

Energy Economics Group TU VIENNA

Winter school Czech-Austrian Energy expert group

ELECTRICITY ECONOMICS

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SURVEY

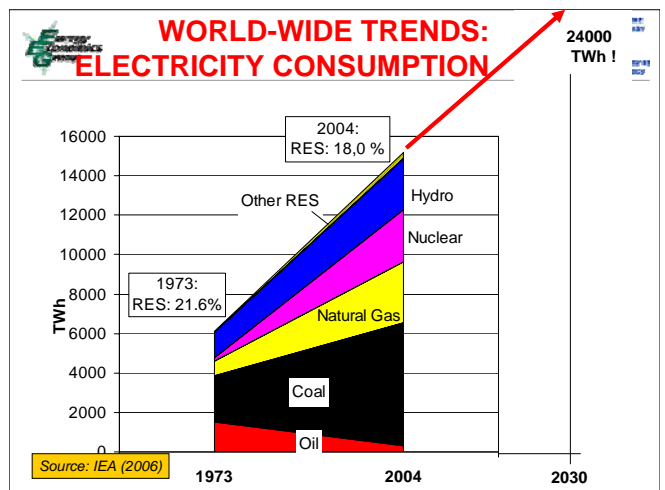
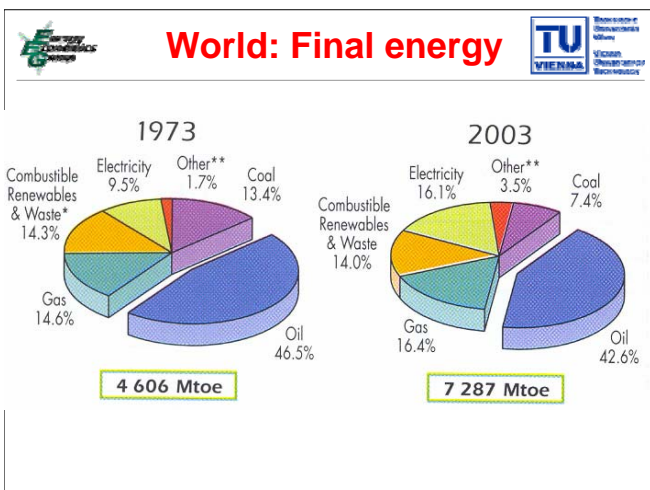
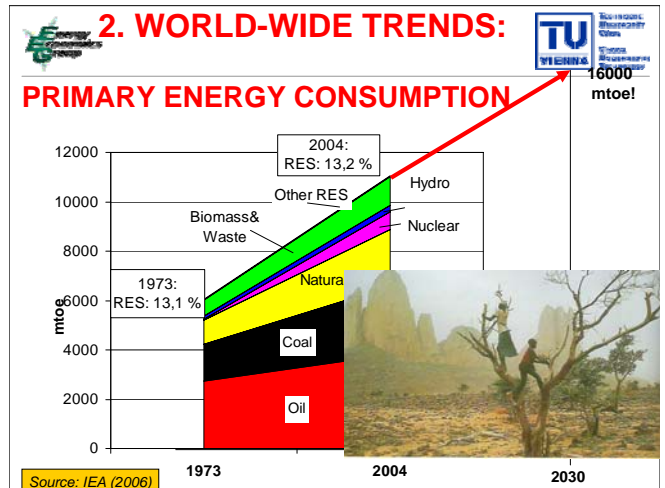
1. Introduction
2. Trends electr. supply/consumption
3. Electricity generation costs
4. Reforms of electricity supply
5. How market prices come about
6. Lessons learned
7. Network issues /Cross-border trade
8. Future perspectives
9. Conclusions

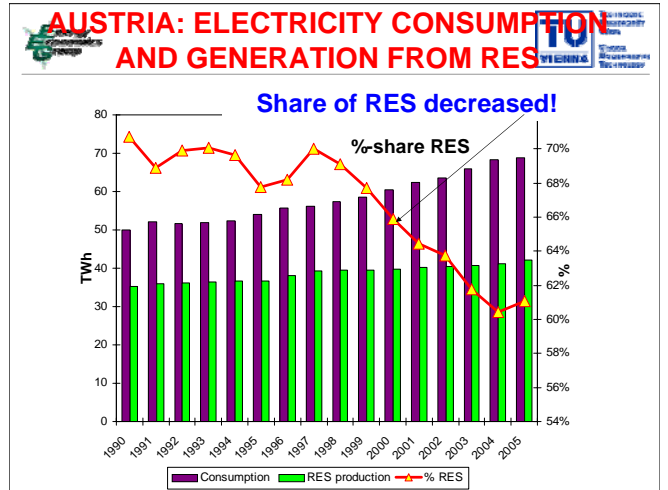
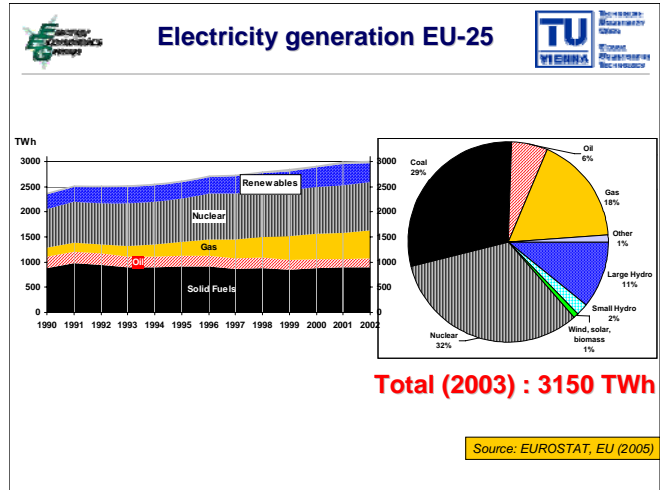
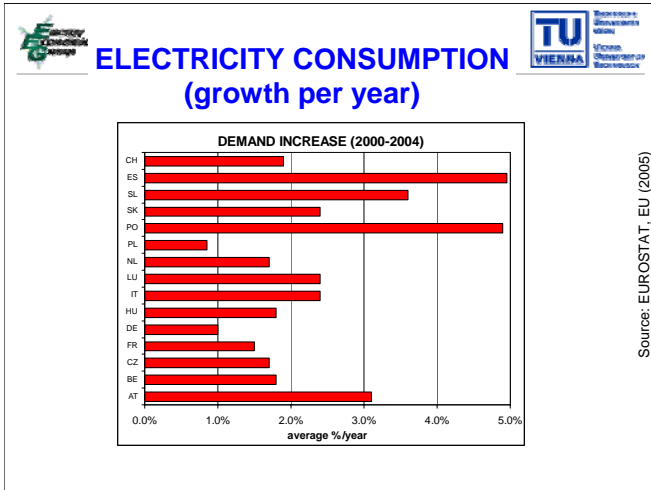
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1. INTRODUCTION

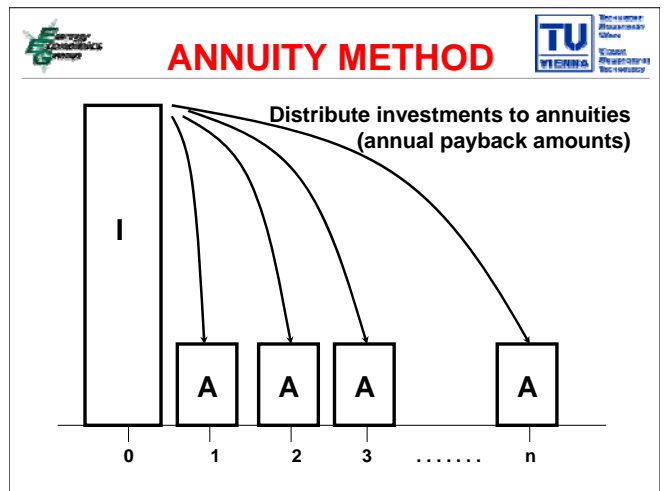
Why are we here today?

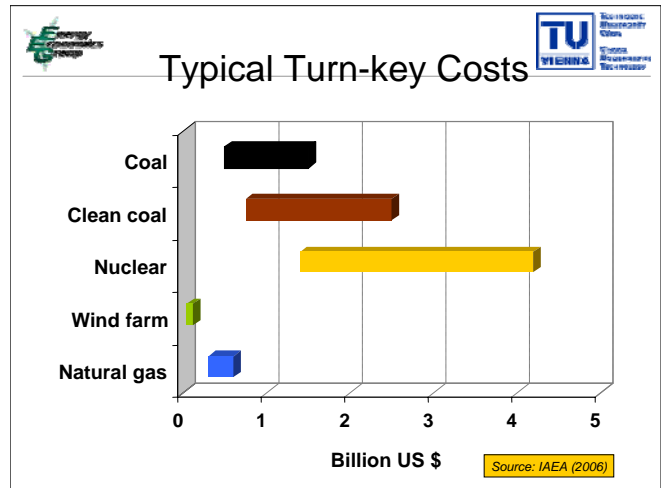
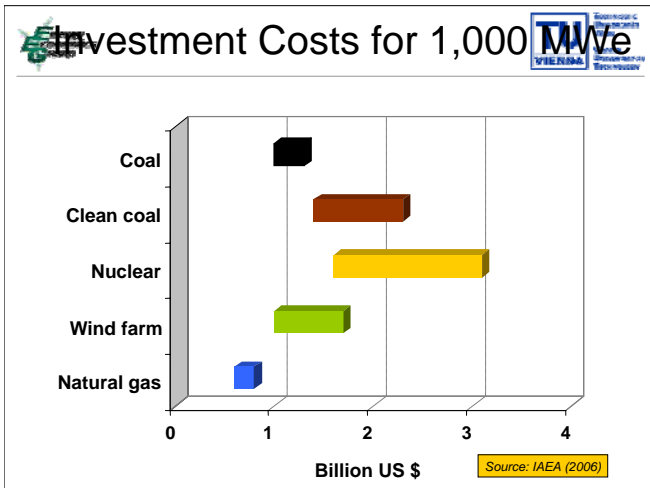
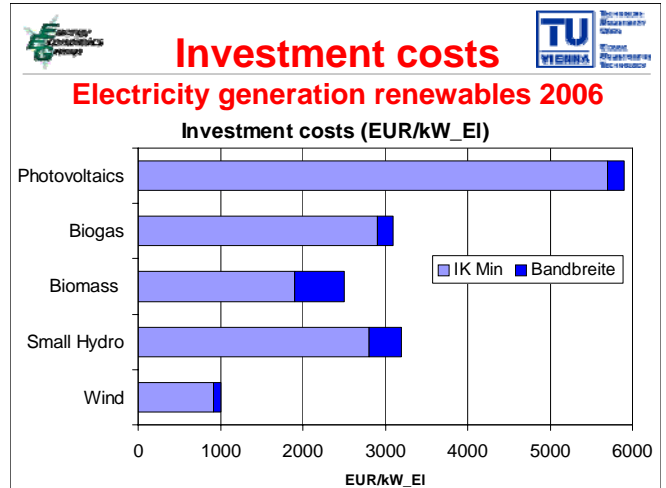
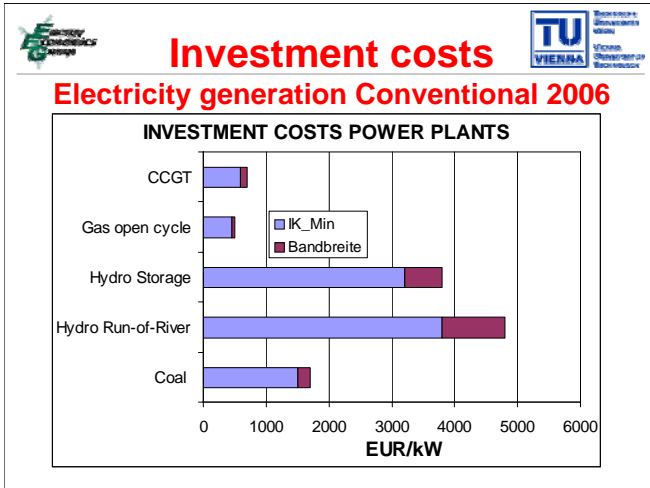
- Energy is the fundament of our standard of life today
- Every second of our life – even in deep sleep – we „consume“ energy
- Dramatic increase in energy consumption in recent years!
- Dramatic increase in energy consumption in the next decades expected!





3. ELECTRICITY GENERATION COSTS





Investment costs of nuclear

Costs of electricity generation

$$C_{Tot} = C_F + C_V = \frac{100 I \alpha}{T} + \frac{p_f}{H \eta} \quad \left[\frac{\text{cent}}{\text{kWh}} \right]$$

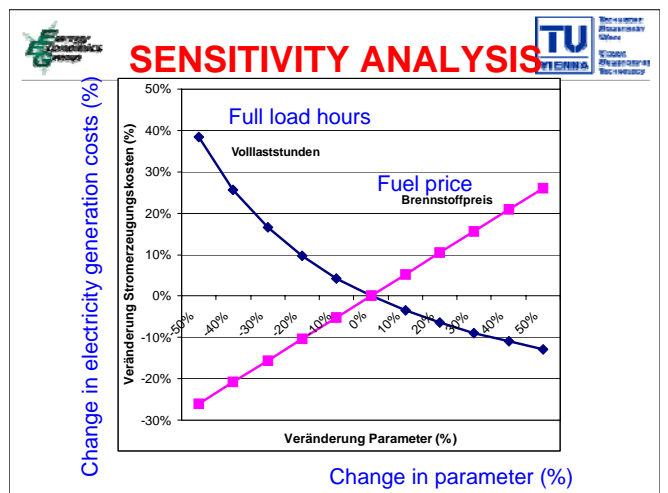
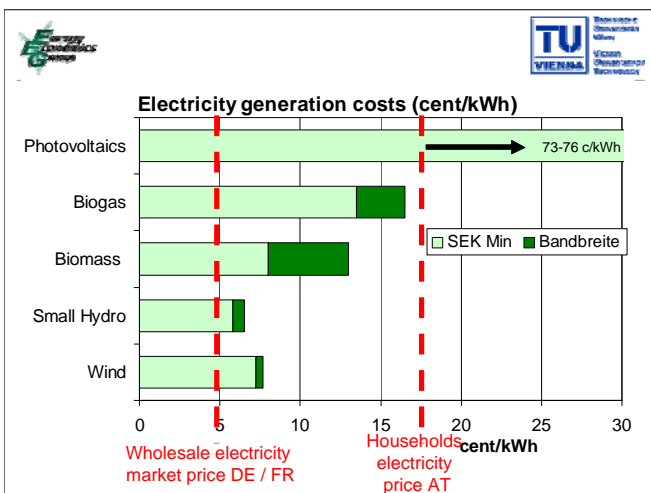
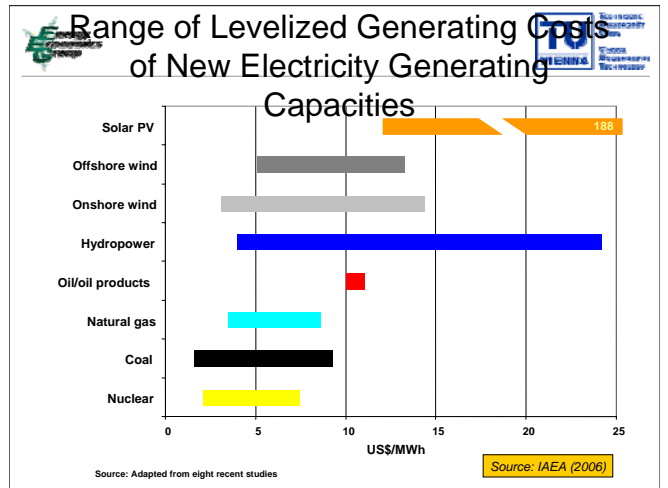
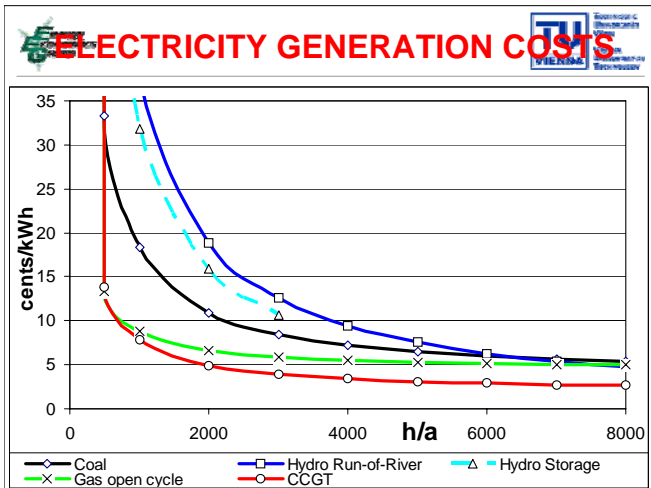
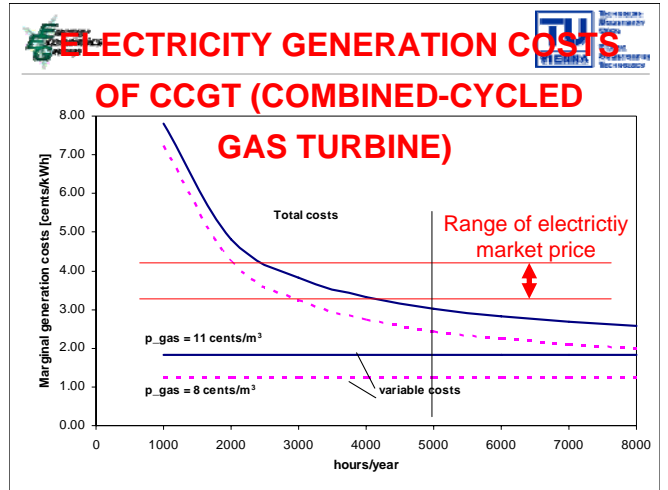
where:

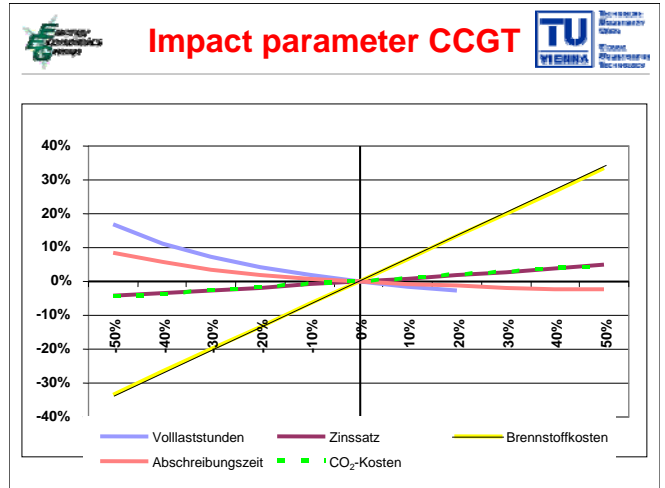
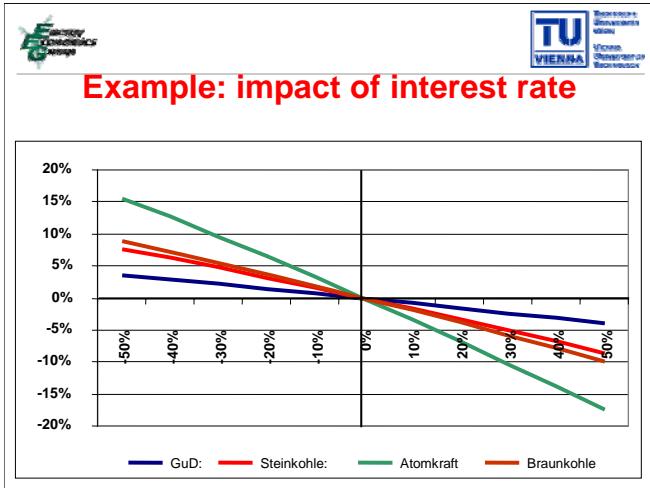
- C_{Tot} ... Total costs (cent per kWh)
- C_F ... Fix costs (cent per kWh)
- C_V ... Variable costs (cent per kWh)
- I ... Investment costs (EUR/kW)
- α ... C.R.F. (Capital recovery factor, e.g. 0.1 for 15 years and 5% interest rate)
- T ... Full load hours (hours per year)
- p_f ... Fuel price (cent/kg or m³, e.g. 11 cents/m³ natural gas)
- H ... Caloric heat content (e.g. 10 kWh per m³ for gas)
- η ... Efficiency of power plant

Example: Costs of electricity generation from CCGT

$$C_{Tot} = \frac{100 I \alpha}{T} + \frac{p_f}{H \eta} = 1.19 + 1.90 = 3.09 \text{ cent/kWh}$$

- I ...Investment costs = 600 EUR/kW
- α ... C.R.F. (Capital recovery factor, e.g. 0.1 for 15 years and 5% interest rate)
- T ...Full load hours = 5000 hours per year
- p_f ...Fuel price (cent/kg or m³, e.g. 11 cents/m³ natural gas)
- H ...Caloric heat content (e.g. 10 kWh per m³ for gas)
- η ...Efficiency of CCGT plant = 0.58





4 REFORMS OF ELECTRICITY SUPPLY HISTORY (1)

- Before 1990, almost every ESI in Europe was vertically integrated either state-owned (the majority of cases) or under price-regulated mixed private/public ownership (as in BE, DE, CH).
- Regulated area monopolies prevailed in all countries.
- Until the end of the 1990s, the standard model was “a vertically integrated franchise monopoly under either public ownership or cost-of-service regulation”.
- The first spot markets for electricity in Europe emerged already in the 1970s in Norway;

HISTORY (2)

- 1989: Britain’s restructuring and privatisation showing that vertical unbundling and the creation of wholesale electricity markets was actually feasible ...
- 1999: European Common market Directives has succeeded in maintaining the pace of reform in the original EU-15, and in a number of associated and accession countries, and, as well as achieving a certain degree of standardisation of structures, institutions, and rules in national markets.

Milestones of reforming 1 (Cont. Europe)

1996	EU-15	European Council of Energy Ministers and Parliament: agreement on a market liberalisation directive
February 1997	EU-15	This “Directive concerning common rules for the internal market in electricity” (Directive 96/92/EC) became valid while waiting up to two more years for its transposition by countries
1998	Spain	Introduction of a Spanish centralised pool
1998	PL	Introduction of TPA (market opening: 22%)
1998	DE	100% market opening in one step
February 1999	EU-15	Directive went into force after a 2 years transposition delay: Market opening due the directive in Austria, Belgium, France, Italy, Spain, Portugal and The Netherlands between 30% and 35%
2001	AT	100% market opening (in a second step)

Milestones of reforming 2 (Cont. Europe)

2001	EU-15	Approval of “Directive on the promotion of electricity from renewable energy sources in the internal electricity market (RES-E Directive)”
2003	EU-25	Approval of (second) “Directive concerning common rules for the internal market in electricity”
2003	Spain	100% market opening
2004	EU15 +10	Extension of the EU to 25 member countries, new CE member countries to open their market with 30 % minimum
2004	EU 25	Electricity Directive 2003/54 due to be transposed by member states; EU Regulation on cross-border electricity trade came into effect
2005	PO, NL	100% market opening
2007	EU 25	Due to Electricity Directive 2003/54, 100 % market opening in all EU-25 countries in July 2007

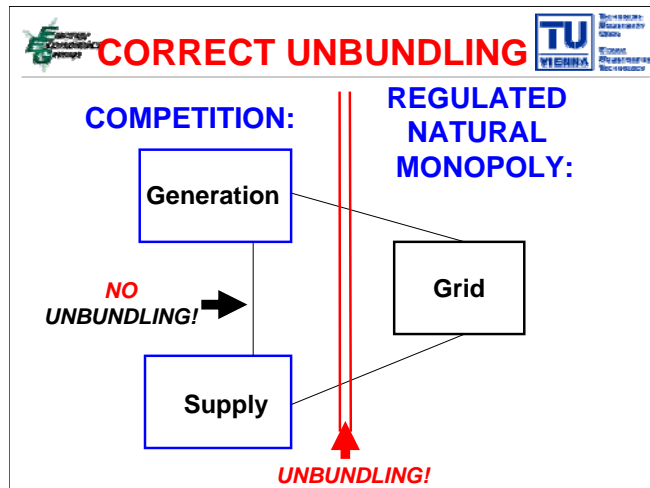
THE EU-DIRECTIVE(S)

The European Commission's main expectation was the belief that "market forces [would] produce a better allocation of resources and greater effectiveness in the supply of services"

How? Political instruments:

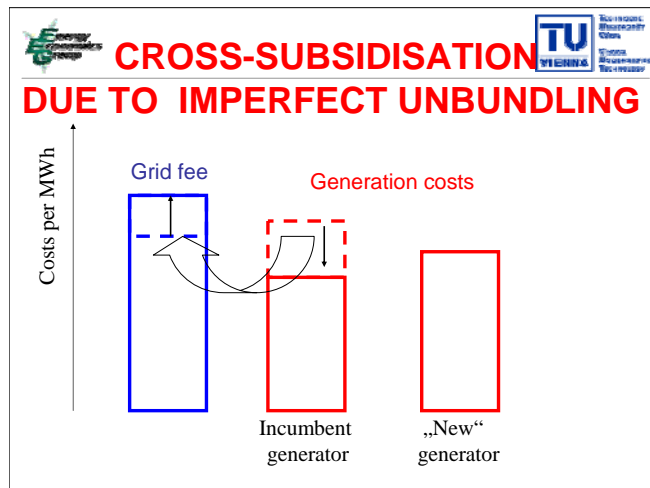
- Unbundling
- Access to the grid
- Market opening

Target:
Competition in one joint European electricity market

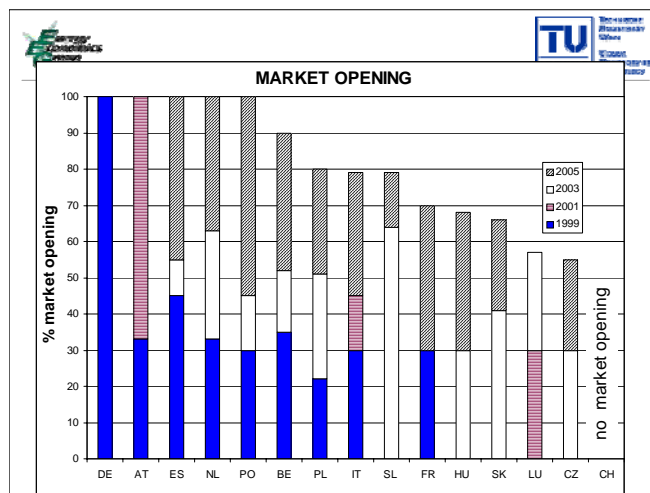


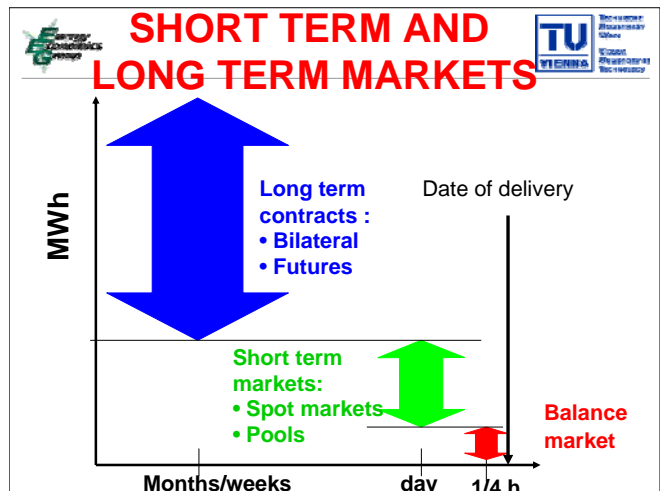
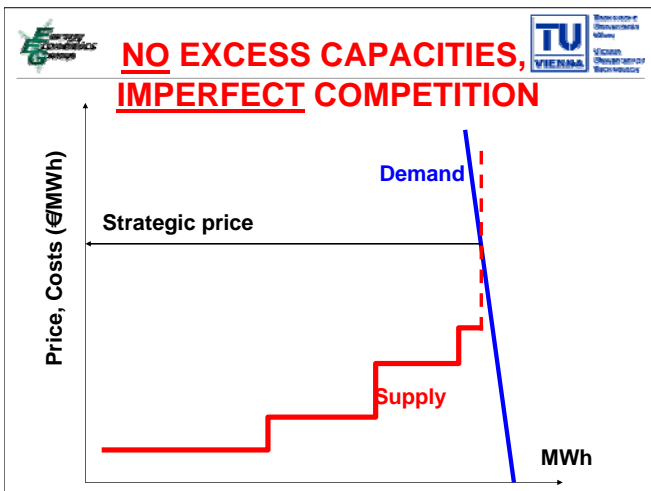
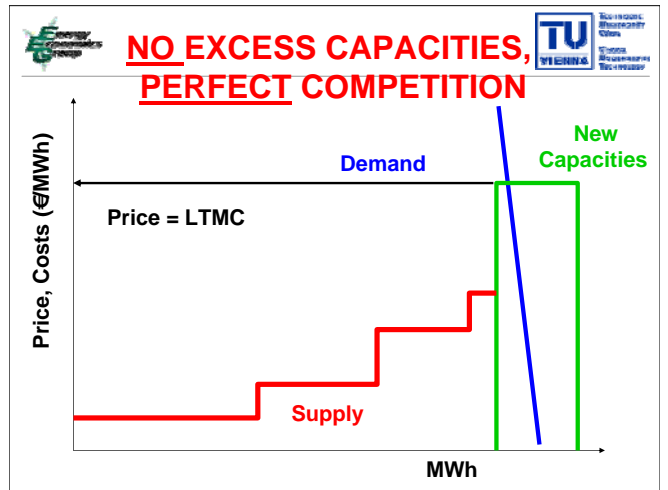
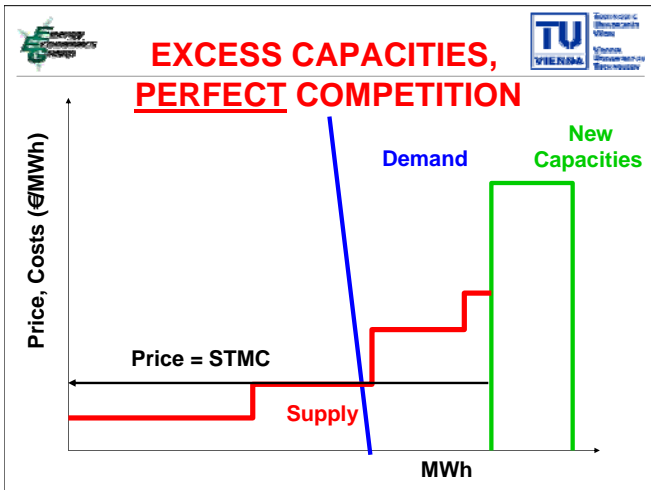
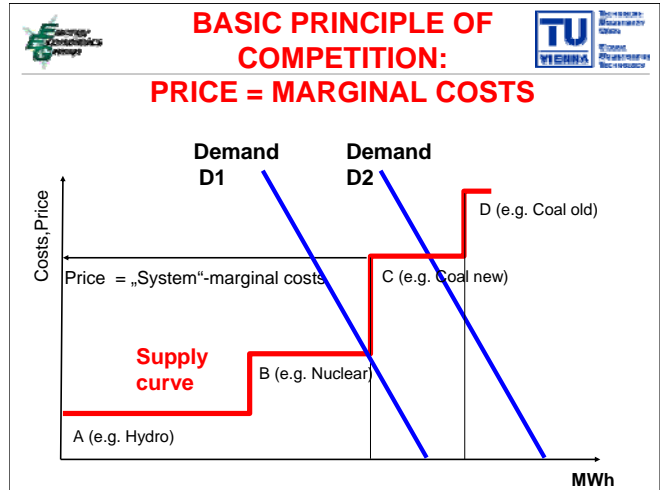
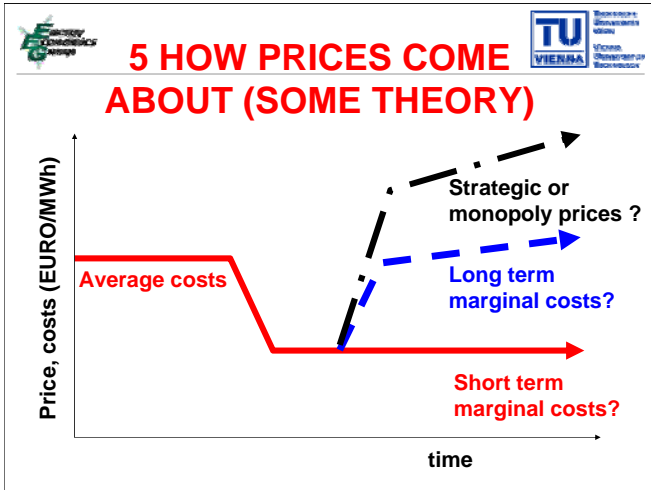
WHY UNBUNDLING ?

- To avoid discrimination of other generators (old as well as new competitors)
- To avoid cross-subsidization of generation by transmission



Country	Unbundling TSO+	TSO	Ownership	Access to the grid 2004
AT	Legal (APG); Management (TIWAG, VKW)	APG (90%), TIWAG (6%), VKW (4%)	100 % public, 100 % public, 51 % public	rTPA
BE	Ownership	ELIA	100% Electrabel, (2005: floated)	rTPA
CZ	Legal	CEPS	(51% CEZ, 49% public)	rTPA
FR	Legal	RTE	100% EdF	rTPA
DE	Legal	RWE Netz, E.ON-Net, EnBW-Net, Vattenfall Transmission	100% RWE, 100% E.ON, 100% EnBW, 100% Vattenfall Europe	nTPA
HU	Legal	MAVIR	100 % public,	rTPA
IT	Ownership	GRTN	100% public	rTPA ... eligible customers SB(rTPA)... captive customers
LU	Management	ELIA (BE) RWE-Netz (DE)	100% ELIA, 100% RWE	rTPA
NL	Ownership	TenneT	100% public	rTPA
PL	Legal	PSE (Polskie Sieci Elektroenergetyczne S.A.)	100% public	rTPA
PO	Ownership	REN	100% public	rTPA ... eligible customers SB(rTPA)... captive customers
SK	Ownership	ELES	(100% public)	rTPA
SK	Legal	SEPS		rTPA
ES	Ownership	REE	100% public	rTPA
CH	No	Regional vertically integrated companies		No





IMPACT PARAMETERS ON ELECTRICITY PRICES

Four categories:

Supply parameter:

excess capacities, hydro availability...

• Demand parameter:

elasticity, price, income...

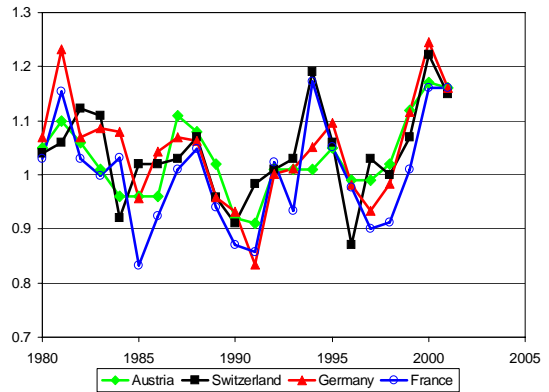
• Market structure:

number of players...

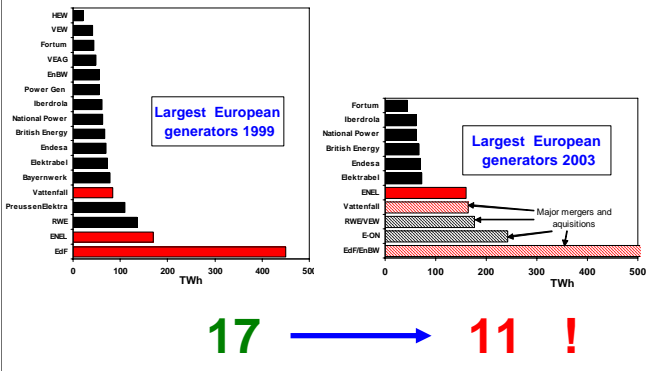
• Policy:

taxes, subsidies...

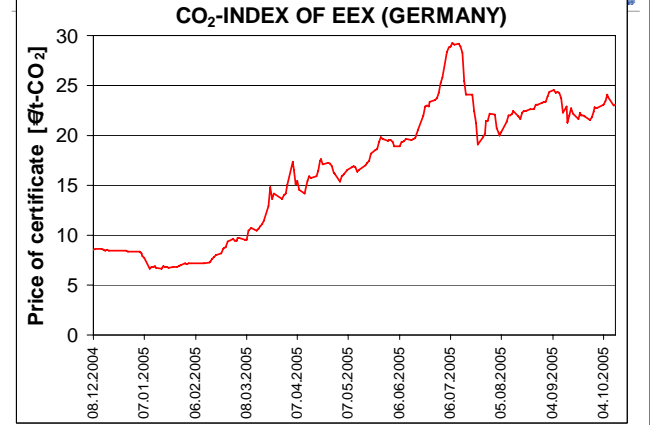
The impact of hydro power



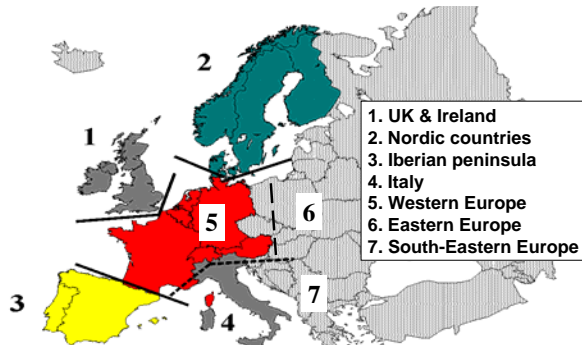
NUMBER OF LARGE GENERATORS IN EU-15



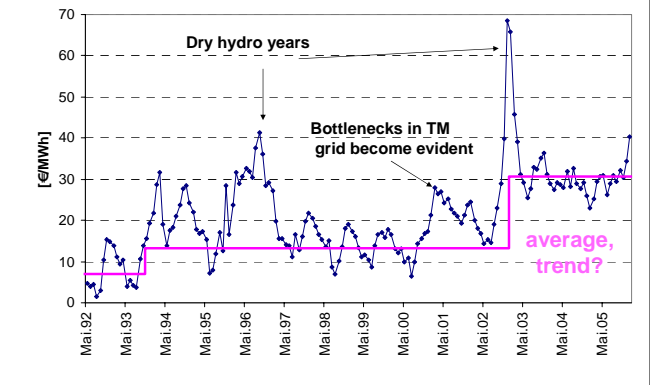
CO₂-INDEX OF EEX (GERMANY)

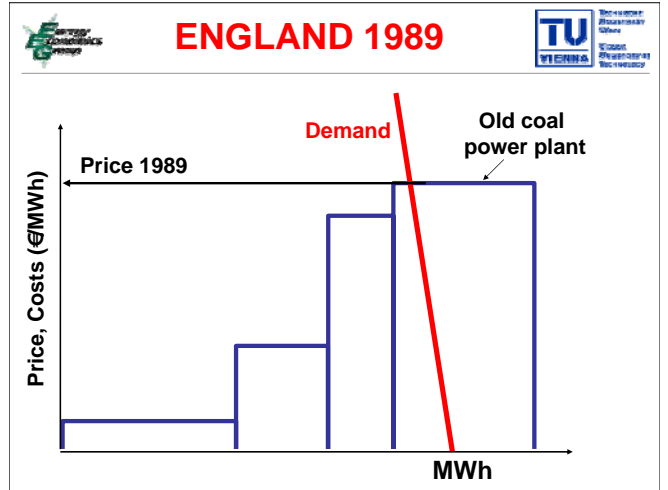
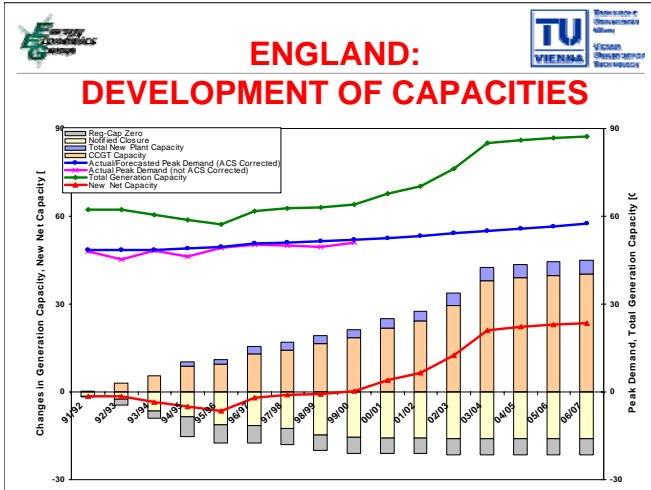
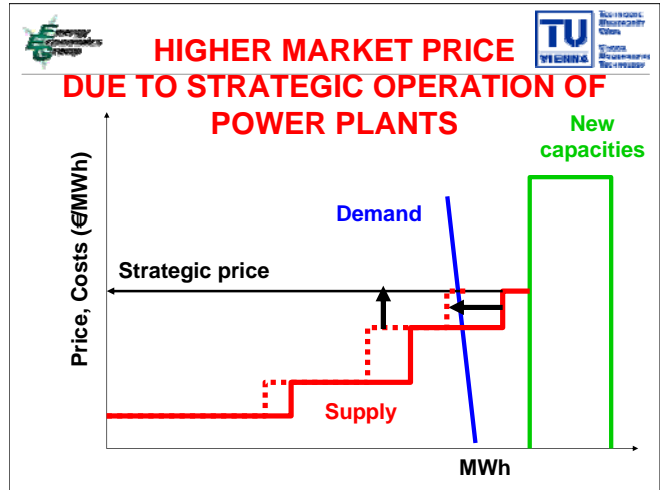
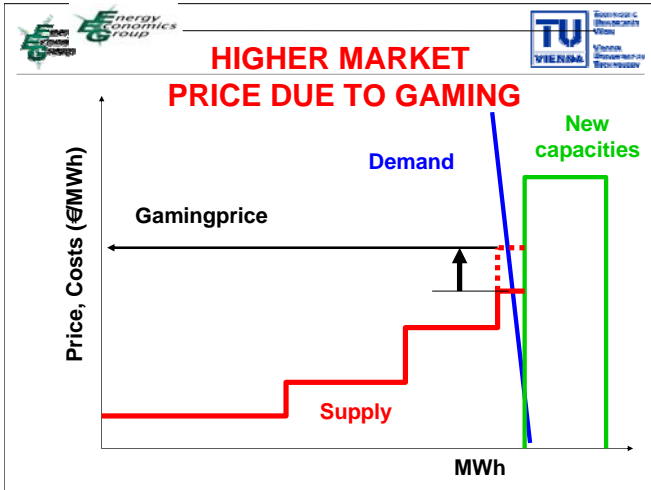
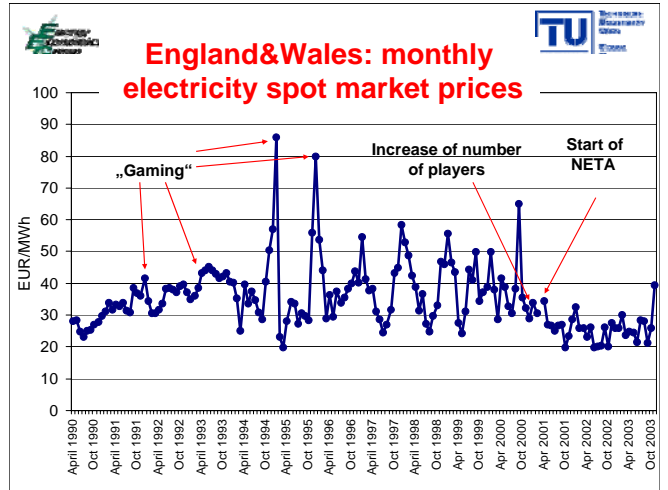
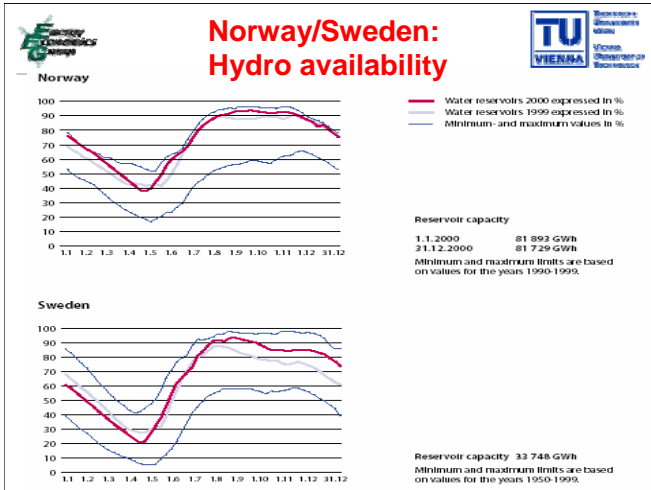


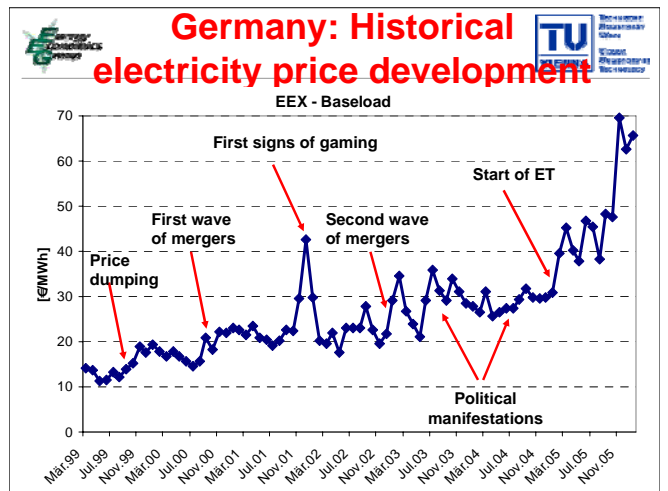
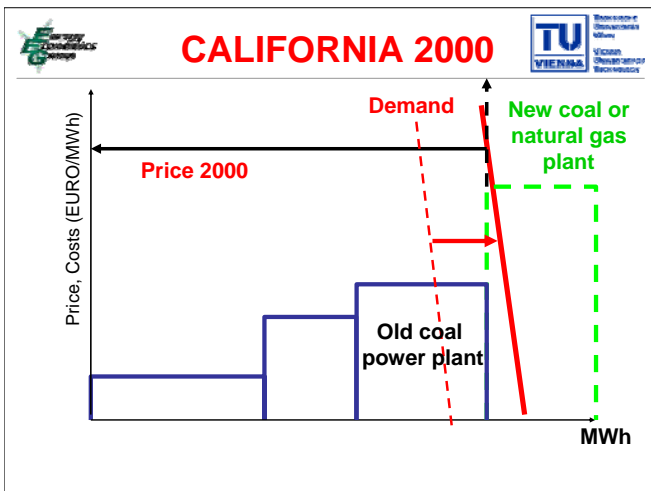
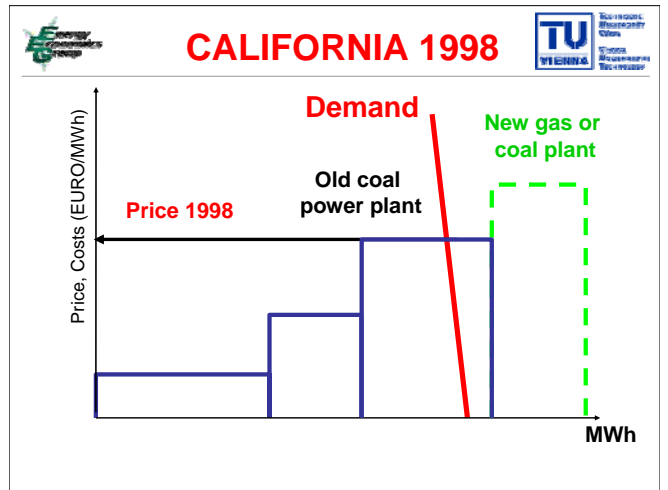
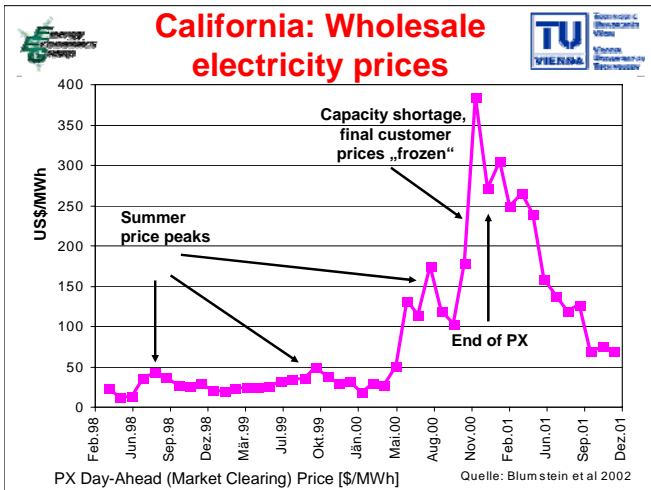
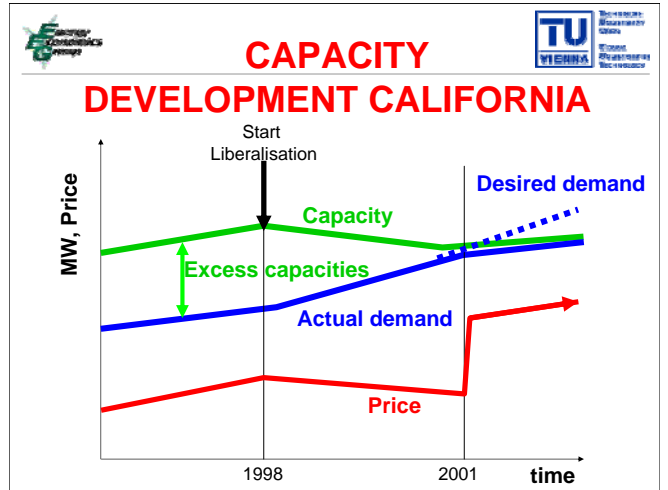
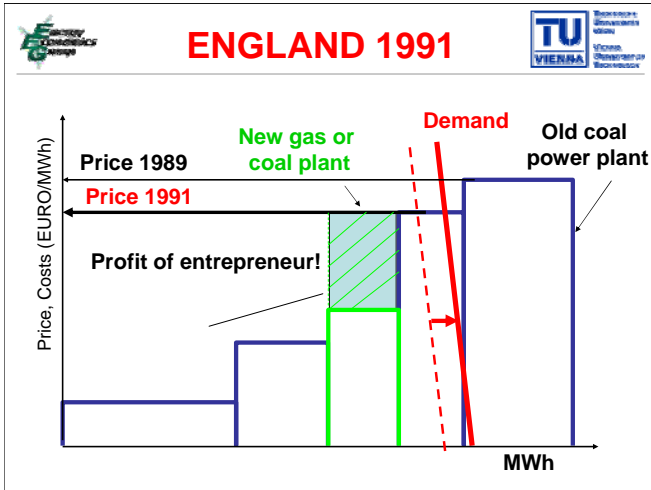
6 LESSONS LEARNED: DEVELOPMENTS IN SOME MARKETS EUROPEAN ELECTRICITY SUB-MARKETS

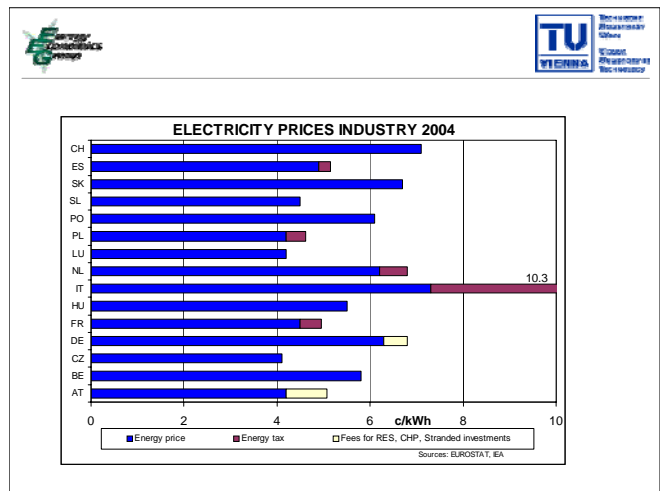
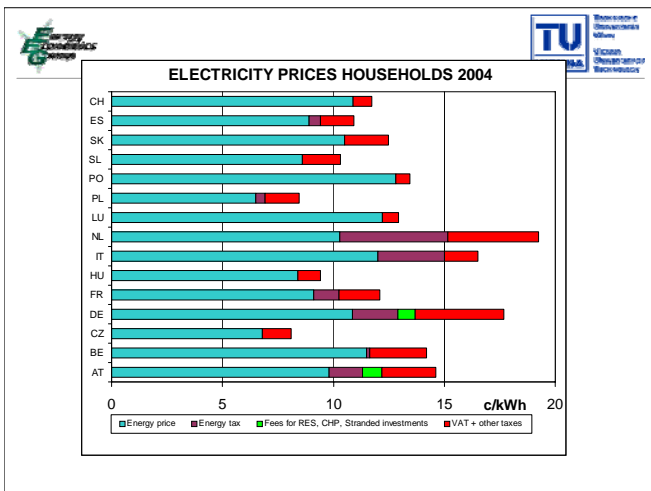
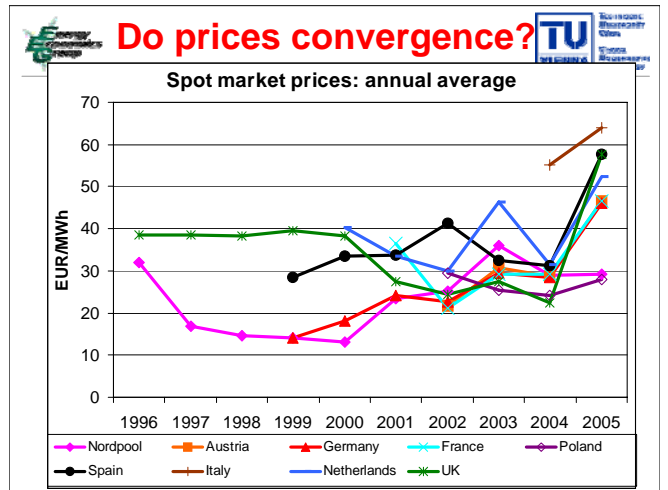
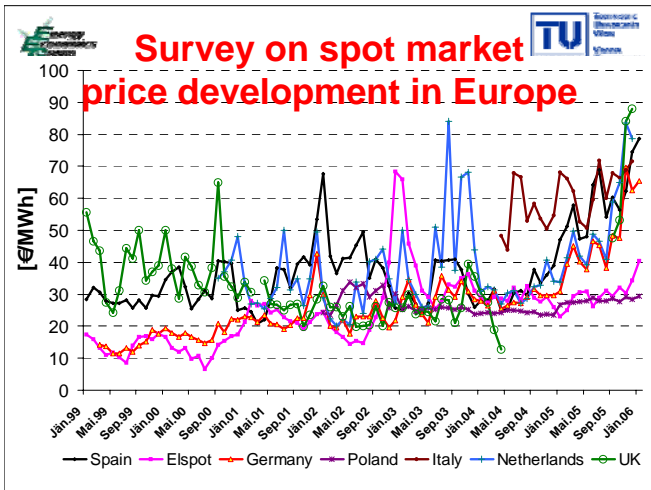
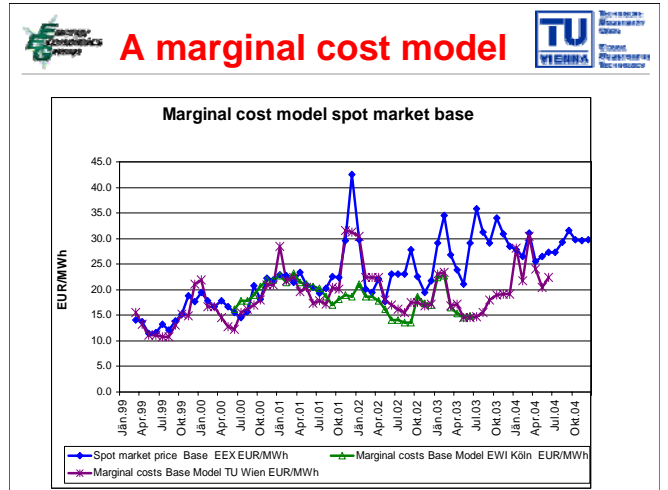
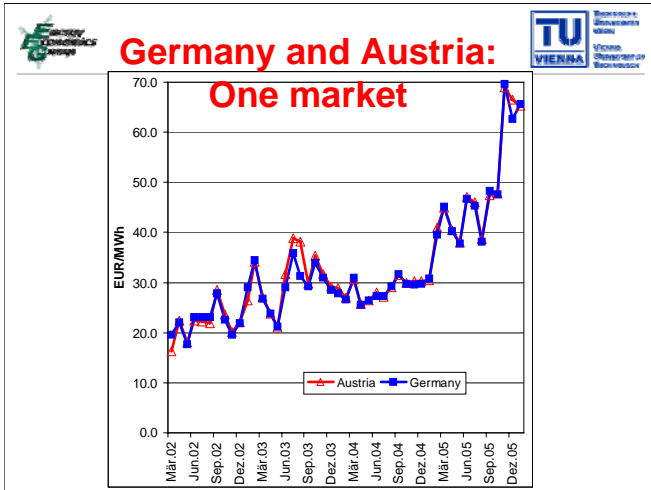


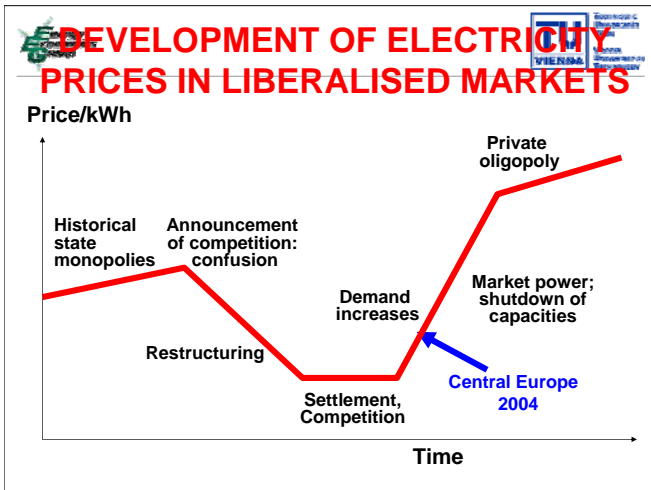
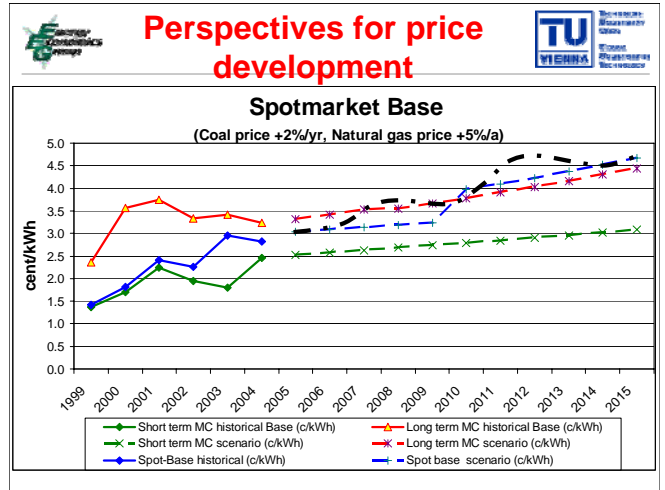
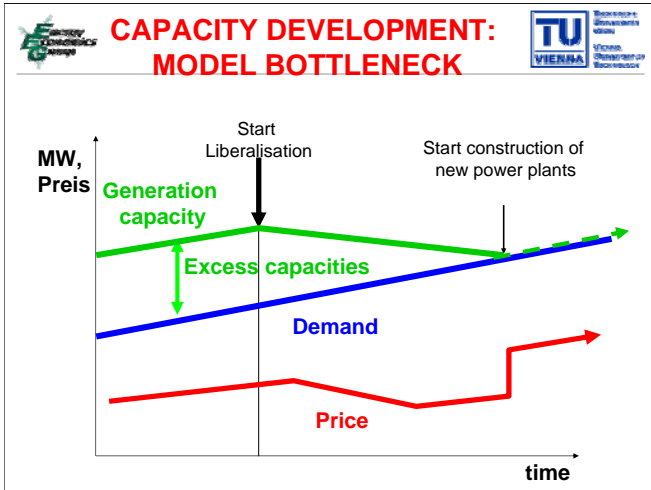
NordPool: Elspot (monthly average base)











FURTHER INFORMATION:

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