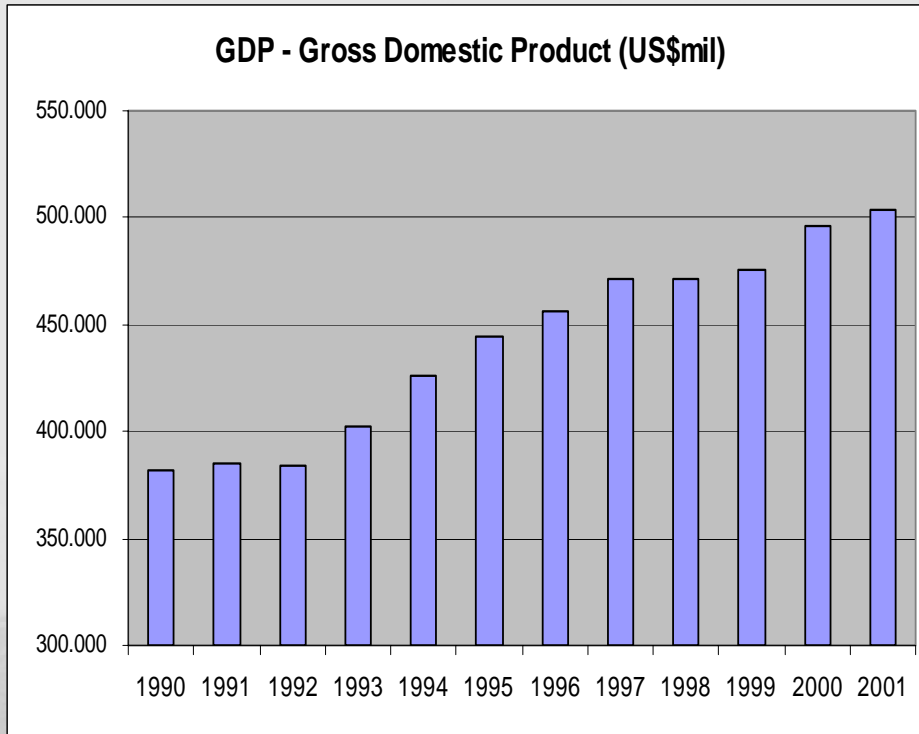
- Worst drought in 70 years in the northeast region, simultaneously with moderate drought in the southeast region, starting when more than half of the storage had been used, during the non-drought previous years

	SE Region	NE Region
Worst drought in 70 years	17,542 MW avg 59% LTM	3,894 MW avg 47% LTM
Year 2001	20,360 MW avg 67% LTM	3,894 MW avg 47% LTM

The 2001 Brazilian Electricity Crisis

- **10-month electricity rationing program from June 2001 to March 2002: reduction of usage by 15% to 25%, depending on customer category (industry, services, residential)**
- **Industrial production declined, impact in GDP growth rate: 1.5% in 2001 (4.4% in 2000), but raised consumer awareness about energy savings**

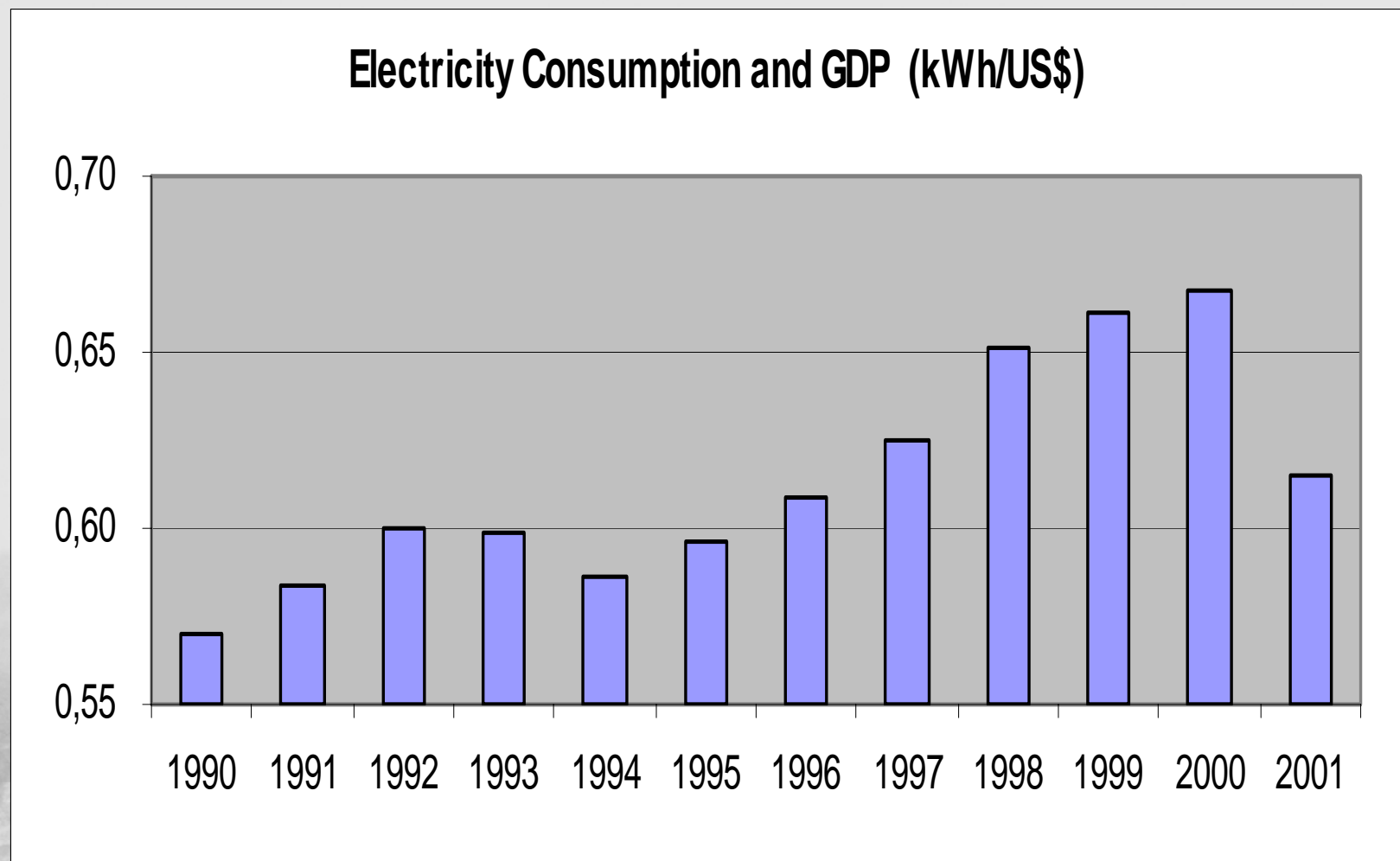
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Lessons Learned - Worldwide

- Need for diversification of global energy supply and for increasing the share of renewable energy
- In many developing countries hydropower constitutes one of the most important means to provide reliable, affordable and sustained energy services
- Other renewable energy technologies alone can not meet the energy needs of most countries

Lessons Learned - Brazil

- Introduction of “risk aversion curves” to reservoir operation rules to avoid over-depletion of the energy storage during non-drought periods
- Need for private sector (national and international) participation in new power projects (US\$160 billion in 30 years)
- Private investment in power projects depends upon stable regulatory regime and attractive power generation prices

Perspectives

- Today, the Brazilian energy consumption per capita is 5 times smaller than OECD's and electricity usage is only some 1,800 kWh per capita. Brazil has developed only around ¼ of its estimated hydropower potential, and most of the new capacity in the near term is expected to be hydro
- Oil and hydropower are expected to remain the key fuels in the Brazilian energy mix, but the share of gas in the power generation mix may increase substantially in the mid term

Perspectives

- World Energy Outlook 2002 (IEA) projects the need to add some 120,000 MW of new capacity by 2030 – 50,000 MW gas fired; 57,000 MW hydro; 7,000 MW with other renewable (US\$ 160 billion investment)
- The need for attractive power generation conditions – the root cause of energy crises – is still present, so that previous liberalization efforts and the future for competition in the electricity market are expected to prevail

Priorities for Governmental Actions

- To provide a supportive regulatory environment, with clear distinction between energy policies and the independent regulator duties
- To provide a comprehensive, national master plan for energy, taking into account simultaneously the social, environmental, technical and economic aspects of sustained development
- As part of the master plan, to foster an strategic survey / inventory for hydropower projects sustainability feasibility, with an integrated view of river basin development and multiple use of water resources

About comprehensive planning efforts

- In the Sixties, with international technical and financial support, a similar work was done, restricted to electricity and to the South and Southeast regions of Brazil, but of course without due consideration of the environmental dimension (by today's standards)
- The planning effort now needed, much broader, is comparable to the previous one, taking into account the technology and abundance of qualified human resources available in modern Brazil

Final remarks

- A high economic and social price has been paid by Brazil for the lack of support to power development in the last 20 years
- Environmental awareness and modern technology can identify potentially negative aspects of hydropower projects, to either avoid, mitigate, or fairly compensate them.
- Hydropower development in Brazil is a success story, with few bitter experiences