



UNIVERSITÉ DE GENÈVE

# Nuclear power The Swiss experience

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# Introduction

# Nuclear power (NP)

- A very controversial issue
- Last NPP activated in 1984 !
- A new one in the foreseeable future ?
  - The Federal Assembly could say **YES**
  - The electric sector : **YES**
  - The financial sector : ?
  - The people (referendum) : ?

# Electricity sector I

- Focal point for the European network
- Generation : ~ **58%** hydro, ~ **38%** nuclear, ~ **4%** other
- ~ **900** electric companies (public/private/mixed) and **2** poles
  - West pole, led by ATEL+EOS
  - East pole, led by Axpo

	EBIT* MCHF	ES** TWh
West 2006	1134	194
East 05/06	1411	112

# Electricity sector II

- Process of liberalization: since 1998
- Two Federal Acts
  - Electricity Supply Act, 23.3.2007
  - Energy Act, 26.6.1998 (revised 23.3.2007)
- Rules concerning
  - Opening the market to competition
  - Supply security (short, medium/long term)

# Our presentation I

- NP in Switzerland, its history, its perspectives, its specificities
  - Risks related to
    - Social acceptability
    - Regulation
    - Price and cost evolution
    - External costs monetization
  - *Convergence/divergence between two goals*
    - Supply security (quantity, prices)
    - Business

# Our presentation II

- NP *in the context of the Swiss electricity mix*
  - To take into consideration all the risks of the electric system
  - Comparison between
    - NP, its main concurrent :
    - Combined Cycles Gas Turbines (CCGTs), and
    - Hydro power (HP)

# Energy policy

# Sixties

- The government and the electricity sector bank on NP
  - To deal with the depletion of the hydro potential
  - To avoid air pollution (FFPPs)
- Beznau I/II\* and Mühleberg\*\* are built
- Opposition almost inexistent

\* PWR, 2x350 MWe (today 2x365)

\*\* BWR, 355 MWe

# Seventies / Eighties I

- Same approach: NP to contribute
  - To supply security (*cf.* oil shocks)
  - To air quality (*cf.* acid rains)
- Stake: substitution of oil by electricity

# Seventies / Eighties II

- The rise of antinuclear opposition
  - Increasingly so following Three Mile Island and Tchernobyl
  - Doubts about the Confederation's bodies/ experts (*cf.* their adhesion to the nuclear paradigm)
- Gösgen\* and Leibstadt\*\* are built
  - Kaiseraugst project is abandoned in 1988
  - Long term contracts with French NPPs

\* PWR, 940 MWe (today 970 MWe)

\*\* BWR, 990 MWe (today 1165 MWe)

# Nineties

- The Swiss people accept the Constitutional article on energy (23.9.1990)
  - A turning point for energy policy
  - More active energy policy, supply/demand side
- 10 years NP moratoria accepted (following a popular initiative)
  - The electricity sector itself expresses doubts on the future of NP (*cf.* market liberalization, low consumption growth)
  - NPPs' power uprates

# The start of the new century

- How to replace the NPPs and long term contracts abroad that are reaching their end?
  - The government proposes
    - NPPs and/or CCGTs
      - NPPs are generally contested by the left; CCGTs by the right
    - Renewable energy
    - Rational use of energy
- The people reject the renewal of nuclear moratoria (18.5.2003)
  - However, from here the referendum battle was won, opening a nuclear site, the road is long...

# Institutions

# Federal Acts

- Federal Atomic Energy Act, 21.2.2003  
(replacing the 1959 Act)
  - Decisions are centralized by the Confederation, authorisation system
- Federal Hydropower Act, 22.12.1916
  - Decisions are decentralized to cantons/municipalities, concessions system
- No specific Acts for FFP
  - Decisions are decentralized

# Nuclear power (NP)

- The construction of a NPP requires
  1. The general authorisation
    - Granted by the Federal Council (government)
    - Must be ratified by the Federal Assembly
    - Subject to a facultative referendum (50000 signatures required)
  2. The construction and exploitation authorisations
    - Granted by the Federal Department of the Environment, Transport, Energy and Communications

# Nuclear power (NP)

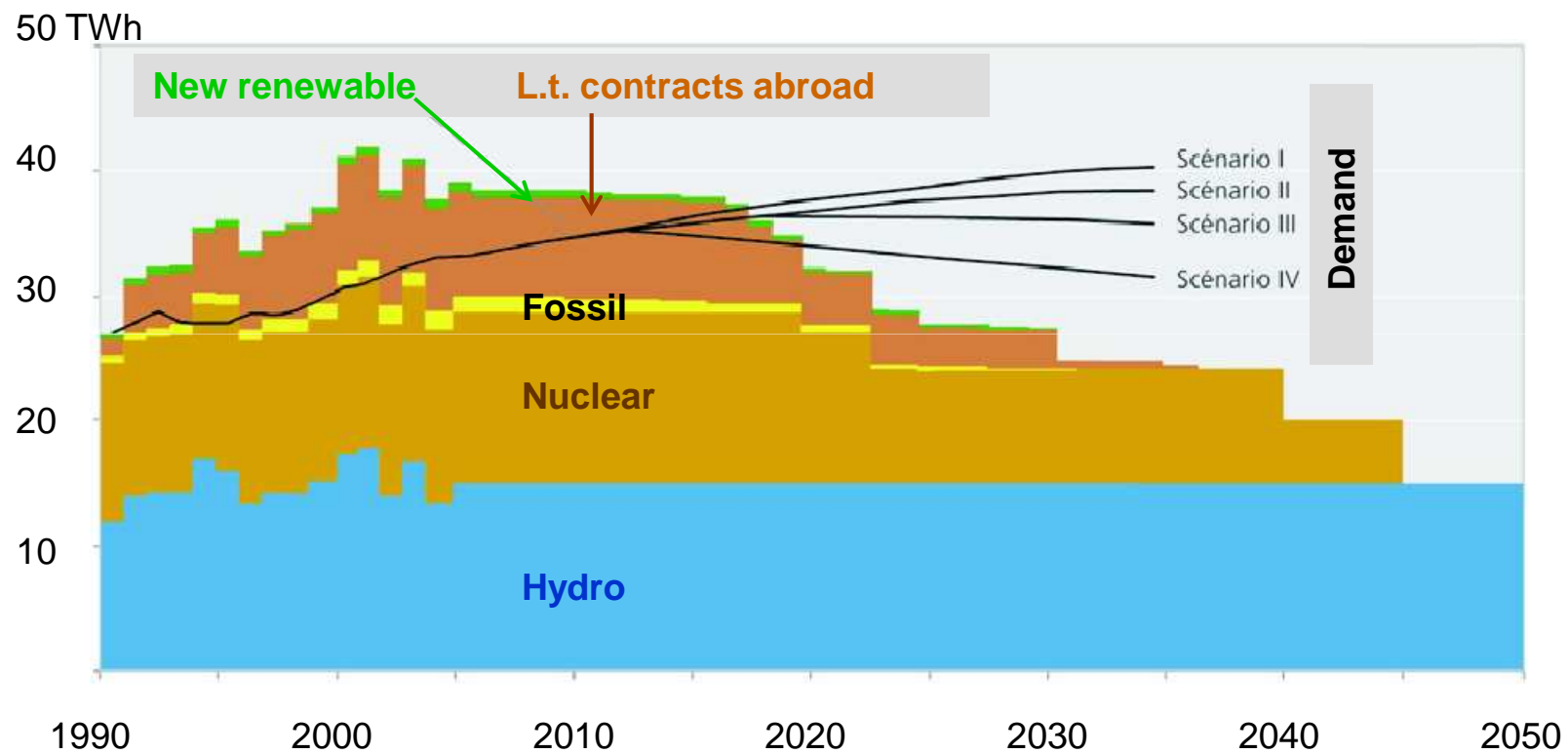
- Cantonal laws
  - Recall: several cantonal constitutions force the authorities to oppose the construction of nuclear installations (ex. GE, BS)
  - They are taken into account in the measure that they don't impede construction projects in a disproportional manner
  - The canton can appeal if the department gives consent despite its opinion

# Safety – Supervision

- The government determines supervisory bodies
  - « Nobody can give technical instructions to supervisory bodies, who are formally separate to the authorities responsible for granting authorisation »

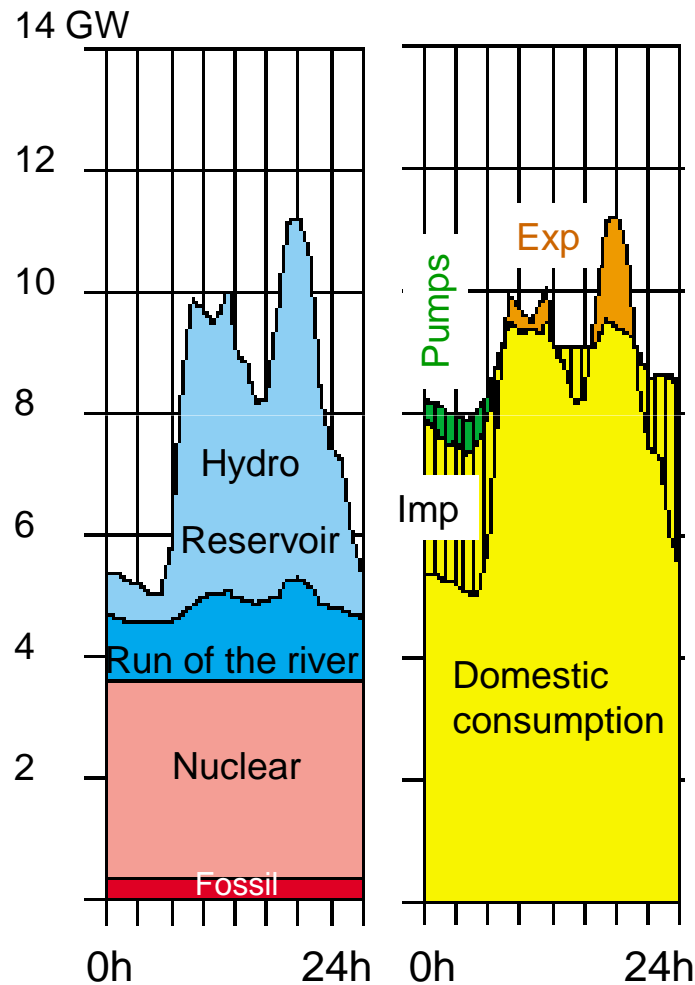
# Electricity supply

## Electricity supply and demand, with no new investment (winter)



Source: Swiss Federal Office of Energy, 2007

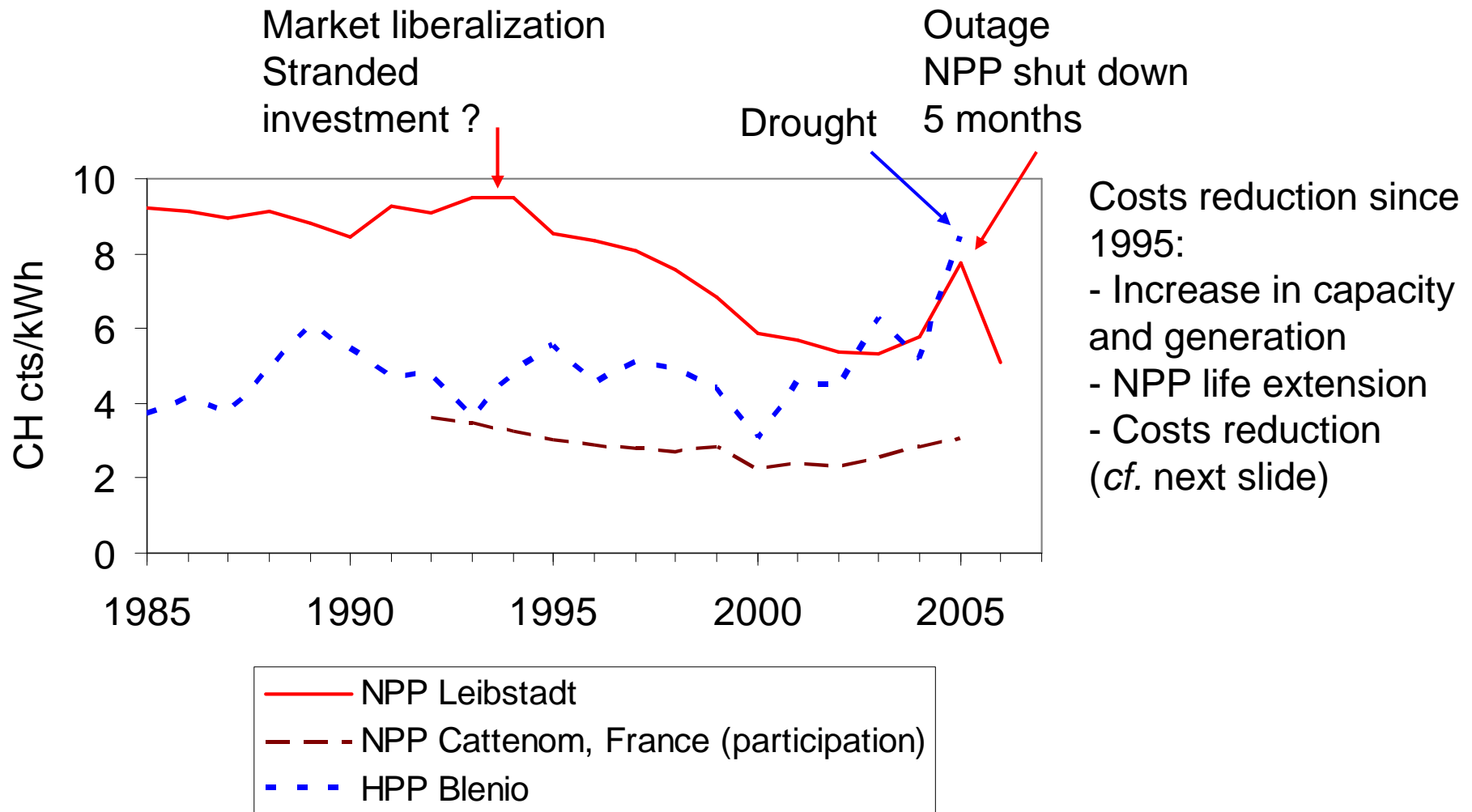
# Load diagram, 20.12.2006



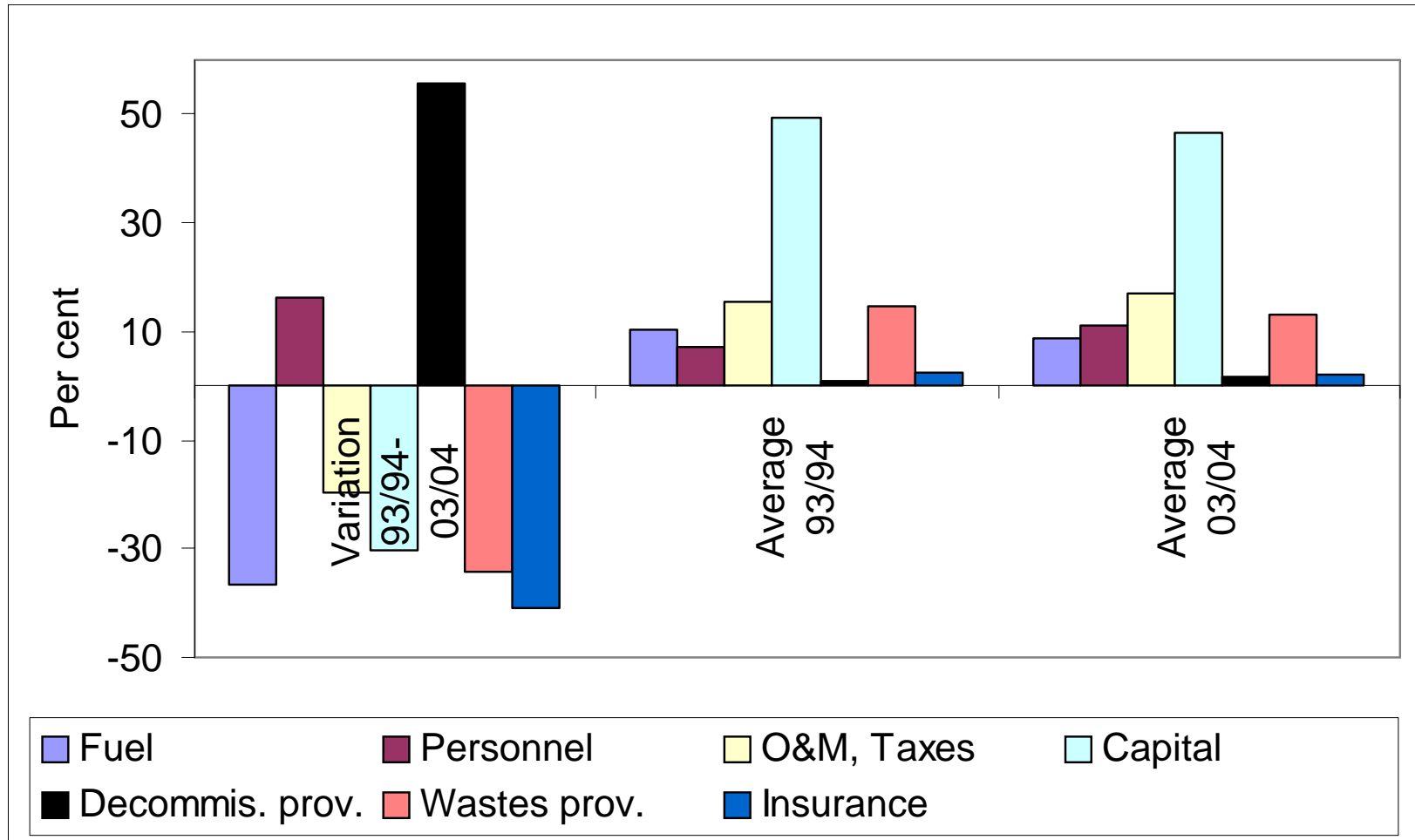
- Power plant integration
  - Base, intermediate load
  - Peak, super-peak
- Role played by X-M
- Problems
  - To invest in base load
  - To invest in networks (bottlenecks)
  - Long term contracts abroad *versus* third party access

# Generating costs

# Generating costs of existing power plants

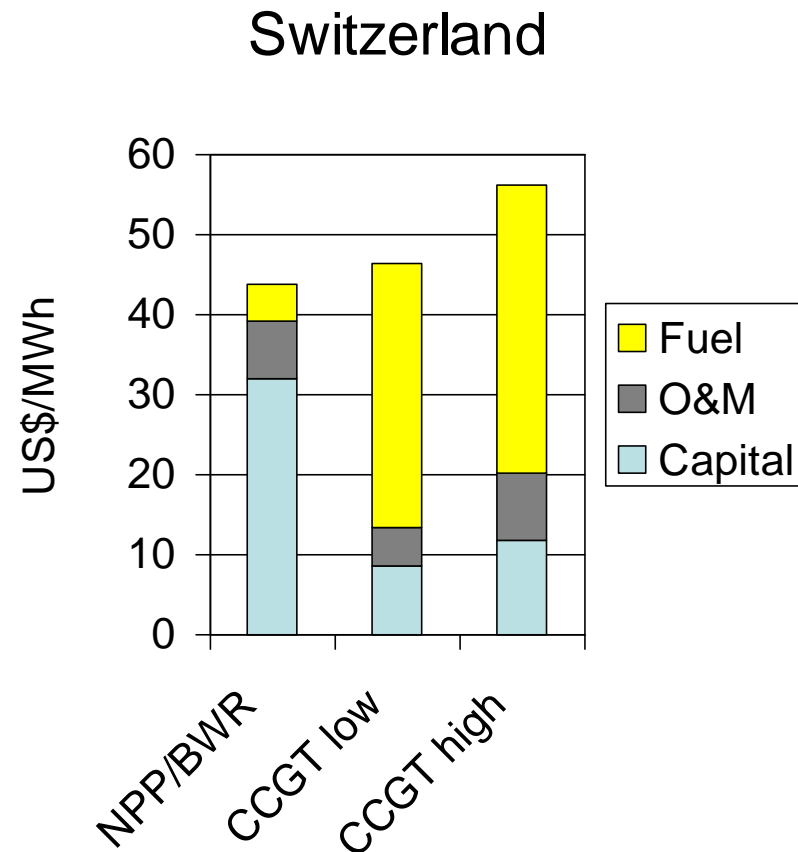


# NPP Leibstadt generating costs



# Projected generating costs (NEA/IEA 2005)

- Estimations drawn from «paper and pencil studies», rather than from actual experience
  - *Decommissioning, waste disposal, insurance included | Taxes and duties not included*
  - *Discount rate 10% | Gas price rate of growth: 1.9%/yr | Capacity: NPP 1600 MWe; CCGT 100 (high cost) and 400 MWe (low cost)*



# Competitiveness

## Regulatory stability, licensing processes

- Opponents will attempt to take advantage of all the opportunities offered by regulation in order to create obstacles
- Time required between general authorisation and activation
  - 16-18 years according to federal authorities
  - 12-15 years according to the electric sector

# Efficient management

- Cost control is difficult, uncertainties are high
  - News from Olkiluoto 3 not reassuring
    - Is Mr. Didier Beutier\* right ?
      - « The *first movers* bear once for all risks, bringing valuable information and experience to the followers... The unparalleled experience we are now gaining in Finland will be valuable for next projects »
- (CeSSA Conference, Berlin, 2007)

\* AREVA

# Conditions of appropriate financing

- Financing large power plants facilitated by adopting the model of the «partner companies»
  - The risk is shared between the partners
    - Each partner absorbs the production, covers the generation costs, in proportion to his share in the investment
- Furthermore
  - *Cf.* the financial solidity of companies such as ATEL, Axpo, etc.
  - *Cf.* the guarantees provided by public companies

## Stability of sale prices

- Because of the market price volatility and the NPPs capital intensity, electric companies should take long term contracts
  - These contracts can be facilitated by a certain degree of integration between generation and supply (case of ATEL and Aypo)

# CCGTs' alternative

- CCGTs' advantages
  - Short payback times
  - Flexibility (staged construction)
- Disadvantages
  - Gas geopolitics
  - Insufficient opening of gas markets to competition (in Switzerland, EU)
    - Ex. indexation of gas prices to oil prices
- Existence of uses for the heat ?

# Climate policy

- Placing a significant «price» on CO<sub>2</sub> emissions gives an advantage to NP
- Measures taken in Switzerland follow this trend
  - Example: in principle, new gas power plants have to compensate the CO<sub>2</sub> emissions, of which at least 70% in Switzerland (abatement costs are higher)

# Investments

# Willingness to invest I

- Electric companies are willing to invest
  - To do business
  - To ensure supply security, to satisfy the customers' expectations, to comply with regulation
- They have medium and long term strategies
  - « ... large irreversible investment decisions are based on analysing market fundamentals, not just current trading views... » (David Newbery)
  - Investments with long payback times can be preferred

\* Companies in the census=95% of the domestic generation

Source: *Statistique de l'électricité 2006* | 1 CHF=0.6 Euro=0.4 £ (1.7.07) |

# Willingness to invest II

- Why invest in NP ?
  - Traditionally, electric companies express a favourable attitude towards NP (as well as HP)
    - With the exception of the companies which belong to antinuclear cantons
  - Probably, they tend to under-estimate the nuclear risk and over-estimate the risk related to gas

# Investments envisaged by the sector

	TWh	1000 MCHF
NP (a)	20	10-12
CCGTs	3	2
Renewable	5	8-10
Hydro pumps	(super-peaks)	3
Network	(to avoid bottlenecks)	2-3
Total	28	25-30

Source: G. Leonardi, CEO ATEL, March 2007.

1 CHF=0.6 Euro=0.4 £ (1.7.07)

(a) Generation III

Radioactive waste disposal, plant decommissioning, insurances

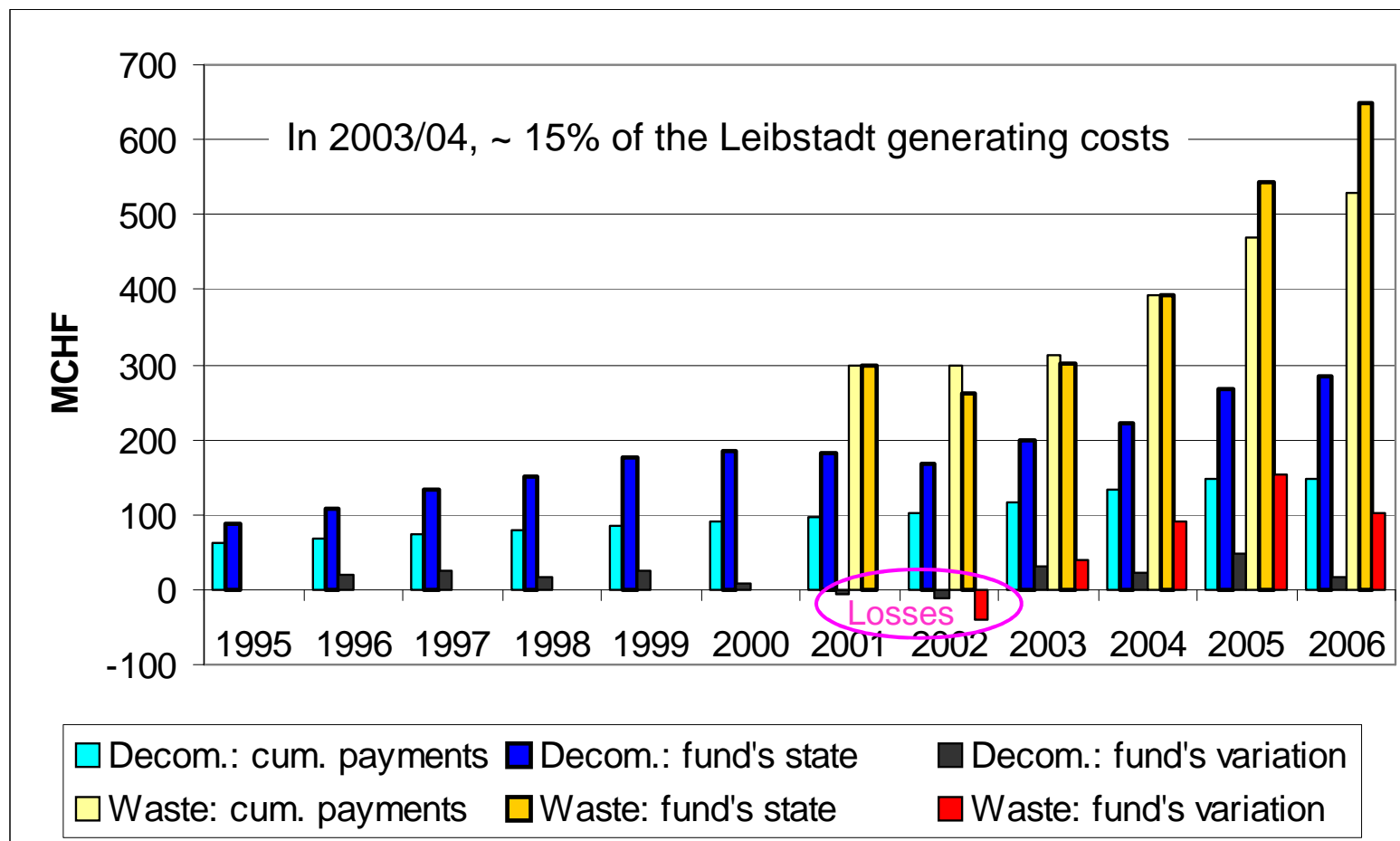
# Waste disposal

- Federal Atomic Energy Act: « The general authorisation [new NPP] may be granted... if it is demonstrated that radioactive waste will be disposed of » (art. 13/1.d)
- The creation of a nuclear depot requires the authorisation of the Federal Assembly
  - The host canton is associated to the work; it can appeal
  - In the past, local populations expressed themselves negatively (ex. Wellenberg)

# Provisions for waste disposal / decommissioning

- In principle, these costs are covered by funds
  - Managed by the Confederation
  - To which NPPs owners contribute
    - These contributions are re-evaluated periodically
    - One estimates a lifespan of 40 years for the NPPs
    - Problem of return on funds (*cf.* losses in 2001/02)

# Leibstadt NPP: cumulated payments, funds' state and variation



Sources: *Stilllegungsfonds und Entsorgungsfonds: Jahresrechnungen* | 1 CHF=0.6 Euro=0.4 £ (1.7.07) |

# Civil liability

- Coverage
  - Private insurance up to MCHF 300
  - Insurance from the Confederation up to MCHF 1000, in the measure that damages exceed the sum covered by the private insurer or that they are excluded from the cover
- Such an insurance system does not exist for HPPs and FFPPs
- In 2003/04, insurance costs represented ~ 2% of the Leibstadt generating costs

# Conclusion

# Public acceptability

- Main obstacle: public acceptability
  - As the risks cannot be eliminated completely, for opponents they will never be low enough
  - Supporters must show that an appropriate solution exists for radioactive wastes
- Risk that the debate slides into demagoguery
- Risks that a «butterfly's wings» in a Japanese NPP or at Gazprom strongly condition the outcome of a referendum

# Public acceptability

- Without forgetting the economic obstacles
  - The challenges are not for risk-averse decision-makers
- A « Swiss compromise » to overcome the gridlocks ?
  - To find a consensus on an energy mix with medium and long term goals
  - To adopt a compulsory program allowing us to leave fossil and nuclear energy within the XXI century
  - But does the political will exist ?

# Market mechanisms

- Market works, even for supply security
  - *Cf.* willingness to invest in different technologies, including HP, *even in NP*
  - No significant divergences between the security goal and the business target
- However, the ideal market does not exist... *even in Switzerland...*
  - *Cf.* conditions of deployment of different technologies, in particular the political and institutional aspects

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